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RESEARCH ARTICLE

Strategic intervention: water crisis and its impact on sustainable development in cape town, south africa

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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 their peak and became a crisis as taps were expected to run dry. The study explored the causes and impacts of Cape Town's water crisis, and the strategic intervention by the government to improve access and availability of water to a population nearing 5 million. To understand the objectives of the study, it employed a qualitative approach that used interviews and documentary sources. 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 a referral to other participants. Participants were selected for interviews, particularly from government, business, industry and institutions. Forty-two participants were interviewed for the required data. The systems theory guided the study process. The study established that climate change and governance issues were 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. Hence, government strategies have gained support in alleviating water problems and establishing cohesion in a racially divided Cape Town. The study concluded that the effect of 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).

Keywords: sustainable development; Sustainable Development Goals (SDGs); water crisis, public participation

1. Introduction

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 supports adequate basic services and rights to the people. However, the prevailing unequal basic services distribution signifies the

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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 (Nikki and Inga, 2011). The company forcefully drove away 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 (Turton, Hattingh, Maree, Roux, Claassen and Strydom, 2007). 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 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) (Nikki, Karen, Rascher and Turton, 2008:5). 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 (Nikki and Inga, 2011). 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 (Turton, Anthony R., et al., 2007). A cost-recovery water service was adopted, treating water as both a 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 service delivery. In such settlements, basic services protests are widespread and usually destroy public infrastructure.

Declining water supply and growing demand are 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.

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 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 per cent owing to low dam levels. Dam levels were below 20 per cent 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 per cent from 2016/17 to 2017/18 farming seasons. The Western Cape economy contributes about 13 per cent 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 per cent of the national economy (Parks et al., 2019:4). Fruit and vegetable production dropped by 15 per cent 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). In light of the aforementioned, this study unearths the real causes and impacts of the water crisis and the government intervention to improve access and availability of water in advancing sustainable water resource management systems. This is an extract from a larger study with Ethical clearance no: 2022CHS51871947.

2. Literature review

Water is a crucial resource in maintaining life on earth. Water enhances economic power and dignity, promises, 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 the water resource management crisis, among others, were the chief culprits behind the causes of the water crisis (Turton, Anthony R., et al., 2007: 12). 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 (Nikki and Inga, 2011: 14).

2.1 Water crisis, scarcity and security

The water crisis happens when the available, potable, and unpolluted water within a region is less than that region's demand (UN, 2016:1). It is the lack of freshwater resources to meet the required standard water demand of a particular area or region. The 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. 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.

Water security has diverse framings that 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).

A broad, integrative approach is a favoured framework as it incorporates the 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 are 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.

2.2 Causes of water scarcity

There are many causes of water scarcity such as climate change, ground water depletion, government policy, wars, international relations, globalisation and the dominance of neoliberal policies, declining and poor water infrastructure, environmental degradation, population growth and poor natural resource management. Climate change is the root cause of water scarcity, prompting the 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 (Nikki and Inga, 2011). Furthermore, the 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). 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.

2.3 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 affects the sustainable livelihoods of many people in developing countries.

Water fetching can also limit education and economic opportunities, particularly for girls in Africa (Mugagga and Nabaasa, 2016:218). 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 create a cycle in society that exacerbates the male patriarchy's weight (Mugagga and Nabaasa, 2016:218).

Water scarcity results in food shortages as agriculture is 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.

2.4 Water governance in practice

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. 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. 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 in 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.

2.5 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). 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 the 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, recycling 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.

2.6 The Role of Public Participation in South Africa

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 frequently the ward committee meets, the 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 the ward committee as a 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 the 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).

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. IDP 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). Public participation is a vital tool for democratising governance processes and facilitating the 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.

3. Research Objective and Methodology

The study explored the causes and impacts of Cape Town's water crisis, and the role of public participation in improved access and availability of water in Cape Town, south Africa. A qualitative research method was adopted, relevant literature was systematically reviewed, and relevant experts and staff were interviewed objectively.

3.1 Research methods

The study was exploratory and descriptive, following a qualitative approach that uses interviews and documentary sources (scholarly journals and municipal policy documents). 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).

3.2 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). Purposive sampling strategically sampled units based on relevance to the research problem and participants were selected for interviews. The technique was used first to select participants in DWS, institutions and businesses where only participants at the managerial level were chosen. Participants were from the level of supervisors and upwards. It was used to select councillors and community leaders, who were communities' gatekeepers, contacted for interviews. In addition, snowball sampling was used as these gatekeepers were asked to provide referrals of potential study participants. 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 household 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.

3.3 Data Analysis and interpretation

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). The method can identify patterns of meaning across a dataset that answers the research question being addressed (Du Plessis 2017:21). 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. Thematic analysis of the data was undertaken and that generated nine themes, two of which are discussed in this chapter. Trustworthiness was ensured through credibility, transferability, dependability, and confirmability. During credibility, triangulation, peer review, persistent observation and reflexivity were employed. Transferability was maintained by providing rich accounts of the context, the sample, sample size, sample strategy, demographic, interview procedure and excerpts from the interview guide. To ensure dependability, a pilot test was conducted with a population that was similar to the main study. And to fulfil the task of confirmability, an audit trial which included process notes, observation notes, audio recordings, transcripts was maintained. The research was guided by the following key ethical considerations: Human participant's protection, informed consent, voluntary participation, protection from harm and privacy, anonymity, and confidentiality.

4. Theoretical Framework

Theories are designed or formulated to forward prediction, analysis, explanation and understanding of phenomena through investigation of relationships within social systems. The study uses a theoretical framework called system theory. The systems approach is used to advance the objectives of this study. The systems theory is the overarching, comprehensive and all-embracing approach to achieving the desired outcomes of sustainability. The 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 and explains the interaction reaching beyond or across disciplines (Montuori, 2011:1).

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 into 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. It fails to offer any tools or techniques to establish integration and the nature of interdependencies between organisations and ecological systems (Santosh, 2021:3). In addition, the determination of the system's boundaries and identification of interrelations of sub-systems becomes problematic in the application of the system theory.

5. Presentation of Findings

This section 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 the strategic interventions employed by authorities, and the role of public participation in stabilising the crisis.

5.1 Causes of the water crisis in Cape Town

Climate change is a real phenomenon facing the province with no signs of ending 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 per cent 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 much 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 rain for almost three consecutive days are rarely 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 unveiled in many global regions and escalating the El-Nino impact.

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 risk 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. 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 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 in 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.

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 an 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."

Governance system

Poor governance issues were at the centre of the Cape Town water crisis. The absence of a 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."

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."

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 per cent 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 were continuously strained.

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 the 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.

Political controversy

Political infighting within the top national and local government 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 toward 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 stabilizing disputes rather than solving a burning issue of the time which was the water crisis."

The former DA Western Cape leader Bonginkosi Madikizela argued that Mayor Patricia De Lille had caused 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 managing 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.

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 blacks 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 marginalized are the most hit, and recovery takes time due to their high level of vulnerability, deepening their poverty status.

5.2 The impacts of the water crisis on sustainable development in Cape Town

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 per cent 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 per cent of the national GDP, which means that a reduction by a single percentage in the province's GDP draws off about 0.13 per cent of the national economy (Parks *et al.*, 2019:4).

Farmers have reduced the planting hectarage 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 the quantity and quality of fresh vegetables and fruits needed daily by 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 the short term and production maximised.

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 it is 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 on 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.

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, and 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.

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."

The above indicates 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. A lack of trust between authorities and the public developed. Many citizens blamed the city authorities, arguing that they were 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 did 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. Businesses and 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.

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 the government level. We were 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).

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 service delivery.

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 in saying that,

> "… the apartheid regime long segregated us and today our government is not pulling us out of this messy, the rich are getting richer, and we are getting poorer. See how the rich were accessing water from far away sources and even drilling boreholes in 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 upkeeped the operating supply system. Serving people based on the haves and have-nots creates 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 in different ways such as increasing poverty and inequality, crime and violence.

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 in 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 a

lack of basic services such as water, issues such as violence, social dissolution and basic services, protests seem to remain popular in the city.

5.3 Strategic interventions implemented by authorities for improved water services delivery.

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 force 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.

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 per cent. 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 per cent mark), calling for a major interruption. Based on consumption scenarios, the Day Zero dam level was set at 13.5 per cent, 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 predicting various parts of the city facing disconnections from the reticulation system and residents turning to designated collection 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 in April 2018, with weekly dam levels dropping by 1.4 per cent. By March 2018, the weekly dam level drawdown had decreased to 0.4 per cent, with agriculture utilising only 4 per cent 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).

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 drops 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 in 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).

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).

Reduced water pressure

Water pressure management not only reduces 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 waters burst pipes and less consumption."

Consumption was lessened through the 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.

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 reach 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 in 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 on or was calculated on the amount of exceeded consumption from the required limit.

Water reuse

A water reuse scheme comprising 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 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 by international best practices and associated water safety protocols (CCT,2019:14).

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, and exerts environmental impacts, especially on marine life by chemical 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 for 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 consideration 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 filter 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 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 plunged the authorities into a problematic situation.

6. Concluding Remarks

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, and 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 the quality data required to obtain the intended results. The challenges encountered during the study were limited, and the objectives were satisfactorily met.

The systems theory and the concept of social sustainability have informed and guided the study. The concept holistically integrates all 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 were 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 the 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 the national level and corruption in 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

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Conflict of interest

The authors declare no conflict of interest.

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