A thesis

entitled

Examining water governance and water efficiency strategies in 3 - 5 star graded game lodges and associated residential beneficiation: The case of reflexive water governance at the Dinokeng Game Reserve in Gauteng, South Africa

submitted

by

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Student number: 44376995

towards the degree

Doctor of Philosophy in Environmental Science

in the

Department of Environmental Sciences

UNIVERSITY OF SOUTH AFRICA

Supervisor: Prof. L. Leonard

February 2024

Open Rubric

DEDICATION

This research study is dedicated to my parents “Miya” and all those who have been instrumental in my growth. Thank you for your immeasurable love and support.

“*There’s a pot of gold where the rainbow ends*”

DECLARATION

I, **Simphiwe Mnguni**, hereby declare that the thesis which I hereby submit for the degree of **Doctor of Philosophy in Environmental Science** at the University of South Africa, is my own work and has not previously been submitted by me for a degree at this or any other institution.

I declare that the thesis does not contain any written work presented by other persons whether written, pictures, graphs or data or any other information without acknowledging the source.

I declare that where words from a written source have been used, the words have been paraphrased and referenced and where exact words from a source have been used the words have been placed inside quotation marks and referenced.

Student signature:  Date: 12-06-2024

ACKNOWLEDGEMENTS

I would firstly like to thank God for strength to enable me to complete this study. He strengthened my heart, he led me until I saw victory and I am thankful.

With gratitude I would like to express my sincere appreciation to my supervisor Prof. Llewellyn Leonard for guiding me, challenging me, his patience and continued advice throughout the study. I appreciate your acknowledgements when you received my document and for all the solid feedback. I have come this far because of you. Thank you very much.

I doubt that I would have continued with my studies had it not been for Prof. Kevin Mearns, thank you for giving me the push I needed when I was on the verge of giving up. I hope more students could be given such great support.

I would also like to thank everyone, especially Bridget Moema, Musa Masango, Boitumelo Marokane and Ikanyeng Phetlhu, who assisted me in collecting data in unfamiliar areas. This would not have been possible without you.

To all the participants in the study, I appreciate your taking the time to provide all your valuable inputs.

To everyone who supported me during my studies, especially Kentse Setshedi and Dr Khomotso Semenya, you were heavenly sent. Thank you for being part of this journey, for allowing me to share my frustrations and most importantly for standing with me in prayer. May God richly bless you. To Prof. Shadung Moja and all my colleagues thank you for your support and encouragement.

More importantly, I would like to thank my family for exerting strong belief in me that I will conquer. My husband Prof. Lindelani Mnguni - my inspiration, you have been so supportive, loving and I thank God for you. Wandile and Ndumiso hearts.

Abstract

The world is facing a global water crisis, with many regions experiencing intense competition for limited water supplies among various stakeholders, including game lodges, residents, agriculture, and various other industries. This crisis is exacerbated by water scarcity, mismanagement, and climate change which necessitates robust water governance for sustainable development. Addressing these issues requires a holistic and collaborative approach that considers the needs of local communities, involved stakeholders and the environment while promoting equitable and efficient water use. Tourism is a significant global economic contributor, and any disruption in the availability of water in areas such as game lodges can have a cascading effect on the overall tourism sector and local economies and employment. Effective is crucial for sustainable development in water-scarce areas, as conflicts over water use between these stakeholders can contribute to broader concerns related to social equity and justice.

Sustainable water management is imperative for environmental conservation and the longevity of game lodges and is integral to the tourism industry as water scarcity directly impacts their operations. Most game lodges are situated in remote, ecologically sensitive areas that are crucial for biodiversity conservation with little to no infrastructure, relying on rivers, dams, and boreholes as water sources. Due to their remote locations, game lodges face unique challenges, relying heavily on water for guests and employees. Staff members residing nearby contribute to high water consumption. Thus, game lodges must ensure a sufficient water supply, educate visitors and employees on water usage, and reduce imbalances for neighboring residents. Such residents play an important role in managing available water resources to prevent social tensions that can impact community relations and the overall stability between game lodges, residents, and other water users.

In South Africa, where water is a scarce resource, effective water management strategies are crucial, especially in arid areas hosting game lodges. This study explored the reflexive water governance practices adopted by game lodges and neighboring residents to enhance efficient water use, mitigate scarcity, and achieve sustainable water management. Data were collected from key study participants representing the government, water companies, water

authorities, residents, and the game lodge owners who answered questions in semi-structured interviews. Secondary data were also used to provide information about the governance and sustainable management of water in the study area. Findings demonstrated the intricate relationship between game lodges, neighboring residents, and water resource management that, if not optimally managed, could lead to pollution and degradation of water quality, affecting not only the immediate environment but also all water users.

According to the study, poor water governance, particularly for residents in local communities, resulted from corruption, a lack of efficient policies, inadequate monitoring and evaluation systems, a lack of water awareness, insufficient efforts to reduce water consumption, and inadequate water management. While multiple game lodges with 3–5-star ratings equipped themselves with water efficiency systems, a lack of government policy enforcement and stakeholder collaboration hindered the adoption of water measures such as the efficient use of taps and toilets. On the other hand, residents in local communities who faced an intermittent water supply increased their water supply by adopting water conservation efforts through reuse, reduction, and recycling because the municipality in their neighborhood did not provide enough water and there were limited water resources.

The study findings also indicated that the game lodges made provisional access for their employees to obtain water but there was no community beneficiation implemented towards improving water access in a sustainable and equitable manner. Overall, the benefits of the use of reflexive governance and the water governance framework which require a collaborative and sustainable approach was suggested as a means of managing water resources between game lodges and residents. This research contributes to the ongoing discourse on responsible tourism, emphasizing the need for reflexive water governance as an integral component in the pursuit of sustainable development within the context of game lodges and their associated residents. It is crucial to ensure that the core right to access water for basic needs is met for everyone, and any additional initiatives should contribute to overall social welfare without compromising this fundamental right. A variety of strategies for better water governance in the region were suggested by the study.

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Definitions

For consistency and clarity, the terms described below are used throughout this study.

Beneficiation

Beneficiation refers to the process of adding value to a service through actions of improving something or adding to its worth (Habiyaremye & Mupela, 2019). Beneficiation can include fostering positive relationships, collaborations, or mutually beneficial arrangements.

Conflict

Refers to competing or opposed behavior of incompatibles, leading to a hostile state or behavior due to diverse beliefs and interests on a specific subject (Swatuk, 2015).

Constitution

The constitution is a set of governance rules with provisions of the legislative mandate (laws) to ensure that citizens are aware of their rights including their duties and the structure of government (Nevhutalu, 2016).

Dolomite

Dolomite is a sedimentary rock that is composed of calcium magnesium carbonate, and it is known for its susceptibility to dissolution and the formation of sinkholes (Mabin, 2013).

Drought

This is a period during which an area has lower than average precipitation resulting from reduced water availability such as inadequate rain which results to diminished water availability (Makaya et al., 2020).

Ecotourism

Refers to an expansion of sustainable tourism through promoting local community improvement, profit-making and cultural heritage (Alberts, et al., 2022).

Environmental legislation

Environmental legislation is the collection of laws and regulations that are essential towards environmental sustainability (Lyon et al., 2017).

Hotel

Hotels are accommodation establishments that offer hospitality to tourists during their temporary stay for different purposes such as recreation, leisure, or business (Dwyer, 2018; Sharpley, 2018).

Game lodge

Game lodges are nature-based accommodation establishments located in natural environments (non-man made) with less developed infrastructure and among a wide range of unique wild animals (Line et al., 2017; Rogerson, 2013; Cheung, 2012).

Governance

Governance refers to the process and systems through which decisions are made, policies are formulated, and authority is exercised in each organization or society. It involves establishing rules, regulations, and mechanisms to ensure effective and accountable management of resources, institutions, and public affairs (Cashore et al., 2021; i Gispert, et al., 2020; Keping, 2018).

Greening

Greening refers to the process of making something more environmentally friendly or sustainable by adopting practices that promote conservation, recycling, and the use of eco-friendly materials (Umrani et al., 2020).

Potable water

Potable water refers to water that is safe and suitable for human consumption by being free from contaminants, pollutants, and harmful microorganisms (Marinoski et al., 2018; Wright & Jacobs, 2016).

Reflexive Governance

Reflexive governance refers to a participatory and adaptive approach to decision-making and policy implementation. It involves self-reflection, learning, and incorporating diverse perspectives to address complex and uncertain challenges (Feindt & Weiland, 2018; Gunningham, 2012).

Residents

Refers to individuals who live in a particular place, such as a city, town, or community, on a permanent or long-term basis. Residents are considered members of the local population and are usually involved in the day-to-day life of the area where they reside (Marzouk et al., 2018).

Stakeholder alliances

Stakeholder alliances refer to partnerships from public, cooperate leaders, professionals and government who support a specific endeavor to support long term success in achieving a common goal (Ferreira, et al., 2021; Warner & Sullivan, 2017).

Sustainability

Sustainability refers to the ability to maintain or endure over time. Sustainability is about meeting the needs of the present whilst ensuring that future generations are not compromised (Kuhlman & Farrington, 2010).

Sustainable development

Sustainable development is a broader concept that integrates sustainability principles into the planning and decision-making processes for societal development. It emphasizes the need to balance economic, social, and environmental goals to achieve long-term prosperity and well-being for current and future generation (Vila et al., 2018).

Water competition

Water competition occurs when there is competition among different users for limited access to water resources (Motschmann et al., 2020). This can happen when there is not

enough water to meet the demands of all users, or when different users have conflicting water needs with tensions that do not involve violence or physical conflict (Yu & Lu, 2018).

Water conflict

Water conflict is a more severe form of water-related tension, where the competition for water resources escalates to a point where physical violence or military action is used to secure access to water often with long-lasting social, economic, and environmental consequences. (Swatuk, 2015).

Water consumption

Water consumption is the water flow rate that is utilized by consumers per time unit. Water consumption can be obtained from values on a water meter or municipality system (Gössling et al., 2019; Dinarès & Saurí, 2015; Scheepers, 2012).

Water demand

Water demand refers to the amount of water required by individuals, communities, industries, and ecosystems for various purposes such as drinking, sanitation, irrigation, and industrial processes (Barberán et al., 2018; Gabarda-Mallorquí et al., 2018). It is influenced by population growth, economic activities, climate conditions and water management practices.

Water efficiency

Water efficiency is a concept of the optimal use of water resources to accomplish a specific task by applying water-saving strategies or measures such as innovative technology and practices to reduce water loss or waste (Popely, 2018; Dinarès & Saurí, 2015; Pereira et al., 2012).

Water efficiency measures

Water efficiency measures refer to strategies and practices aimed at reducing water consumption and optimizing water use. These include technologies such as efficient

fixtures, water-saving appliances, as well as behavior changes and educational campaigns promoting water conservation (Popely, 2018; Dinarès & Saurí, 2015).

Water governance

Water governance is a system that involves collective decisions in advocating for actions relating to the use, equitable distribution, and management of water resources through administrative, economic, social, and economic implementation systems (Keping, 2018; Pahl-Wostl, 2017).

Water management

Water management refers to the planning, development, distribution, and optimal use of water resources to meet various needs while ensuring sustainability and environmental conservation. It involves the coordination of policies, strategies, and activities to efficiently use and allocate water for different purposes (Del Carpio et al., 2021; Cosgrove & Loucks, 2015).

Water pollution

Water pollution refers to different contaminants e.g., disease-causing microorganisms such as coliforms, toxic waste, trace metals, organic and inorganic pollutants that render water unsafe for human, animals, and aquatic ecosystems (Chen et al., 2020; Hasan et al., 2019).

Water stress

Describes a situation where water demand exceeds the available amount of water which affects water availability during a certain period and results in water restrictions (Müller et al., 2020).

Water Quality Index

A numeric expression used to evaluate the quality of a given water body for easy understanding by managers (Bordallo et al., 2006).

List of abbreviations and acronyms

CBD	Central Business District
CBNRM	Community-Based Natural Resources Management
COVID-19	Coronavirus Disease 2019
DNR	Dinokeng Nature Reserve
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
FEDHASA	Federated Hospitality Association of South Africa
FTT	Fair Trade in Tourism
GDP	Gross Domestic Product
GTIP	Green Tourism Incentive Program
IR1	Innovative Reducing
IR2	Innovative Reuse
IR3	Innovative Reaching
IR4	Innovative Recycling
ISO	International Standards Organisation
IWRM	Integrated Water Resource Management
LVBC	Lake Victoria Basin Commission
MDGs	Millennium Development Goals
NDT	National Department of Tourism
NWA	National Water Act
NWRS-2	The National Water Resource Strategy, Version 2
POPI Act or POPIA	Protection of Personal Information Act

SANS	South African National Standard
TDS	Total dissolved solids
TGSA	Tourism Grading Council of South Africa
TIP	Tourism Incentive Programme
RWH	Rainwater Harvesting System
RWWTP	Rooiwal Wastewater Treatment Plant
SDGs	Sustainable Development Goals
WF	Water Footprint
WMI	Water Management Institution
WSA	Water Services Authorities
WSA1	Water Services Act
WSP	Water Services Providers
WQI	Water Quality Index
WUI	Water Use Index
WULA	Water Use License Application
UNWTO	United Nations World Tourism Organisation
USA	United States of America

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CHAPTER 1 BACKGROUND OF THE STUDY

1.1 Introduction

Water resources around the world are facing a heightened pressure because of a rising need for water (McLoughlin et al., 2020; Nastar et al., 2018). An increasing global population, an increase from competing uses, climate change and poor water governance have all contributed to the growing pressure on water resources (Archer & Hill, 2019; Shah, 2016). As such, it has become increasingly important to manage water resources sustainably for fair and efficient water utilization considering the needs of local communities, relevant stakeholders, and the environment (UN-Water, 2019; World Bank, 2019; Halbe et al., 2015). Given the substantial global economic impact of tourism, disruptions to water availability, particularly in water-scarce regions where game lodges are situated, can have far-reaching consequences on local economies, employment, and the broader tourism sector (Mthembu & Dlamini, 2018). Game lodges often require large amounts of water to maintain their facilities such as watering gardens, filling swimming pools, and providing guests with luxurious amenities such as spas (Ryan & Stewart, 2009). The significance of adequate water access for game lodges is underscored by its direct impact on the sustainability of the tourism industry, biodiversity conservation, and the broader ecological health of the regions where these lodges are situated (Cater & Blignaut, 2019). To ensure sustainable water use in game lodges, an integrated approach to water management is crucial. This involves not only monitoring and understanding water consumption patterns as suggested by Mearns & Grobler (2016) but also implementing comprehensive strategies considering the interdependence of ecological, social, and economic factors within a particular environment. Consequently, ensuring effective water governance between game lodges and residents in nearby communities becomes pivotal for sustainable development.

The main objective of water governance is to guarantee that the needs of all stakeholders are satisfied while also protecting the environment (Keping, 2018; Pahl-Wostl, 2017; Meissner et al., 2013; Rothstein, 2012). While tourism, especially in game lodges, contributes significantly to the global economy, there is a noticeable gap in research addressing the

specific water challenges faced by these establishments (Cater & Blignaut, 2018). Academic studies highlight the need for focused attention on water management practices in game lodges, emphasizing the potential adverse effects on operations, biodiversity, and the broadertourism sector if sustainable water practices are not prioritized (Snyman, 2014). Establishing a robust academic foundation is imperative to guide policies and practices that ensure the longevity of game lodges and their positive contributions to both local economies and environmental conservation.

While game lodges may have water demands for their operations, it is crucial to recognize that residents, particularly in rural communities, also have essential water needs for their daily living. This includes requirements for sanitation, drinking, cooking, cleaning, and irrigation for agricultural production (World Bank, 2021; World Health Organization, 2017; United Nations, 2010). Balancing the water needs of both game lodges and residents in nearby communities becomes imperative to ensure equitable water access and address the diverse requirements of various stakeholders within a community (Srinivasan et al., 2012). In this context, examining water governance and water efficiency strategies in 3-5 star graded game lodges and associated residential beneficiation becomes crucial to stay informed about water conservation policies and adapt management strategies accordingly.

An unequal distribution of water resources can lead to competition and conflicts over water allocation, with residents facing challenges in meeting their basic water needs (Swatuk, 2015; Becken, 2014). In many cases, game lodges have access to water sources that residents do not, such as rivers or boreholes which can lead to competition over water allocation (Grobler & Mearns, 2020). Conflicts over water use in these scenarios can exacerbate concerns related to social equity and justice (Bruch et al., 2020). One example can be found in certain regions of Southern Africa, where game lodges or private reserves have secured access to water sources such as rivers or boreholes, while nearby rural communities face restricted availability of clean water for drinking and irrigation (Morinville & Rodina, 2013; Mbaiwa, 2005). Such water competition may put a strain on already scarce water supplies and lead to hostility between game lodge owners and residents who depend on water for daily needs. This requires a need to implement policies and

practices that ensure fair and sustainable use of water resources (Queiros et al., 2018). Water governance aims to address water competition by implementing policies and regulations that promote equitable distribution of water resources (Motschmann et al., 2020). Examining water governance and water efficiency strategies in game lodges and residential beneficiation can contribute to the development of effective strategies that promote water conservation and sustainability.

Section 1.1 of this chapter began with a detailed introduction for the current study. The background of the study was given in section 1.2. Literature was provided on water demand in the tourism and hospitality sector in section 1.2.1 as well as literurate on water demand by residents. The problem statement for the study was provided in section 1.3 and was followed by the research aim, objectives, and research questions in section 1.4. The study rationale was detailed in section 1.5 and was followed by the research methodology in section 1.6. The conclusion was in section 1.7 and is followed by the outline and structure of the study.

1.2 Background

Although water is generally considered a 'renewable resource', studies have shown that water is a limited resource and is also highly vulnerable to human activity (Candido et al., 2022; Sabbaghi et al., 2020). To ensure the long-term sustainability of this crucial resource, water governance needs to be strengthened to ensure equitable water availability through elements such as laws and policies (Queiros et al., 2018). Globally, water governance is a critical area due to enormous pressure from different industrial practices including the hospitality and tourism industries (Mansson et al., 2022; Nastar et al., 2018) that are a major contributor to water demand affecting residents (Gössling et al., 2012; Tortella & Tirado, 2011). Even though the agricultural sector also has a high demand for water, the hospitality and tourism industry tourism sector accounts for over 10 percent of domestic water use, highlighting the importance of considering tourism in national discussions on water security (Gössling et al., 2012). Given the complexities of water use inside society, allocating and regulating water requires decisions on effective water management to ensure economic development, human wellbeing, and the environment (Mitchley, 2018). Poor water

governance threatens both economic development and water security (Halbe et al., 2015). Different stakeholders such as government, water corporations, water authorities, residents, consultants, industries (such as the hospitality industry and tourism industry) have a responsibility towards water management for effective water governance (Ahmed et al., 2020; Ambalam, 2014).

There is no escaping the fact that competition will increase for water resources due to increasing water demand (Cole & Browne, 2015). It has been found that conflicts over water use in many countries, particulary island states, are due to water shortages and this could potentially occur in a region like southern Africa that is water stressed (Krampe, 2017; Swatuk, 2015; Becken, 2014). In Africa, the current reality is that population growth is accompanied by simultaneous urbanization and industrialization, often associated with limited water supply channels due to past injustices (Nastar et al., 2015). Conflicts and competition over water distribution may result from the disparity in water access (Howard et al., 2016). Rural areas may experience limited institutional support and governance structures for water management. This can result in inadequate planning, coordination and implementation of water projects and initiatives for rural residents (Lapworth et al., 2017). These challenges have important ramifications for the health and wellbeing of rural residents in Africa, and addressing them requires a concerted effort from governments, development partners, and residents themselves towards infrastructure development, capacity building, water quality management, and community participation in water governance (Nastar et al., 2018). Game lodges often rely on the natural beauty and resources of the surrounding area to attract tourists, ensuring the sustainable use of water resources and minimizing any negative impacts on the environment or local communities thereby contributing to the long-term viability of tourism in the area (Snyman, 2013). This requires a need to implement policies and practices that ensure fair and sustainable use of water resources. Effective governance can help to encourage fair distribution of water access, protect the environment, and support economic development for all stakeholders involved (Jiménez et al., 2020). More research is needed to better understand the complex social, political, and associated environmental factors surrounding water governance.

1.2.1 Water demand in the tourism and hospitality sector

Globally, tourist destinations are challenged by the increasing demands for freshwater due to the high tourist increase, making water a critical concern for the hospitality and tourism industry (McLennan et al., 2017). Within the tourism industry, water is necessary for basic human consumption involving hygiene, the production of food and beverages, the maintainance of facilities such as irrigation of plants, and general pleasure activities such as swimming (Barberán et al., 2013; Roberts & O'Donoghue, 2013; Gössling et al. 2012). According to the United Nations World Tourism Organisation (UNWTO), the global hospitality and tourism industry reached 1.235 billion international tourists in 2016 and generated US$ 1 220 billion in revenue worldwide (UNWTO, 2018). The number of tourists is anticipated to grow to 1.8 billion global arrivals by 2030 (Seyfi et al., 2018). In 2020, foreign arrivals in South Africa plummeted by 71%, from 15.8 million in 2019 to under 5 million, attributed to the global impact of COVID-19 and associated lockdowns (StatsSA, 2023). Based on the statistics presented above, it is evident that South Africa, for example, requires good water governance and stakeholder alliances to bring about more efficient management of water resources to attain sustainability whilst enabling economic and social development within the tourism and hospitality sector.

The hospitality industry is the large sub-sector of the tourist industry offering accommodation with the extensive use of water resources (Tirado et al., 2019; Becken, 2014; Mensah & Blankson, 2014). On a global level, different studies have suggested that tourists' per capita water consumption, at 300 - 3423 L/day (Gössling, 2012, Charara et al., 2011), is much higher than the water consumption of residents which is on average between 150 - 240 L/day (Tirado et al., 2019; Styles et al., 2015; Barberán et al., 2013; Gössling, 2012). Thus, tourist water use in developed countries can be double or triple (UNWTO, 2012) or up to fifteen times higher than in developing countries (Gössling, 2001). "In general, tourists use more water when they are on holiday than when they are home, which increases total global water use" (Zhao, 2018, p. 154). In South Africa, luxury hotels in the urban periphery (the graded hotels, ranging mainly from 3 - 5 star) that offer high end facilities such as spas, private baths, and big rooms have been shown to be more inclined to offer priority to the adoption of water efficiency measures mainly to comply with

international standards (Ismael & Rogerson, 2016; Sucheran, 2013). As a result, there is a need for business operators within the hospitality industry, irrespective of their location (urban or rural), to contribute towards sustainability efforts through efficient water use. Lack of water governance in setting norms and formulating policies for regulation within the hospitality industry is generally to blame for the lack of implementation of sustainable water efficiency measures in South Africa (Mbasera et al., 2015; Sucheran, 2013; Zengeni et al., 2013). Good governance should be effective, equitable and promote the regulation of policies (Keping, 2018; Gel'man, 2017).

1.2.2 Water demand by residents

The population of the world is indicated to increase to 9.8 billion in 2050 from 8.6 billion in 2030 due to growth in both rural and urban regions (Salem et al., 2022; Islam & Karim, 2019). Africa will provide majority of the world's population, which will increase from about 400 million people in 2010 to 1.2 billion by 2050 (Weng, 2014). Globally, the increase in water use and water demand in recent decades has increased at a rate twice that of the population growth which raises concerns about water security (Islam & Karim, 2019). While water use is expanding, accessible water resources are declining in numerous locales around the world (Antonova et al., 2021). Given the increase in water demand, many parts of the world are now experiencing water stress due to the higher per capita water usage in both the residential and industrial sectors (Islam & Karim, 2019). In Africa, improved water governance is needed to keep pace with the rising demand for water and sanitation within a growing population (Nastar et al., 2018). There is an indication that many countries in sub-Saharan Africa such as Morocco, South Africa and Somalia are experiencing water stress with less than 1,667 m^3/capita/year (UNEP, 2014). Water shortages in affected countries are particularly due to poor investment in water resource infrastructure, poor governance from involved institutions as well as poor implementation of existing policies by government in regulating water shortages (Van den Berg et al., 2021; Anderson et al., 2015; WWAP, 2015; Adeleke & Bezuidenhout, 2011). More studies are needed regarding water governance to ensure that effective measures are in place to sustainably manage a sufficient water supply.

Globally, the amount of water used in liters (L) per person per day varies significantly between high income and low-income countries (Cosgrove & Loucks, 2015). According to data from the World Bank, in 2021, the average freshwater withdrawal per capita in high-income countries was 315 liters per day, while in low-income countries it was only 38 liters per day. In developed countries, there are various reasons as to why individuals tend to consume more water including higher levels of industrialization, greater access to water-consuming appliances and technology, and higher levels of disposable income (Lord et al., 2021). In contrast, individuals in underdeveloped countries typically have limited access to sources of clean water leading to a lower level of water consumption (Gondo & Kolawole, 2019). However, it is important to note that these averages can vary widely between individual countries, regions, and even households within those regions (Richards, & Syallow, 2018). Overall, the amount of water used L per person per day is an important metric for water management, environmental sustainability, public health, and for ensuring equitable access to water resources.

Access to a safe and reliable water supply is a major challenge for many rural residents in Africa (Lapworth et al., 2017). Some of the challenges include limited infrastructure for water supply, such as pipelines, wells, and water treatment plants and, as a result, rural communities may rely on distant water sources such as wells, boreholes, or rivers, requiring individuals to travel long distances to fetch water. (Gondo & Kolawole, 2019). The effects of climate change, including drought and irregular rainfall patterns, have led to water scarcity in many parts of Africa, making it even harder for rural residents to access adequate water supply (Richards & Syallow, 2018). Additionally, rural residents frequently rely on limited water sources that often deliver poor water quality which may be tainted with harmful bacteria and contaminants, making it unsafe for human consumption (Musingafi et al., 2013). In some cases, lack of education and awareness about water sanitation and hygiene practices can contribute to the spread of waterborne diseases, which can be particularly devastating in rural residents with limited access to healthcare services (Bigas, 2013). Contamination from pollutants, agricultural runoff, and inadequate sanitation facilities can contribute to poor water quality, leading to waterborne diseases and health risks for the population (Pal et al., 2018; Edokpayi et al., 2017).

Moreover, many rural residents lack the financial resources to invest in water infrastructure, such as drilling wells or building water treatment facilities, and maintaining them, which increases their vulnerability regarding access to clean water (Shah, 2016; Howard et al., 2016). To exacerbate this problem, in areas affected by competition for water, water infrastructure may be damaged or destroyed. These factors increase the difficulties experienced by rural residents in fulfilling household duties and in securing sufficient water for agriculture (Motschmann et al., 2020; Shah, 2016).

Competing water issues between residents and game lodges can arise in areas where both groups rely particularly on the same water sources such as rivers or groundwater wells (Renner & Opiyo, 2021, Shah, 2016; Gondo & Kolawole, 2019). Competing water issues between residents and game lodges may include water rights, water pricing costs, differences in water quality and allocations for access to water resources (Gondo & Kolawole, 2019; Shah, 2016). While residents rely on water for daily domestic needs such as cooking, cleaning, bathing and for agricultural purposes such as irrigation (Renner & Opiyo, 2021), game lodges, on the other hand, in addition to providing water for wildlife, may require large amounts of water to maintain their facilities, including watering lawns and gardens, and filling swimming pools (Tirado et al., 2019; Synman, 2014). In certain scenarios, a common water source that both game lodges and nearby residents may share is a natural body of water such as a river, lake, or dam that provides water for wildlife, agriculture, tourism, and domestic use. If the common water source is not sufficiently replenished, game lodges may use a lot of water, which could be harmful to the environment and residents (Bierkens & Wada, 2019).

The presence of game lodges offers several employment opportunities in hospitality, maintenance, and wildlife management to benefit residents (Musavengane & Kloppers, 2020). Game lodges are often located in areas with rich biodiversity, and as such, residents can benefit by being involved in conservation efforts and in awareness programmes to greater understand the natural world (Mbaiwa et al., 2019) and in community development projects, capacity building, and social initiatives (Logan, 2015). This can involve supporting education, healthcare, skills training, and conservation awareness programs, empowering

residents to actively participate in sustainable tourism practices and natural resource management. Overall, game lodges can have a favourable effect on residents and the benefits can change based on the situation, level of community engagement, and the responsible practices implemented by the game lodges (Snyman, 2013). Effective collaboration and equitable benefit-sharing between lodges and rural communities are essential to maximize the positive impacts and ensure sustainable development.

1.2.3 The importance of water governance in the game lodge industry and for residents

Studies in East Africa, Southern Africa and Asia have documented the importance of prominent nature-accommodation establishments such as game lodges that are in environments with a range of wild animals (Turok, 2018; Rogerson, 2017; Telfer & Sharpley, 2015). Game lodges are among the accommodation establishments known to embody ecotourism, which entails the directed efforts to support conservation for the environment and support residents to improve their welfare by selling their locally sourced produce and cultural resources (Rogerson, 2018).

According to Grobler and Mearns (2020), hotels located in a rural setting, such as game lodges, may make use of sources of natural water sources like boreholes, dams, and rivers to meet their water demands and, in most cases, there are no surrounding houses requiring an additional water supply. Thus, many rural residents may rely on alternative water sources such as communal or public water supply systems (Morinville & Rodina, 2013; Mbaiwa, 2005). However, in areas where water resources are scarce and game lodges and residents may compete for access to water, this can lead to tension and disputes (Bijani & Hayati, 2018). Conflicts over water between game lodges and residents can arise from competition for limited water resources, differing priorities in water usage, and inadequate water infrastructure (Cole, 2015; Gichuki, 2002). An example can be found in certain regions of Southern Africa, where game lodges or private reserves have secured access to water sources such as rivers or boreholes, while nearby rural communities face restricted availability of clean water for drinking and irrigation (Morinville & Rodina, 2013; Mbaiwa, 2005). The actual arrangement and sharing of water sources between game lodges and residents would depend on factors such as local water availability, legal frameworks, water

rights, and the prevailing water management practices in the region (Turok, 2018; Zeitoun et al., 2017).

Coupled with increased water demand is an associated increase in conflict which is becoming more intense because of an increase in population as well as urbanization and industrialization (Yu & Lu, 2018). Water conflicts are becoming more deeply ingrained and linked to more significant social problems. According to Swatuk (2015), predictions are that future conflicts over water will take place locally. It has been indicated that most conflict-prone events focus on water infrastructure during the dry season because of droughts or floods (Ide, 208; Krampe, 2017) when access to an adequate water supply may be viewed as a matter of life or death (Yuan et al., 2022). The threat of cutting off or disrupting vital water resources is a contentious and highly emotional issue that is debated (Swatuk, 2015). Water management is therefore crucial to ascertain whether water conflicts can be prevented or if they are unavoidable (Yuan et al., 2022).

Localized rural water conflicts can deeply and enduringly impact the affected communities, making it essential to resolve and prevent these disputes to ensure local stability and development (Zeitoun et al., 2017). According to Krampe (2017) water conflicts can be typically resolved by a combination of geographical scope, diversity of stakeholders and shared vulnerabilities. In Southern African countries, water conflicts have been noted between farmers (livestock owners), national parks and accommodation establishments such as game lodges due to demands for water and pastures and the requirement that residents keep their lifestock away from such water and pastures (Mbaiwa & Kolawole, 2013). To encourage harmony, residents are involved in the management of resources by ensuring that they directly benefit from the available resources. However, in severe circumstances conflicts between competing parties or industries can escalate into outright violence either from local, national, and transboundary confrontations related to competition for water access (Swatuk, 2015). Water scarcity reflects an unequal society because it results from social relations - it makes water scarce for most people while making water abundant for a select few (Swatuk, 2015). It makes sense that areas where water is scarce, there would be an increased likelihood of water-related conflict (Zeitoun et al., 2017). As with water

spanning borders, in recent years attention has increasingly focused on resolving water disputes, as failure to do so is likely to lead to water-related conflicts (Yu & Lu, 2018).

Among the important water management strategies for game lodges are to ensure that water abstraction and discharge points are properly planned to ensure sustainability by maintaining equitible water volumes for all stakeholders (Alberts et al., 2022). For instance, in rural Zanzibar, the hospitality industry competed with residents as to water consumption, with 685 L/day as opposed to 48 L/day for residents (Gössling, 2012). According to Tourism Concern (2011), most hotels on Zanzibar did not use water conservation measures, which resulted in excessive water use and disputes with the local population. The excessive use of water in the hospitality industry can be attributed to several factors, including longer showers, frequent use of hotel swimming pools, and the need to wash clothes and engage in water-based activities such as scuba diving and snorkeling by tourists (United Nations Environment Programme, 2014). Similar data demonstrating greater water consumption by tourists compared to residents were documented by Cole (2012) in a case study from Bali. The study showed that the lack of water governance made it difficult to achieve an equal water distribution between tourists and surrounding residents, particularly in the high season.

While excessive water withdrawal is generally a concern that affects water security in an area, overuse of water by tourists could generally lead to groundwater subsidence and decline in groundwater quality (Cole, 2014; Tribia, 2014, Mbaiwa et al., 2013). Common water sources between game lodges and residents can vary depending on the specific location (Zhuang et al., 2014). Game lodges may have their own wastewater treatment systems, while residents in urban areas may rely on a combination of improved or aging water source infrastructure (Makopondo et al., 2020). In some cases, both game lodges and residents may share the same water sources, but the quality and contamination levels of these sources can differ (Makopondo et al., 2020; Zhuang et al., 2014). Further research and local assessments are necessary to determine the specific common water sources between game lodges and residents in different regions.

Becken (2014) suggested that the hospitality industry needs to integrate their needs with residents and demonstrate social responsibility to achieve the best results for business, tourists, residents, and the environment. By considering the water needs of surrounding residents, the hospitality industry can contribute to the overall sustainable development and well-being of the community (Logan, 2015). Showing concern for the well-being and needs of the surrounding residents, including access to essential resources like water, is a responsible and ethical approach. A study by Grobler and Mearns (2020) specifically investigated water quantity use baselines to benchmark water use in game lodges to improve water management and ensure water was sustainable across southern Africa. Findings of the study indicated that government regulations typically play a crucial role in setting standards, defining permissible limits, and enforcing practices that contribute to the conservation and responsible use of water. Furthermore, the average water consumption across all three investigated countries in southern Africa (Botswana, Namibia, and South Africa) were 2073 L/day which was higher than other nations such as Greece, the USA, Germany, Morocco with the water consumption of 675 L/day and 500 L/day, respectively. This indicates a need to reduce the quantity of water used in the operation of game lodges.

A study conducted by Sucheran (2013) in KwaZulu-Natal, South Africa suggested a reluctance among 3 to 5-star rated lodges in adopting water efficiency measures. The primary concern cited was the perceived potential for these measures to compromise guest comfort and satisfaction. A contrasting study by Logan (2015), explored the awareness and sustainability of tourism by investigating environmental practices in luxury game lodges and private nature reserves found near the Kruger National Park in the Limpopo and Mpumalanga Provinces of South Africa. This study particularly scrutinized the environmental practices adopted by luxury game lodges and private nature reserves neighboring the renowned park. The study found that the luxury game lodges ranging from 3 - 5 stars grading can successfully implement water efficiency measures for water conservation. Such insights provided valuable context for ongoing discussions and initiatives aimed at promoting responsible tourism practices withing the hospitality sector across diverse landscapes in South Africa. Considering the increase in the rural population, the effects of climate change and other external factors such as epidemics, there is increased

pressure on water resources that could lead to water consumption competition between rural residents and game lodges if water is not distributed equitably. (Synman, 2014; Moyle et al., 2010). Therefore, even if the supply of water is met, there is still a need to encourage efficient water use given water demands in an area supporting both the hospitality industry and residents (Haigh et al., 2010). The above highlights a need to adapt and invest in effective water governance strategies towards sufficient water access.

Some of the challenges that may be faced by accommodation establishments such as the 3 - 5-star game lodges regarding water efficiency include complex issues such as low human capital, a rapidly increasing neighbouring population, poor governance, and declining economies that could contribute to poor water management (Van Zyl & Jooste, 2022; Rogerson, 2012). The goal of water governance is to promote sustainable and equitable use of water resources, while balancing the competing demands of various sectors, such as agriculture, industry, and domestic use (Dube at al., 2020). Water governance also aims to ensure the protection and conservation of water resources, and to enhance the resilience of residents and ecosystems against the impacts of climate change and other stresses (Ferreira, et al., 2021; Warner & Sullivan, 2017).

While Mthimunye (2020) and Yates & Harris (2018) have extensively documented the consequences of poor water governance stemming from governmental and municipal failures in implementation, Han and Hyun (2018) along with Gabarda-Mallorquí et al. (2017) have pointed out an alternative perspective. According to their research, the lack of adequate water supply or water scarcity can often be attributed to insufficient water management practices by residents. This deficiency in community-level water management can subsequently hinder sustainable development efforts. It is thus imperative that the key government departments, tourism, and municipality, also known as formal institutions, given their legislative mandate, play a more active role in water governance to secure water access and support vulnerable residents and businesses such as game lodges. According to Dlangalala and Mudhara (2020), collaborative efforts between formal and informal institutions could assist in the implementation of water governance which should take into consideration government enforcement of laws which is usually limited by lack of awareness, finances, and human resources. For example, in a study conducted in KwaZulu Natal province,

South Africa highlighted that water governance can be improved through awareness, devising effective ways to enforce compliance and improve public participation (Dlangalala & Mudhara, 2020). This highlights a need for researchers to determine approaches that can be used to support residents to identify strategies that are effective to ensure water security for residents.

1.2.4 Theoretical frameworks and effective water governance

The concept of governance recognizes the growing interdependencies and intricate interactions within societal policies (Keping, 2018). This complexity arises from factors such as global economic shifts, swiftechnological advancements, and the increasingly unclear distinction between public and private domains (Pahl-Wostl, 2017). Various transnational institutions impact global or regional water governance, including those established by the UN or other international bodies, multilateral/bilateral treaties, and informal institutions formed by professional associations, civil society groups, or market participants. While mainstream governance perspectives often emphasize government regulatory power, global water institutions are weak in regulation but effective in agenda setting, information sharing, mobilization, and resource allocation (Cashore et al., 2021). Effective water governance is essential for managing sustainable water resources and ensuring equitable access to clean water for all (Pahl-Wostl, 2017). In essence, water governance involves a set of rules, practices, and norms determining the allocation of water, addressing questions of who receives water, when, and how (i Gispert, et al., 2020). This encompasses the decision-making systems related to water and the engagement processes of stakeholders within these systems.

Several theoretical frameworks have been developed to guide the understanding and implementation of water governance. Theoretical frameworks refer to theories that allow a researcher to explain, understand a phenomenon, make assumptions, and then challenge existing knowledge (CohenMiller & Pate, 2019). There were four theoretical frameworks to underpin the study to guide the understanding and implementation of water governance a) United Nations Development Programme (UNDP), b) integrated water resource management (IWRM), c) the 4R approach and d) reflexive governance. Overall, the

hospitality industry requires different interventions to meet water demands and share savings by reducing water shortages due to water losses that could seriously impact environments that experience water constraints.

The Water Governance Framework proposed by the United Nations Development Programme (UNDP)

The Water Governance Framework proposed by the United Nations Development Programme (UNDP) is a tool to help governments, civil society organizations, and other stakeholders to improve water governance (De Stefano et al., 2014). The UNDP is a global development network that operates in over 170 countries in addressing various development challenges (Daoud et al., 2022). The UNDP works with governments, civil society, and the private sector to help countries achieve sustainable development goals (Olagunju et al., 2019). It provides technical assistance, policy advice, and financial support to promote inclusive and sustainable development (De Stefano et al., 2014). The UNDP water governance framework is based on the understanding that for water governance to be effective, all stakeholders must be included in the integration of social, economic, and environmental considerations (Jiménez et al., 2020). By adopting the UNDP principles, governments, civil society organizations, and other stakeholders can work together to improve water governance and ensure the sustainable management of water resources (Olagunju et al., 2019). The framework can be adapted to different contexts and used to guide policy development, program design, and evaluation (Daoud et al., 2022). The UNDP water governance framework is suited for this study given the need to explore social (residents, game lodges and private organizations), economic, political (government structures including local municipality, National Department of Water and Sanitation and the Department of Tourism) and the environmental considerations on the effective water governance

Integrated Water Resources Management

The *Integrated Water Resources Management* (IWRM) was defined at the World Summit on Sustainable Development (WSSD) from 2002 in Johannesburg, South Africa by the Global Water Partnership's Technical Advisory Committee (Grigg, 2014; Rahaman & Varis,

2005). Historically, various countries, like Spain with its water tribunals dating back to the tenth century, have practiced integrated water management. Efforts to implement IWRM globally had surged since the 1940s, with examples such as the Tennessee Valley Authority and later initiatives in Hessen, Germany (Rahaman & Varis, 2005). The Mar del Plata Conference in 1977 endorsed IWRM to address diverse water resource uses (Grigg, 2014). Despite waning interest in the 1980s, international efforts in the 1990s revitalized IWRM, culminating in significant discussions and forums highlighting its importance (Grigg, 2008). As such the IWRM has since evolved into a widely accepted framework for sustainable water management at local, national, and international levels.

The IWRM aims to promote the coordinated development and management of water, land, and related resources, with the goal of maximizing economic and social welfare while ensuring environmental sustainability (Rahaman & Varis, 2005). This approach recognizes the interconnectedness of water resources and the need for integrated solutions to address challenges such as water scarcity, pollution, and climate change (Grigg, 2014). The IWRM is considered an effective water management system towards implementation (Bianchi et al., 2021). Thus, the main aim of the IWRM is to ensure effective governance that translates from policy and programme principle into implementation towards more sustainable systems of water resource management to meet water supply and demand (Haigh et al., 2010). The IWRM entails the coordinated development of water efficiency measures to maximize the resulting economic and social prosperity in an equitable manner without compromising the sustainability of critical ecosystems (Pillay, 2017). The IWRM is an inclusive approach aimed at including all stakeholders and residents in water resources planning and management (Musingafi & Chadamoyo, 2013). While there are many aspects of the IWRM approach contributing toward water resource management, this study primarily focused on governance and water efficiency programs which ensure effective use in game lodges and surrounding residents.

In South Africa, water management frameworks are based on legislative powers as highlighted in the National Water Resource Strategy, Version 2 (NWRS-2), under the National Water Act (Act 36 of 1998), which stated a need for all industries to adopt water efficiency measures to achieve sustainability objectives, given an increasing water demand

(Ruiters, 2013).The NWRS-2 also seeks to address the need of adaptation of water efficiency measures in residents through considering the interests of the residents by initially supplying water and sanitation services but also followed by water management particularly considering the impacts of climate change (Maphela & Cloete, 2019). Dlangalala and Mudhara (2020) suggested that the range and complexity of institutions governing the use of water resources needed to be well understood for any efforts to improve water allocations that were effective and yielded the desired outcomes. Government structures also have an important role to play in the effectivce and successful implementation of water management among the hospitality and tourism industries (Amoako, 2022).

The 4R approach

The 4R approach water management framework entails innovative reducing (IR1), innovative reuse (IR2), innovative reaching (IR3) which involves establishing connections with others to advance sustainable water management and innovative recycling (IR4) developed by Kasim et al., (2014) in Malaysia. The 4R approach is suited for this study as it can be implemented by accommodation operators who have interest in water management irrespective of the size, finance, technical knowledge, and managerial capacity for improvement and commercial benefits. For example, Ferreira, et al. (2021) and Warner & Sullivan (2017) suggest that stakeholder alliances between different stakeholders (e.g., government departments, star grading organizations, game lodges and community organizations) can improve water governance of an endeavor for long term success, which in this instance is to ensure successful water governance and successful intervention for greening, this can include the use of water efficiency measures to minimize water use. Within the hospitality industry, formalised policies and strategies are needed for collective decisions and choices relating to water management (Smith & Leonard, 2018). Research studies in the hospitality sector have shown that the adoption of water efficiency measures can assist in reducing water shortages and contribute to sustainable tourism (Logan, 2015; Sucheran, 2013).

According to Carr (2020) and Goffman (2020), the COVID-19 pandemic provided an opportunity to reduce environmental devastation by overuse of natural resources towards sustainable tourism by both residents and the hospitality industry. While there may have been government interventions towards accelerating water governance capacity, the unexpected slowing down of the travel industry may have led to compromised water governance efforts (Dube, 2021). For example, the South African Department of Tourism (NDT) made progress in expanding water governance programs for privately owned tourism enterprises such as game lodges to retrofit their facilities under the Tourism Incentive Programme (TIP) and the Green Tourism Incentive Program (GTIP), schemes that were also prompted by external drivers such as climate change (Department of Tourism, 2020). This highlights that the effectiveness of any industry requires good water governance to maintain sustainability and emphasises the need to examine water governance and water efficiency strategies in 3-5 star graded game lodges as well as associated residential beneficiation. Exploring the efficiency of water strategies, considering the political, social environmental and economic spheres that are in place, may lead to optimal water resource regulation and management and avoid water conflicts between residents and associated game lodges.

Reflexive Governance

Reflexive governance is a concept that describes a new approach to governance, based on self-reflection, self-critique, and self-regulation (Mansson et al., 2022). Reflexive governance is closely related to the concept of reflexivity, which refers to the ability of individuals and organizations to reflect on their own assumptions, beliefs, and practices, and to modify them in response to changing circumstances (Feindt & Weiland, 2018). In the context of governance, reflexivity means that decision-makers are aware of their own biases and limitations and are willing to listen to feedback and adjust their approach accordingly (Gunningham, 2012). The idea is that governance systems should be able to adapt and improve based on their own internal feedback loops, rather than relying solely on external rules and regulations. At its core, reflexive governance is about creating a more flexible, dynamic, and responsive system of governance that is better able to address complex problems in a rapidly changing world (McLoughlin et al., 2020). It involves a shift away from traditional top-down, command-and-control models of governance, towards more

collaborative and participatory models that engage stakeholders in the decision-making process and experimentation around how best to implement it in practice (Feindt & Weiland, 2018).

Transformative change requires both a clear understanding of the current situation and those innovative solutions that are both politically legitimate and environmentally fitting for the promotion of sustainable development (Leonard & Lidskog, 2021). The concept of reflexive governance is seen as a novel approach to respond to risk management that substitutes hierarchical, traditional, and deterministic approaches with more reflexive, collaborative, and flexible ones that draw on diverse knowledge systems to decision-making (Mansson et al., 2022; Gunningham, 2012). By increasing participation and facilitating deliberation across industries, governments, and civil society sectors, a more legitimate decision-making process can be achieved (Dryzek & Pickering, 2017). This requires managing multiple contestations over sustainability and recognizing that legitimacy can be contested. Additionally, an investigation into the effectiveness of reflexive governance in different socio-environmental contexts and its implications for sustainable development outcomes would contribute valuable insights. Reflexive governance has various approaches towards shaping sustainable development and may be appropriate for the present study.

Within sustainability development paradigms, state governance plays an important role in managing unintended side effects and managing risks (Nastar et al., 2018). Even though the nation-state may be weakened in some ways, governance still plays a significant role in management and administrative systems (Barrett et al., 2021). Governance is a crucial aspect for organizations in response to changing external environment (Keping, 2018; Meissner et al., 2013; Rothstein, 2012) particularly as it may be reframed to cope with today's ubiquitous uncertainty (Nastar et al., 2018). Deliberation of citizens is an essential component of enabling them to express their views and to act on those views; the more deliberate the process, the more reflexive the governance will be (Dryzek & Pickering, 2017). In the absence of in-depth information, participatory and deliberative mechanisms may be ineffective (Rothstein, 2012). While policies and legislation may be in place there tends to be little known about the nature and functioning of the governance institutions that

are necessary to effectively enable reflexive governance in society (Dryzek & Pickering, 2017).

The study proposed by Pollard et al. (2023) advocates for adaptive water governance, emphasizing the necessity for governance systems to adapt to changing conditions, uncertainties, and emerging challenges in managing water resources. This approach aligns with reflexive governance, known for its inclusive and self-aware nature (Wyborn et al., 2023). Both emphasize learning, adaptation, and responsiveness to diverse perspectives. The integration of adaptive and reflexive governance holds promise for more inclusive and sustainable water resource management, crucial in addressing complexities tied to environmental and societal changes (Leonard & Lidskog, 2021; Cosens & Gunderson, 2018). Therefore, effective water governance with considering the different theoretical frameworks expanded in detail in section 2.9.1 requires reflexive governance to bring about necessary changes to maximise the resultant economic and social welfare in an equitable manner.

1.3 Problem statement

Despite the increasing importance of water governance in the tourism and hospitality sectors, there is a lack of research demonstrating competing priorities between game lodges and associated residents. This knowledge gap hinders the development of effective water management policies and practices in the sector, and undermines efforts to address water scarcity, climate change, and sustainability challenges. Therefore, there is a need to examine the water governance and efficiency strategies employed by game lodges and associated residential beneficiation, and assess their impact on water consumption, conservation, and environmental outcomes. There is a lack of detailed understanding of how high-standard game lodges manage water resources and the specific strategies they implement for water efficiency. This includes exploring the existence of stakeholder partnerships to jointly contribute to water governance frameworks, aiming to enhance water efficiency and maintain a balance between water supply and demand for both game lodges and residents. The direct effects of these water management practices on overall water usage, conservation efforts, and the local environment have not been thoroughly investigated. This study aimed

to fill this gap by exploring the drivers, barriers, and outcomes of water governance and efficiency strategies in selected game lodges and associated residential beneficiation and provide recommendations for improving water management practices in the sector. While the importance of water efficiency is recognized, the specific motivations and obstacles faced by game lodges in adopting these measures remain underexplored.

Different scholars have shown that Hammanksraal is associated with poor water governance by the munipality (Musingafi et al., 2014). Msiza & Mthembu (2020) pointed out that Hammanskraal residents constantly embark on protests to express mainly their dissatisfaction, which stems from poor water governance. There have not been studies that have singled out water competition between residents and game lodges in the area or any protests regarding water use at game lodges. According to Mbenenge and Thomas (2019), water efficiency measures are necessary to ensure that water resources are managed in a sustainable manner not only for the hospitality industry such as game lodges in maintaining their market competitive advantage, but also to bring balance to the livelihood of residents. There has not been enough research done on the existence and efficacy of cooperative efforts between game lodges, locals, and other stakeholders in water governance. The views and interactions between people and game lodges on shared water resources are not well studied, particularly regarding governance responsibilities.

The 3-5 star graded game lodges were chosen for this study because they are of high standard as they generally provide a certain level of quality in terms of their accommodation, facilities, and services for hospitality relevance. Specific, actionable recommendations tailored to the game lodge sector and its unique challenges and opportunities in water management are lacking. There are over 51 game lodges in Gauteng (Afristay, 2020; SAVenues, 2020). SAVenues (2020) reports that out of the 45 various types of accommodation establishments situated near the Dinokeng Nature Reserve, 25 are graded game lodges. These lodges are in proximity to the rural town of Hammanskraal. This study explored the extent of water governance and water efficiency strategies in 3-5 star graded game lodges in Dinokeng Game Reserve and associated residential

beneficiation. The importance was to explore the applicability of reflexive governance on the adoption of water efficiency measures by different stakeholders.

1.4 Research aim, objectives, and questions

The purpose of this study was to investigate the extent of the implementation of water governance and water efficiency strategies in 3 - 5 star graded game lodges and associated residential beneficiation: The case of reflexive water governance at the Dinokeng Game Reserve in Gauteng, South Africa. Given the water challenges faced by Hammanskraal residents, this study will assist in understanding which water governance structures are within the community for their role and responsibility in ensuring water sustainability. By addressing these questions, the study aims to provide a comprehensive understanding of water governance and efficiency strategies in the hospitality sector, particularly in game lodges, and offer insights and recommendations for sustainable water management practices that balance the needs of both businesses and local communities. The research intended to propose suitable recommendations for effective water governance strategies that could influence water efficiency for the 3 - 5-star game lodges and residents in the study area.

To achieve the above research aim, the following research objectives were addressed:

1. To determine the extent of reflexive water governance and the effectiveness and enforcement of national laws, regulations, and policies in addressing water efficiency to enable good water governance for selected game lodges.
2. To examine the extent of adoption and implementation of water efficiency measures for 3 - 5-star game lodges and residents in the study area.
3. To identify the water governance strategies that are effective in 3 - 5-star graded game lodges.
4. To examine collaborative efforts by different stakeholders (i.e., government, non-governmental sectors, civil society, and residents) to enable reflexive water governance and strategies for game lodges and residents in the study area.
5. To explore if there are competing priorities between game lodges and residents.

This study addressed the following research question:

To what extent has the implementation of water governance strategies been adopted in 3 - 5-star graded game lodges and surrounding residents of the Dinokeng Game Reserve in Gauteng, South Africa?

The following sub-questions were explored:

1. To what extent is reflexive water governance practiced and what is the effectiveness of national laws, regulations, and policies in addressing water efficiency and good water governance for game lodges?
2. To what extent have water efficiency measures been adopted and implemented by 3 - 5-star game lodges and residents in the study area?
3. Which water governance strategies are effective in 3 - 5-star graded game lodges?
4. What governance and collaboration efforts by different stakeholders (both government and non-governmental) are involved to enable reflexive water governance and strategies appropriation of policies on water governance for game lodges and residents in the study area?
5. What are the competing priorities experienced by game lodges and residents in the study area?

1.5 Rationale

Water is a vital resource that is essential for human and ecosystem survival. However, due to high water demands from escalating population growth, climate change, and other anthropogenic activities, the availability and quality of water resources have been severely impacted. Globally, several studies have investigated the adoption of water efficiency measures in the hospitality industry (Tirado et al., 2019; Styles et al., 2015; Barberán et al., 2013; Gössling, 2012; Charara et al., 2011; Hakim & Nakagoshi, 2016; Cheung, 2012). However, the paucity of published research on water governance strategies and adaptation to climate change within the South African tourism industry and the high water demands in this industry validate the need to conduct research as to how 3 - 5-star South African game

lodges may differ in adopting water efficiency measures. Research in South Africa has focused on poor water quality and lack of infrastructure for water and sanitation (Dithebe et al., 2019; Sibiya & Gumbo, 2013) and there remain limited studies that have explored water governance for equitable water use in game lodges and surrounding residents. Given the impact of climate change and droughts, there is an urgent need for water conservation structures to reduce the quantity of water utilized in the tourism industry (Hoogendoorn & Fitchett, 2018). To ensure sustainability, the hospitality industry needs relevant water management guidance and strategies for implementation at operational level to ensure that impacts due to water shortages are minimised within the hospitality industry or experienced by residents living in the area (Hoogendoorn & Fitchett, 2018; Pandy, 2017).

Accordingly, “appropriate institutional water governance is needed to control the social and ecological interface to alleviate water supply management challenges" (Maphela & Cloete, 2019, p. 3). As such, environmental legislation in South Africa requires policy formulations for sustainable use of water resources under the National Water Act, 36 of 1998 on cooperative governance and to prevent conflict that may result from the use of water resources (Maphela & Cloete, 2019). This study will also provide an opportunity to explore if there is competition for water between game lodges and residents which has been underexplored within the South African context. Thus, the present study was interested in investigating the efficiency of water governance strategies for game lodges and residents living with the surrounding area in terms of the established national laws for all relevant stakeholders that are involved on sustainable water services goals. Maphela and Cloete (2020) stressed that in South Africa, the reality of water scarcity has become quite evident with water shedding being experienced in many parts of the country. The advancements in access and water delivery require prioritization. However, in most parts of the country there is lack of equitable water supply and poor water governance. (Yates & Harris, 2018). Consequently, good water governance is crucial to respond to the realities of water delivery systems that, in most cases, disproportionately affect the less privileged residents such as those living in rural areas (Yates & Harris, 2018; Musingafi et al., 2013).

1.6 Research Methodology

This study used the qualitative research method to understand water scarcity and water governance implementation in this South African study site by involving different stakeholders such as government, municipality, and tourism certification programs who are involved in the implementation of government policies and regulations on the upscaling of water efficiency measures. Secondary data such as records, reports, and any relevant publications were used to provide more information on water governance in the study area. The rationale for selecting a 3 - 5-star graded game lodge is because star grading is associated with quality to retain a positive image of providing good service, leading to greater investment (Logan, 2015; Sucheran, 2013). Given the increase in water demand that is also needed to support an increasing population, conducting this study should highlight the need to improve and implement water efficiency measures with a view to sustainability by and for both hospitality establishments such as game lodges as well as residents living nearby. This study will also determine the effectiveness of national policies and regulations for water efficiency and enforcement by government. With 3.8 million international tourist arrivals per annum, Gauteng Province is a suitable study location as it provides a significant tourism revenue of up to R30 billion ($1.6 billion), followed by the Western Cape with 1.7 million tourist arrivals (Tourism Performance Report, 2018).

The qualitative data collected from interviews and focus groups were analyzed thematically. The data will be coded and categorized to identify key themes and patterns related to water governance and efficiency strategies. Ethical considerations will be paramount throughout the study. Informed consent will be obtained from all participants, ensuring voluntary participation and protection of their privacy. Confidentiality and anonymity was maintained during data collection, analysis, and reporting. The study complied with all relevant ethical guidelines and regulations, ensuring the responsible and ethical conduct of research involving human participants. Overall, this study aimed to provide valuable insights into sustainable water management and contribute to the development of effective water governance strategies.

1.7 Conclusion

In conclusion, the chapter addressed the research problem, presented the research questions, and outlined the significance of the study. The literature review provided a comprehensive review of existing research, identifying gaps and limitations. The research framework and the stage for the subsequent chapters to further investigate the research questions and contributed to the existing body of knowledge in the field was provided.

1.8 Outline and structure of the study

This thesis consisted of six chapters as outlined below:

Chapter One provided the introduction to the research topic, the theoretical considerations, the problem statement, and the research aim and objectives. These sections are followed by a rationale for the selection of the research area as well as a synopsis of the thesis chapters.

Chapter Two constituted a literature review with viewpoints of other scholars on the research problem, and according to the theoretical frameworks underpinning the research.

Chapter Three addressed the methodological approach used in the study, the purpose and the explanation for every research design, and the choice of data collection methods, including the sampling strategy used. Ethical considerations are included in this chapter.

Chapter Four presented the primary data collected from the field work that involved interviews/observation, etc. The presentation of primary data findings uses bar charts/pie charts based on identified data themes.

Chapter Five consisted of a discussion and analysis of the primary study data. This chapter compares findings in the literature review to the primary data findings. In addition, discussion is provided in relation to the research aim and objectives.

Chapter Six presented the study conclusions based on the data findings in relation to the research aim and objectives. The scope for future research is highlighted followed by recommendations for strategies that can be used to improve water governance in the study area.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

The accommodation sector around the world is quite diverse (Minazzi, 2012; Wilson-Mah, 2015). A particular element of the hospitality industry is the escalated utilization of the environment, which contributes to different concepts and views regarding the classifification of accommodation establishments (Wilson-Mah, 2015). The Tourist Grading Council of South Africa (TGCSA) indicates that a game lodge is a type of accommodation facility typically found in wildlife reserves or national parks, designed to provide visitors with a comfortable and immersive experience in nature by allowing them an opportunity to observe wild animals and engage in game drives (TGCSA, 2021). The accommodations at a game lodge are generally designed to blend in with the natural surroundings, often using local materials and architectural styles (Makopondo et al., 2020). Lodges can offer a range of amenities, including private or shared chalets, tented camps, dining areas, lounges, swimming pools, and outdoor viewing decks (Magagula & Costello, 2021). There can be additional activities offered by game lodges including provision of information about the local flora and fauna, bird watching, bush walks, cultural experiences, and spa facilities to enjoy the natural environment (Falkof, 2022).

Based on trends in international literature, accommodation establishments are commonly referred to as hotels as opposed to hotel types e.g., games lodges, or a guesthouse. Despite the name differences, they are comparable in checking-in visitors for accommodation and providing housekeeping (Parsons et al., 2018). However, the TGCSA separates them into various groupings based on the accommodation type for business operation (TGCSA, 2021; Tefera, 2015; Rogerson, 2013). For consistency, throughout the literature for this chapter, study accommodation establishments shall also be referred to as hotels considering the lack of literature that focuses on water efficiency measures for specific accommodation establishments such as game lodges.

This chapter commences with the introduction for the literature review followed by details on the global perspective of water demand towards sustainable development. Thereafter

follow sections regarding published literature describing good governance towards sustainable development, details on South African governance towards sustainable development and reflexive governance towards sustainable development. Information is then provided on reflexive governance in water management narrowing in from the global view to South Africa. The following sections describe the global water governance framework, global water quality management and monitoring, water allocation and distribution, global legal and institutional frameworks, water efficiency measures towards climate adaptation, and stakeholder engagement and participation.

Information is also then provided on global water governance in the hospitality and tourism industry by describing factors that influence water governance in South Africa and the development and growth of the hospitality and tourism industry in South Africa. Focus then shifts onto global strategies used by game lodges towards sustainability by providing details on strategies used by game lodges in South Africa towards sustainability. Then, global water management in the hospitality industry describes the global quantities of water used in hotels, water saving methods used in hotels, and details of in-house technologies and alternative water sources. Global factors influencing water consumption in the hospitality industry are then provided and finally, global theoretical considerations in water resource management This is followed by a conclusion. This chapter of the literature review intends to identify gaps in knowledge and assist in understanding the current state of research regarding water governance with emphasis on the hospitality industry and the impact of water use in game lodges on residents living near to such game lodges.

2.2. Towards sustainable development, the global perspective of water demand

From a global to local perspective, water availability and usage are integrally linked to human development and ecosystem needs (UN-Water, 2015). The World Water Development Report 2015 (UNESCO-WWAP) stated that the foundation water availability is at the core of sustainable development. On the national, regional, and local levels, safe drinking water is an important issue for health and development (Herrera, 2019). In some regions, investment in sanitation and water have shown to yield net economic benefits, as

reductions in negative health impacts and health care costs outweigh implementation costs (Gofen et al., 2021). This applies to investments ranging from significant infrastructure for the water supply to household water treatment. Because of the importance of water, the government systems of both developing and developed countries must be equipped to ensure access to safe water (UN-Water, 2015). Experience has also demonstrated that policies aimed at increasing access to clean whether in rural or urban settings, largely benefit the impoverished and can be a useful component of programs to reduce poverty (Di Vaio et al., 2021). Sustainable environmental management may be enhanced by meeting human water needs at the local level.

Due to overconsumption of water resources, the challenge for the future is to balance the perpetual state of diminishing water supplies demand with the available supply in both urban and rural areas through using appropriate water management mechanisms (Alberts et al., 2022). In addressing future projected effects of climate change, measures such as encouraging the introduction of efficient water use sooner rather than originally planned may be needed (Del Carpio et al., 2021). Within the sub-Saharan Africa context, many cities experience regular water shortages due to underdeveloped water infrastructure (Pillay, 2017). The situation is worsened not only by climatic changes but also demographic drivers such as an increase in population with an expected increase of up to 2.4 billion people by the year 2050 (Jankielsohn, 2012). This highlights the need to invest in infrastructure projects to ensure that there is access to a good quality water supply in the future affecting both residents and industries, such as the hospitality industry.

In response to global water demands and advancement towards sustainability, the General Assembly of the UN adopted 17 Sustainable Development Goals (SDGs) (Fonseca et al., 2020). Consequently, SDG targets require an understanding of water availability and its dynamics both locally and globally (Herrera, 2019). Research is important in assessing and implementing the SDGs from a water perspective. Several of the Sustainable Development Goal targets are interrelated, such as SDG-15 (freshwater ecosystems), SDG-12 (sustainable consumption), SDG-6 (clean water and sanitation), SDG-3 (health and wellbeing) and SDG-2 (food security). Given the connection of many areas of activity between the SDG,

addressing water governance would positively impact several other interconnected problem areas. Specifically, SDG 6 aims to ensure access to water and sanitation for all and to improve water quality. Examining water governance and water efficiency strategies in game lodges and associated residential beneficiation can contribute to achieving SDG 6. To reflect the reality that the corresponding goals are completed at various scales, Bhaduri et al. (2016) claimed that it is urgently necessary to incorporate water quality and sanitation assessments at the home and community levels. There is no doubting the critical importance of water to both social and economic advancement and sustainable development.

2.2.1. Good water governance towards sustainable development

To achieve sustainable development, social problems must be addressed by governance (Westling et al., 2019). Governance is a crucial aspect for organizations in response to a changing external environment (Keping, 2018; Meissner et al., 2013; Rothstein, 2012). Governance involves the sharing and distribution of power, shared priorities, and policies between stakeholders towards bringing about social solutions and technological development (Keping, 2018). Governance systems set guidelines around which management and administrative systems will follow. Within the literature on development, the term 'good governance' is frequently used. Specifically, the donors advance the notion that 'good governance' is a prerequisite that must be met to create an atmosphere that encourages the decrease of poverty and sustainable human development (Halbe et al., 2015). Good governance has also been accepted as one of the targets of the Millennium Development Goals (MDGs) because it is expected to be participatory, transparent, accountable, effective, and equitable and promotes the rule of law (Keping, 2018; Gel'man, 2017).

Good governance is the useful collaboration between the state and residents, and the way into its prosperity lies in the participation within the political organization (Keping, 2018). According to Rothstein (2012), residents should have adequate political ability to take an interest in strategy, organization, and oversight for economic and social change. Importantly, the guidelines that regulate the operation of management and administrative systems are established by governance systems.

It is common to mistakenly associate management with governance, with the former mostly referring to the tasks of organizing, carrying out, and overseeing operations to produce predetermined outcomes. (Meissner et al., 2013). According to Gel'man (2017), the understanding of good governance is highlighted by the World Bank's Worldwide Governance Indicators program (World Bank, 2020), where six key dimensions form the foundation of effective governance:

- "Voice and accountability.
- Political stability and absence of violence.
- Government effectiveness.
- Regulation quality.
- Rule of law.
- Control of corruption".

The other four metrics define the characteristics of distinct aspects of good governance, while the first two categories are more concerned with the caliber of political regimes than with the caliber of governance per se. Likewise, Keping (2018) highlighted the six elements which are relevant in good governance to manage various conflict of interest for citizens as follows:

- Legitimacy.
- Transparency.
- Accountability.
- Rule of law.
- Responsiveness.
- Effectiveness.

The higher the degree of good governance, the higher the adequacy of organization would be (Keping, 2018; Gel'man, 2017). In contrast, Gel'man (2017:4) also maintains that while there are good dimensions to good governance, bad governance can be a cumulative impact of the following elements: "(1) lack of the rule of law or perversion of its basic principles – the "unrule of law"; (2) a high degree of corruption; (3) poor quality of regulation; and (4)

government ineffectiveness". These characteristics are specifically linked to state governance. In the meantime, while political instability, violence, and a lack of accountability may all be viewed as components of bad governance in specific institutional and political contexts, these characteristics characterize political regimes rather than bad governance per se. It is true that many aspects of political regimes have an impact on the standard of governance, but these effects are frequently indirect and not always obvious.

2.2.2. South African water governance towards sustainable development

In South Africa, water governance is guided by the National Water Act (NWA), which provides for the equitable and sustainable use of water resources (Maphela & Cloete, 2019). As indicated in Figure 1, the national, provincial, and local spheres of government are the three separate, but interdependent domains of government established by the South African Constitution, Act 108 of 1996., also referred to as 'co-operative government. (Meissner et al., 2013; Van Wyk, 2012). The three spheres of government have allocated functions but prohibit one sphere from transgressing onto the area of jurisdiction of another sphere (Van Wyk, 2012). The national sphere of government is responsible for several functions that affect the country as a whole and require uniformity for service delivery (Meissner et al., 2013). The provincial sphere is involved in terms of efficient and sustainable execution of legislative and executive powers (Van Wyk, 2012). Local government is closest to the surrounding citizens and its legislative competence lies over both national and provincial government (Oosthuizen & Thornhill, 2017). The result is that municipalities rely on funds issued from the national government to provide basic services such as water, electricity, refuse removal and sanitation (Maphela & Cloete, 2019). As such, municipalities should have capacity in responding to government's developmental goals and to achieve its service delivery objectives to create new infrastructure and to maintain infrastructure already constructed.

While Makoti and Odeku (2018) had concluded that the new system has become well established in a short time, its long-term success in promoting the values of democratization, effective governance, and conflict management remains uncertain. Other scholars have indicated that there is slow development in rural areas without infrastructural development

and basic services due to former segregation laws (Oosthuizen & Thornhill, 2017; Tleane, 2011). However, municipalities have a role in promoting sustainable service delivery and in promoting developmental local government depending on sound financial management systems in place to meet its service delivery obligations continuously effectively and efficiently (Oosthuizen & Thornhill, 2017).

Figure 1: The three spheres of government for service delivery function in South Africa.

Source: *Gauteng City Region (2013)*

Some of the challenges municipalities address on water management include securing water for people; securing water for food production; developing job-creating activities; protecting vital ecosystems; dealing with the variability of water in time and space; managing risks; creating public awareness and understanding of water resource management issues (Tleane, 2011). Municipalities face challenges in supplying water to rural residents because they may be in remote locations, yet the demand usually exceeds the natural availability of water - this requires an increase in water use efficiency measures (Maphela & Cloete, 2019; Mothetha et al., 2013). Due to the shortcomings presented above, Reddy (2002) has argued that water security has not been achieved in South Africa. It is thus imperative that water governance be improved towards better management of water resource and to achieve sustainability goals.

2.3. Reflexive governance and water management towards sustainable development

To enable societal development towards sustainability, reflexive governance has emerged as an interactive process that mobilizes knowledge and resources to address social issues through policy, science, and behaviour linkage (Barrett et al., 2021). The concept of reflexive governance was adopted following research on environmental and sustainability governance as the movement against neoliberalism (Gottschick, 2018). Thus, it is viewed as a new way to respond to risks by replacing traditional, hierarchical, and deterministic approaches with more reflexive and collaborative ones that draw on diverse knowledge systems (Voss & Kemp, 2005). According to Margulis et al. (2013), reflexive governance is a system of public administration which began in the 1990s in response to global-scale challenges such as climate change and international migration which required an effective response for management and critical approaches for necessary initiatives. Thus, reflexive governance arose from the urgent need for sustainable development, as sustainability goals are subject to varying degrees of awareness and interest (Halbe et al., 2015).

Reflexive governance aims to establish policy legitimacy, effectiveness, and efficiency (Scherer & Voegtlin, 2020). Van Assche et al. (2021) highlighted that reflexive governance is viewed as a strategy that could bring robust changes towards sustainable development. Therefore, reflexive governance evaluates the legitimacy, effectiveness, and efficiency of approaches that can contribute to sustainable development (McLoughlin et al., 2020). By increasing participation and facilitating deliberation across industries, governments, and civil society sectors, a more legitimate decision-making process can be achieved (Van Assche et al., 2021). Deliberation and participation are key to reflexive governance in addressing development challenges (Barrett et al., 2021). Despite this understanding of reflexive governance, there is a widespread lack of understanding of the nature and functioning of the governance institutions necessary to enable reflexive governance in society.

2.3.1. Reflexive governance in water management: A global overview

Future efforts will not only need to focus on decreasing water demand but also promoting water conservation (Swatuk, 2015). The employment of unconventional technologies, the exploitation of new or unique fresh water sources, or the long-distance transfer of ever-larger amounts of water from locations with sufficient supplies will be required to meet the demands for greater supplies of fresh water (Nastar et al., 2018, UNHABITAT, 2016). Recently, reflexive governance has assisted in managing water resources in mitigating the effects of climate change and introducing technology that could assist in handling water challenges (Meisch et al., 2012). According to Meisch et al. (2012), since water has very varied meanings to various individuals in different circumstances, water governance is vital to avoid value conflicts. However, water governance systems can be strengthened through reflexive governance (McLoughlin et al., 2020). Transformative change requires both a clear understanding of the current situation and innovative solutions that are both politically legitimate and environmentally sustainable (Leonard & Lidskog, 2021). Even with this understanding of reflexive governance, there is a largely a lack of understanding about the nature and workings of the governance institutions that are necessary to enable reflexive governance in society (Ghorbani et al., 2021). It is necessary to conduct more research to determine whether reflexive governance may improve comprehension of the politics of man's influence on the environment and whether it could be a factor in bad governance.

According to Voss and Kemp (2005:4) there are six strategies of reflexive governance in handling societal problems, which are: “1) Integrated knowledge production on problems and their dynamics 2) Adaptive strategies and strategic experiments to actively deal with uncertainty 3) Systematic anticipation of long-term and indirect effects 4) Iterative, participatory formulation of governance objectives, taking account changing and diverse social values 5) Interactive strategy development by actors with various sources of influence 6) Congruence of problem space and governance space”. Since societal needs are a central objective for innovation policy, a wide range of stakeholders are influencing and being influenced by the agenda of this policy (Kuhlmann & Rip, 2018; Borrás & Edler, 2014). Governments may need to include citizens, users, professionals, NGOs, and lower governments to move beyond well-established innovation systems (Frenken, 2017).

Increasingly, reflexive governance is recognized as a political process involving a broad range of stakeholders and governance structures that must manage conflicts along the lines of the core values of any society.

Reflexive governance is thought to aid in better understanding human-environmental impacts that might potentially spiral into poor governance if divergent views are not considered (Mansson et al., 2022). Through consultation and participation with local authorities, government, and industry, the positive aspects of arrangements can be brought into the formal system and vulnerabilities can be reduced (Barrett et al., 2022; Gottsschick, 2018). A growing number of citizens have expressed a desire to be involved in decisions involving water-related issues that could affect their lives and livelihoods (Gottsschick, 2018). Criticism of reflexive governance was leveled against the discourse of participation within development, but this led to failure in many of the development initiatives as most participation are more interested in advancing their own development and less in being transformative (Doody et al., 2023). More studies are needed to demonstrate the role of reflexive governance is responding to pressing public concerns. There is currently limited literature on reflexive governance globally and within the African continent (Leonard & Lidskog, 2021). There is also little known about the nature and functioning of collaborative efforts that are necessary to effectively enable reflexive governance in society towards water governance (McLoughlin et al., 2020; Nastar et al., 2018).

2.3.2. Reflexive governance and water management in Africa

Many African countries, particularly in southern Africa, are largely arid to semi arid with most major perennial rivers shared by three to eight countries (Swatuk, 2015). Freshwater supplies are finite, and existing water demands in some parts of the region are rapidly reaching the limits of conventional technologies (Nastar et al., 2018). The need for additional fresh water will have to be met using unconventional technologies, the development of new or novel sources of fresh water, or the transfer of ever-increasing amounts of water over long distances from regions with adequate supplies (Swatuk, 2015). In the future, increased efforts will also be needed to reduce water demand and increase the

efficiency of water-use (Halbe et al, 2015). This highlights the need for water governance and increased reflexive capacity for sustainable water management.

Water is essential for sustainable urban development, yet in many regions in Africa, safeguarding the existing and future supplies of water is difficult (Nestar et al., 2018). According to Erdiaw-Kwasie (2020) in Ghana, most water management companies focused more on the technical aspects of water supply than on a proper engagement strategy involving customers in the decision-making process. To improve water governance institutional and governance, arrangements have been recommended to influence citizen participation strategies at all levels of water service delivery. For Pahl-Wostl (2019), understanding reflexive governance is a key step in building effective governance approaches and systems to address complex societal challenges. This author further argued that the development of such reflexive governance approaches and systems requires a combination of intentional design and self-organization essential to address complex water management challenges. (Pahl-Wostl, 2019).

There are also significant disparities in water availability, with many residents living in low-income informal settlements and paying up to 50 times as much as residents of higher income categories (UNHABITAT, 2016). Within the context of highly unequal societies of African cities, the elite manipulate the process of participation in urban water governance to determine uneven allocations of resources, at the expense of more widespread urban improvements (Nestar et al., 2018). This use of participation is the failure of neighbourhood and community-based initiatives to ensure access to services and to improve livelihoods in non-serviced peripheries, as participation becomes a way to transfer costs from water companies to poor households (Nestar et al., 2018; Halbe et al, 2015). Erdiaw-Kwasie (2020) argued that water governance is most effective when governments are committed to helping educate and empower citizens, build trust, and build collective wisdom by building capacity. The institutional approaches on water governance need to leave room for participation and access to water by unorganized and "informal" stakeholders, especially the poor.

Rural residents in sub-Saharan Africa frequently have insufficient, and occasionally unsafe, access to water (Mbaiwa, 2011). The contributing factors to this include traditional and formal systems of water governance, inadequate frameworks, land fragmentation because of mergers in legislation, as well as competition over land resources between the government and the private investor (Tantoh & Simatele, 2017). Community-based natural resource management (CBNRM) over the past 20 years has been a development approach and strategy with a wide range of pathways aimed at giving residents opportunities to customize their development process and to promote the participation of people within communiities (Mbaiwa, 2011). Increased disputes over the use of natural resources and current misunderstandings between development stakeholders and citizaens where development should be implemented have been greatly influenced by this development (Tantoh & Simatele, 2021). Despite the focus on CBNRM's advantages as a successful resource management strategy, disagreements over residents' capacities to manage natural resources in a fair and sustainable way remain a topic of policy discussion and are an integral part of larger conflicts over political and economic power (Tantoh & Simatele, 2017).

Emanating from the CBNRM approproach was community-based water supply management (CBWSM) (Tantoh et al., 2020). The centralized approach of CNWSM has been to give citizens more authority and privilege in managing water resources that are crucial to support their way of life. The CBWSM is one of the fundamental ideas for societal transformation and efficient water resource management to transfer water governance power to residents (Tantoh et al., 2021). The realization of the state's incapacity to achieve sustainability led to the development of this method of resource management. However, the existence of ineffective leadership, unequal participation, corruption, lack of official recognition, and insufficient sources of income has been a challenge in the CBWSM approach (Tantoh et al., 2021).

Furthermore, it has frequently proven challenging for residents to negotiate on an equal footing with external officials and stakeholders with scientific knowledge due to the complexity of many CBNRM's operating structures (Tantoh & Simatele, 2017). The workable strategy of reflexive governance is the best alternative strategy as it encourages

state governance as crucial in interventions to manage risks and address unintended side effects within the sustainability development paradigms with a significant role in society. Reflexive governance is indicated to be more reflective, inclusive, and reacts to complex risks associated with sustainable development (Feindt & Weiland, 2018).

One example of reflexive governance in transboundary water management in Africa is the case of the Lake Victoria Basin East Africa, shared by Kenya, Tanzania, Rwanda, Burundi, and Uganda (Lugo et al., 2014). Lake Victoria is the largest freshwater lake in Africa and an essential resource for the region, supporting millions of people's livelihoods and ecosystems (Mwebesa, 2021). The lake was being impacted by a variety of problems, such as siltation and overfishing, species invasion, industrial pollution, and watershed erosion due to deforestation contributing to difficult social, economic, political, and technical barriers to the health of the lake's ecosystem (Lugo et al., 2014). The management of Lake Victoria faced significant challenges due to multiple competing interests, including agriculture, industry, and domestic water supply (Al-Muqdadi, 2022). Historically, governance structures focused on top-down decision-making processes, where government agencies held most of the decision-making power, often leading to fragmented and ineffective water management practices. In response to these challenges, the Lake Victoria Basin Commission (LVBC) initiated a reflexive governance approach to foster collaboration, participation, and learning among stakeholders (Nunan & Onyango, 2017). The LVBC recognized the importance of involving various stakeholders, including government agencies, local communities, civil society organizations, and researchers, in decision-making processes to challenge their own perspectives and learn from the experiences and knowledge of others. They established a participatory platform called the Lake Victoria Stakeholders' Forum, which brought together these diverse stakeholders to engage in dialogue, exchange knowledge, and jointly develop solutions for sustainable water management (Lugo et al., 2014). This allowed for a more comprehensive understanding of the complex issues surrounding water management in the Lake Victoria Basin.

The reflexive governance approach encouraged stakeholders to reflect on their own interests, values, and assumptions regarding water management Through reflexive

governance, stakeholders were able to identify common goals and develop shared visions for the sustainable management of Lake Victoria's water resources (Nunan & Onyango, 2017).They also collaborated on the development of integrated water resource management plans, incorporating ecological, social, and economic considerations (Lugo et al., 2014). Furthermore, reflexive governance in the Lake Victoria Basin involved ongoing monitoring and evaluation of water management practices. This allowed stakeholders to assess the effectiveness of their actions, learn from successes and failures, and adjust their strategies accordingly (Al-Muqdadi, 2022). Regular feedback loops and adaptive management approaches were established to ensure continuous improvement and responsiveness to changing conditions towards sustainable solutions for water management. Although Lugo et al. (2014) stated insignificant improvements in the lake, the research underscores that improving governance necessitates a comprehensive understanding of the factors that impact both conflict and cooperation in the management of transboundary water. It pinpoints areas that require meticulous attention, precision, or intricate coordination in collaborative management for effective problem resolution towards improved water supply. Overall, the reflexive governance approach adopted in the Lake Victoria Basin contributed to more inclusive, participatory, and adaptive water management practices.

2.3.3. Reflexive Governance and water management in South Africa

Within sustainability development paradigms, state governance plays an important role in managing unintended side effects and managing risks (Halbe et al., 2015). The participation of citizens is an essential component of enabling them to express their views and to act on those views; the more deliberate the process, the more reflexive would be the associated governance (McLoughlin et al., 2020). Without responsible innovation through reflexive governance, it is impossible to address major challenges affecting the environment and to achieve sustainable development (Mansson et al., 2022). In the sustainable development paradigm, national governance is considered critical to addressing the risks posed by industrial societies. By increasing participation and promoting consultation across industry, government and civil society sectors, a more legitimate decision-making process can be achieved (Nastar et al., 2018). Revolutionary change requires both a clear understanding of the current situation and innovative solutions that are politically justified and

environmentally sustainable (Leonard & Lidskog, 2021). However, most governments around the world, including South Africa, face significant challenges in managing their water resources effectively (Kapfudzaruwa & Sowman, 2009). Given the risk of droughts and floods in South Africa water governance is fundamental to ensure access to safe water and adequate sanitation (Makaya et al., 2020).

According to the WRC (2018) as cited by Makaya et al. (2020), the total arrangement of water governance in South Africa is a "three-dimensional arrangement of components, including (i) principles and mandate, policies and legislation, regulatory framework, institutional arrangements, and practice; (ii) multiple levels including international, national, regional, local and neighborhood; and (iii) responsibilities of government, non-government organizations, and civil society".

It is therefore essential that the non-formal institutions and government institutions within South Africa are integrated to involve citizens for water governance. However, Kapfudzaruwa and Sowman (2009) argued that many attempts to engage residents in decision-making led to unresolved tensions and allegations which rendered people-oriented water governance ineffective in offering an opportunity to share ideas even at the municipality level. More studies are required to investigate how residents and local municipality officials can improve understanding for more rigorous, disciplined, and effective approaches towards water governance.

According to the Constitution of South Africa, every South African citizen has the right to access sufficient water. Water management within the Constitution provides that the national government acts as a trustee regarding the ownership of water resources, based on the White Paper on National Water Policy and the Water Services Act, (DWAF, 2000). The implementation of the Water Services Act (WSA1) 108 of 1997 and the National Water Act (NWA) of 1998 provides the legislative framework within which water resource management and water use takes place within an initial supply of water and basic sanitation services (Maphela & Cloete, 2019). It is noteworthy that the post-apartheid era saw the adoption of a new Water Services Act before a new Water Act. Millions of South Africans

were willfully ignored or underserved because of apartheid, which made an urgent need for necessary water supply (Maphela & Cloete, 2019). To correct the injustices of the past, the right to an adequate and safe water supply is part of South Africa's Constitution, which must be prioritised by the government. The second, important objective on the management of water resources is ensuring that water resources must be used in a sustainable manner (Tleane, 2011). This means that there needs to be a balance between water availability and efficient ways of managing the water resources to optimise social and economic benefits (DWAF, 2004).

In terms of Section 152(1b) of the Constitution and the Local Government Transition Act, Act 209 of 1993, the municipality is entrusted with the responsibility to ensure access to water resources within the area of its jurisdiction (Tleane, 2011). Water use is also managed by municipalities also referred to as Water Services Authorities (WSA) and Water Services Providers (WSP) that include municipalities, water utilities, and private firms such as Water Boards under the authorization of the Department of Water and Sanitation (DWS) with the mission to ensure that the population in the country, including those from needful households, have access to at least a basic level of service (Mothetha et al., 2013). Makaya et al (2020) reported that the role of the DWS was no longer to supply water but had handed that responsibility to the WSA and WSP. Therefore, the DWS makes funds available to allow for the development and supply of water infrastructure (Maphela & Cloete, 2019). The result is that municipalities rely on funds issued from the national government to provide basic services such as water, electricity, refuse removal and sanitation (Maphela & Cloete, 2019). The municipalities therefore should have capacity to supply water resources to residents and businesses, the different water boards, irrigation boards, government water schemes or other sources (Tleane, 2011). Water boards play a key role in the water sector in South Africa as they are involved in the operation of dams, large water supplies, retail infrastructure and sewage systems for water resource management. Water boards may offer technical support to residents by collaborating with municipalities, even though they ultimately report to the DWS.This approach facilitates a more comprehensive and localized approach to water management, considering the specific challenges and requirements of the residents.

The provincial sphere is involved in terms of efficient and sustainable execution of legislative and executive powers (Van Wyk, 2012). Among other things, the DWS manages dams and maintains infrastructure (boreholes, storage reservoirs, etc.) for both urban and rural residents. Municipalities, Civic Associations, and Water Users Associations are all recognized as key water stakeholders by the National Water Act of 1998. While there is an interrelationship between and among South African water management institutions, their roles need to be coordinated at the national and provincial level (Makaya et al., 2020). Water management institutions are responsible for the management and regulation of water resources (Orimoloye et al., 2021). Water management institutions encompass both governmental bodies and non-governmental organizations (NGOs) (Azlini et al., 2021; Meilani et al., 2021). Government agencies often engage in water resource management, implementing initiatives focused on health, sanitation, and nutrition in rural areas (Scott et al., 2017). Conversely, NGOs partner with governments to deliver health services, including water-related projects (Firnanti et al., 2019; Zaidi et al., 2012). It is also important to note that according to the South African Constitution, every domestic user has a right to sufficient water, but not to adequate and overflowing water (Makaya et al., 2020). This means that the right to adequate water does not apply. Thus, during droughts people cannot force the government to supply them with enough water for their other needs, aside from domestic requirements, (Orimoloye et al., 2021, Makaya et al., 2020).

The WSA and WSP supply a minimum of 6,000 liters of water, which equates to 25 liters per person each day, free of charge. However, if a household uses more than this basic free water allocation, they must pay for the excess usage (Maphela & Cloete, 2019; Mothetha et al., 2013). The approach of charging when the basic water allocation is exceeded encourages efficient usage of the water resource and allows equal distribution of water while avoiding higher tariff charges (Maphela & Cloete, 2019). While higher water prices discourage overconsumption, subsidised water allocations encourage overuse of water (Wheeler et al., 2017). There is a need for greater emphasis and upscaling on water efficiency measures e.g., re-use of wastewater to further ensure that water users stay within the boundaries of not exceeding the basic water allocations. To determine the most appropriate waste and

sanitation options that will ensure community health and protect the environment, participation of the residents is a necessity (DWS, 2019). According to Weaver et al. (2017), water management within the South African municipalities is poor and residents are inherently inefficient, therefore the NWA recognizes the need for robust water management through different institutions to successfully manage water. This philosophy is directly analogous to equating effective water resource management with good governance (Ambalam, 2014).

According to Ambolam (2014), institutions have power to collaborate with social organizations e.g., local government structures to avoid mismanagement of water resources. Such collaboration between institutions also assists in the implementation of water management, which is usually limited by finances and human resources (Herrfahrdt-Pahle, 2010). There is an urgent need for capacity development of local government personnel on sustainable environmental development approaches (The World Bank, 2021). This is imperative because international investigations reveal perceptions and approaches which rural residents close to accommodation establishments utilize to be more adaptive given the anticipated moderate to strong negative impacts due to climate change.

2.4. The Global Water Governance Framework

Fresh water resources are scarce and very susceptible to human activities and, globally, in recent years, public awareness of this fact has risen significantly (Yu & Lu, 2018). This is because water is closely associated with irrigation, food production processes, energy supply and sometimes transportation systems (Swatuk, 2015). Inadequate access to water affects the dignity, health, and resilience of affected individuals (Hu et al., 2016) and access to inadequate water supplies is usually viewed as a matter of life or death (Yuan et al., 2022).

Water scarcity in Gauteng, South Africa is a pressing concern, with projections suggesting an imminent shortage of potable water (Osman et al., 2017). To address this, measures, including water transfers from provinces like Lesotho, have been taken to supplement Gauteng's water needs (Liphadzi & Vermaak, 2017). Addressing Gauteng's water shortages

involves implementing water-sensitive strategies, like the Sustainable Drainage Systems training program, to enhance water management skills (Carden & Fell, 2021). Overall, a comprehensive approach, including water demand management and inter-provincial transfers, is crucial for ensuring sustainable water resource availability amidst growing demand and potential scarcity.

The threat of cutting off or disrupting vital water supplies is an emotionally charged and hot topic of intense debate (Swatuk, 2015). Broadly speaking, water is a key factor in the prosperity of nations (Zeitoun et al., 2017). Therefore, decision-making processes that affect the allocation, development, use, and protection of water resources are essential (Yu & Lu, 2018). The water governance framework proposed by the United Nations Development Programme (UNDP) outlines some key elements of water governance that are relevant for residents and game lodges which will be explained in detail below.

2.4.1. Global Water Quality Management and Monitoring

Water quality management involves a range of activities aimed at protecting, preserving, and restoring the quality of water bodies such as rivers, lakes, groundwater, and oceans (Tang et al., 2019). It encompasses various measures, including pollution control, watershed management, water treatment, and regulatory frameworks (Hamid et al., 2020). The goal is to maintain water quality within acceptable standards to support human needs, safeguard aquatic ecosystems, and promote sustainable development (Deng, 2020). Water is a vital resource for sustaining life and supporting various ecosystems, but an increasing population, urbanization, industrialization, and agricultural practices have placed tremendous pressure on water resources, leading to water pollution and degradation of water quality worldwide (Liu et al., 2019). To address these challenges, global water quality management and monitoring have become crucial in ensuring the availability of clean and safe water for current and future generations (Edokpayi et al., 2018).

Regular monitoring of water quality is necessary to ensure that water resources are safe for human consumption to ensure the safety and health of communities that rely on water resources for drinking, agriculture, and industrial purposes (Mohamed et al., 2019).

Likewise, water quality management involves implementing strategies to improve or maintain water quality to ensure the safety and sustainability of water resources (Edokpayi et al., 2018). This can include implementing regulations or policies to reduce pollutants and prevent contamination, as well as implementing best management practices for activities that can impact water quality, such as agriculture, mining, and wastewater treatment (Benameur et al., 2022). The process of maintaining water quality monitoring and management such as water treatment and filtration systems should be available to remove pollutants and maintain water quality (Castillo et al., 2021).

At the global level, several organizations and initiatives play a significant role in water quality management and monitoring. The United Nations (UN) and its agencies, such as the United Nations Environment Programme (UNEP) and the World Health Organization (WHO), promote international cooperation, set guidelines and standards, and facilitate capacity building in water quality management (Li & Wu, 2019). The Global Water Partnership (GWP) and the World Water Assessment Programme (WWAP) are also instrumental in advocating for integrated water resource management and supporting knowledge exchange among countries (Brennan et al., 2021). This knowledge is derived from a growing, interdisciplinary body of inventive insights that prioritize addressing problems, involving both scientific experts and members of society.

Advances in innovations such as sensor technologies, data analytics, and remote sensing enable real-time monitoring and early detection of pollution events to transform global water quality management and monitoring efforts (Habeeb & Weli, 2021). Integrated modeling and decision-support systems help policymakers and water managers to assess the impact of different management scenarios and to make informed decisions (Hosea, 2022). Furthermore, citizen science initiatives and community involvement enhance public awareness, participation, and accountability in water quality management (Li & Wu, 2019). However, several challenges remain in achieving effective global water quality management and monitoring. These include inadequate funding and resources, fragmented governance and regulatory frameworks, limited data availability in certain regions, and the complex nature of pollution sources (Habeeb & Weli, 2021). Addressing these challenges requires

enhanced collaboration among governments, international organizations, and stakeholders at all levels, as well as the integration of water quality management with broader sustainable development goals.

At the local level, municipalities or water utilities may conduct regular water quality tests to ensure that the water supply meets regulatory standards and is safe for consumption (Edokpayi et al., 2018). Effective water quality management requires collaboration among various stakeholders, including government agencies, water utilities, industries, and the public (Lebek et al., 2021). Water quality monitoring can be conducted at different levels, including the local, regional, and national levels with the growing reality that it is becoming more difficult and expensive to provide sufficient potable water to meet the growing demands within countries (Hosea, 2022). Coupled with increased water demand is the increase in water competition, which is becoming more intense because of widespread population expansion as well as increased rates of urbanization and industrialization (Yu & Lu, 2018). By implementing comprehensive monitoring programs, establishing robust regulatory frameworks, fostering international cooperation, and leveraging technological advancements, water quality can be protected and secured towards a sustainable future for all.

2.4.2 Water allocation and distribution

Water allocation and distribution play a crucial role in sustainable development, meeting human needs, supporting agriculture and industry, protecting the environment, and addressing water-related challenges (Gebre et al, 2021). Efficient management of water resources is essential for social, economic, and environmental well-being at both local and global scales (Saatsaz, 2020). Historically, access to clean drinking water has been a significant issue in many parts of the world (Tzanakakis et al., 2020). The process of allocating and distributing water involves determining how much water is available, who needs it, and how it will be distributed (Vichete et al., 2023). Water allocation and distribution can be a complex process that requires careful planning and management to ensure that all stakeholders receive the necessary amount of water (Xiang et al., 2021). One of the primary challenges in water allocation and distribution is balancing competing

demands for water (Elleuch et al., 2019). Another challenge in water allocation and distribution is ensuring equitable access to water resources. Different sectors, such as agriculture, industry, households, and the environment, require different amounts of water (Kapetas et al., 2019). In many cases, these demands conflict with each other and in some cases certain groups may be denied access to clean drinking water due to social or economic factors (Gebre et al, 2021). For example, farmers may need more water during droughts to irrigate their crops while environmentalists may argue that some rivers need more flow to support fish populations (D'Odorico et al., 2020). To effectively manage water challenges, governments must develop comprehensive policies for managing freshwater resources. These policies should include measures for monitoring and regulating the use of freshwater resources while also promoting sustainable practices that ensure equitable access for all stakeholders.

The allocation of water resources includes measures such as constructing dams and laying pipelines and other water delivery systems to allow adequate water allocation and distribution (Gany et al., 2019). Adequate water infrastructure is necessary to ensure that water resources are available to all users (Xiang et al., 2021). In southern African countries, water competition was noted between farmers (livestock owners), national parks and accommodation establishments such as game lodges due to demands for water and pastures (Mbaiwa & Kolawole, 2013). To reduce tensions, residents are involved in the management of resources by ensuring that they directly benefit from available resources. In extreme cases, water conflicts between competing parties or industries can escalate into outright violence from local, national, and transboundary controntations related to competition for water access (Swatuk, 2015). The lack of capacity for government to supply sufficient potable water supply to residents increases the potential for political tension for the residents involved (Jankielsohn, 2012). Effective management of water resources is vital in maintaining an adequate water supply, meeting demand to support residents, and maintaining the functionality of ecosystems for sustainable economic development (Bebbington, 2014). In relation to the current study, the allocation and distribution of water resources will be evaluated to determine if there is equal water distribution to meet the

present and future needs for all stakeholders e.g., residents, game lodges, and the environment in the study area.

2.4.3 The global legal and institutional frameworks regarding water management

Legal and institutional frameworks are essential to ensuring that water resources are managed effectively and sustainably by providing clear guidelines for water allocation and management (UNDP, 2014). This involves laws, regulations, and institutions that govern water resources management at the national, regional, and local levels, and the roles and responsibilities of various stakeholders (Cook & Cook, 2020). Proactive measures can be prioritised on water rights systems, water licensing regimes, water use regulations, enforcement of water conservation and quality standards and many of the water-related issues that are faced by residents, industries, and other water users (Warner et al., 2017).

The most straightforward illustration of these might involve the relatively low-intensity water competition over water access between two adjacent landowners. Such a situation would be resolved through less strategic (government-level) intervention (Swatuk, 2015). On the other hand, water access problems may be compounded by a territorial dispute over the precise location of an international boundary (Renner, 2021; Cook & Cook, 2020). In these circumstances, institutional and governmental engagement will be possible because national law is effective in preserving people's rights and obligations (Swatuk, 2015). Central to water competition is the ability of government institutions, particularly municipalities, to react to the delivery of existing water resources for domestic use (Jankielsohn, 2012). Political issues related to water management go past the cycle of service delivery, considering the safety and sustainable water supply which is significant for the country’s environmental, social, and economic development (Jankielsohn, 2012). There is therefore a need to understand the social, economic, political, and ecological factors involved in reducing the increase of water conflicts and water competition.

Given water scarcity due to climate change, an inability to implement policy is the main challenge to government in adjusting water efficiency measures (Green, 2005). While some changes require political interventions, habits of individuals and residents also influence the

level of water consumption. In a similar argument, Ryan and Stewart (2009) noted that much of the discussion in tourism and the hospitality industry has focussed on improving the sustainability performance of suppliers rather than changing the values and behaviours of the tourists themselves. According to Robins (1999), not much will change unless the tourism and hospitality sectors specifically address, modify, and hold consumers accountable for sustainability. This seems potentially problematic for tourist accommodation e.g., game lodges where new practices and technologies mean that consumers can continue to have a luxurious experience without having to compromise on their expectations of comfort and service (Logan, 2015).

2.4.4 Water efficiency measures and climate adaptation

Water efficiency measures are an essential component of climate adaptation strategies (Owen, 2020). Many places are experiencing more frequent and severe droughts due to climate change, which emphasizes the need for adaptable strategies (Morote et al., 2019). Effective water management is essential to ensure that water resources are used efficiently and sustainably and to adapt to changing climatic conditions (Xiang et al., 2021). The likelihood is that any adverse consequences related to potential changes in the global climate, such as less precipitation or higher temperatures, will pose a significant threat to water resources (Morote et al., 2019). This reveals the need to persuade the pertinent institutions and authorities in charge of water management to focus their efforts on longer-term policies, plans, and initiatives that will prevent water competition rather than sticking to a short-term focus (Swatuk, 2015). Likewise, water users must uphold the principles of equity and sustainability (Krampe, 2017).

Water efficiency measures play a crucial role in climate adaptation by ensuring the sustainable use of water resources and reducing the vulnerability of communities to water scarcity and climate change impacts (Morote et al., 2019). The following are several key water efficiency measures that can contribute to climate adaptation:

1. Promoting water conservation practices is essential to reduce overall water demand (Song et al., 2018). This can include public awareness campaigns, education

programs, and incentives for water-saving behaviors such as fixing leaks, using efficient appliances, and practicing responsible irrigation techniques (Warren et al., 2017).

2. Use of rainwater harvesting systems to capture and store rainwater for later use can supplement traditional water sources and reduce pressure on freshwater supplies (Imteaz et al., 2022; Alim et al., 2020) Rainwater harvesting systems can be implemented at both the individual and community levels, ranging from simple rain barrels to more sophisticated systems for larger-scale water collection (Campisano et al., 2017).
3. Greywater reuse where wastewater generated from non-toilet sources such as sinks, showers, and laundry is recycled and treated to help meet non-potable water needs such as landscape irrigation or toilet flushing (Zhu et al., 2018).
4. Efficient irrigation systems can significantly reduce water waste and increase crop water productivity by implementing efficient irrigation techniques such as xeriscaping (landscaping designed to reduce water use) and by promoting the use of native or drought-tolerant plants (Sucheran, 2013; Grossling et al., 2012; Tang, 2012).
5. Water-efficient technologies and appliances, such as low-flow toilets, efficient showerheads, and water-saving washing machines, can greatly reduce water consumption in households and commercial buildings (Gössling et al., 2019; Verma & Chandra, 2018; Styles et al., 2018; Mbasera et al., 2016).
6. Implementing water pricing mechanisms that reflect the true cost of water can encourage consumers to use water more efficiently. Additionally, providing financial incentives, rebates, or tax credits for water-efficient practices and technologies can further motivate individuals and businesses to adopt water-saving measures (Rhee & Yang, 2015).
7. Effective water management and governance structures are crucial for implementing and enforcing water efficiency measures (Krampe, 2017). This includes developing integrated water resource management plans, monitoring water use, enforcing regulations, and promoting stakeholder participation (Swatuk, 2015).

Rapid adaptation on investments for water efficiency measures in enhancing productivity, conserving, and recycling water is necessary to strengthen water security and promote sustainable social, economic, and political systems (Pinto et al., 2021). This can involve measures such as monitoring water use, promoting water conservation, and implementing water-saving technologies (Tortajada et al., 2019). In addition to reducing water consumption and the impact on water resources, the adoption of water efficiency measures reduces costs (Verma & Chandra, 2018; Styles et al., 2015; Grossling, 2012; Riazi et al., 2023). However, it is those who can afford technological advancements who will preserve and retain resources, whereas those who do nothing will not acquire resources (Logan, 2015; Sucheran, 2013). By implementing these water efficiency measures, communities can enhance their resilience to climate change, reduce water stress, and ensure the sustainable use of water resources for future generations.

2.4.5 Stakeholder engagement and participation

Engagement and participation of all stakeholders in water governance processes is critical to achieving sustainable water management (Megdal et al., 2017). This can involve public consultations, stakeholder forums and community engagement initiatives involved in decision-making processes and have access to information about water resources towards ensuring that water governance is effective and equitable (Wong et al, 2020). The Arnstein model for participation is a framework that outlines the different levels of citizen participation in decision-making processes (Gaber, 2019). This Model emphasizes that true democracy requires active and meaningful participation from all members of society (Varwell, 2023). It serves as a useful tool for evaluating levels of citizen involvement and identifying areas for improvement in decision-making processes.

The Arnstein model provides a ladder of participation that consists of eight rungs, each representing a different level of participation, ranging from non-participation to full citizen control. By understanding and applying the Arnstein model (see Figure 2), stakeholders in water governance can strive to move up the ladder, ensuring more meaningful and effective citizen participation in managing water resources. The model aims to analyze power dynamics and the extent to which individuals or communities have a genuine say in

decision-making. The eight rungs of the Arnsten model based on Gaber (2019), each representing a different level of participation are explained as follows:

At the bottom of the ladder is **manipulation**, where citizens are merely informed about decisions made by those in power without any opportunity to provide input or feedback. This lowest rung on the ladder represents situations where power holders use information tactics to deceive or manipulate citizens. It involves no actual participation or influence over decisions, with power centralized in the hands of a few.

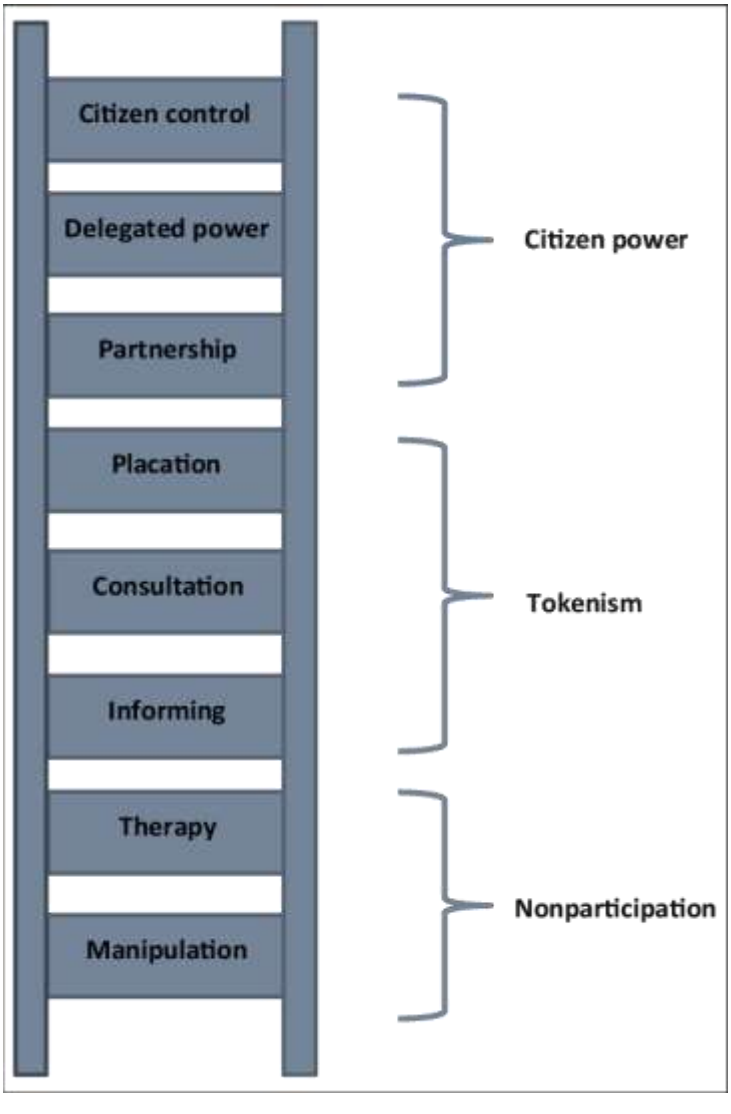

Figure 2: The Arnstein's Ladder of Citizen Participation. ***Source:*** *Cook et al. (2013)*

The next level is **therapy**, where citizens are allowed to express their concerns but have no real influence on decision-making. In this stage, participation is still limited as citizens are seen as objects to be "fixed" or "treated." The focus is on changing individuals' attitudes or behaviors through educational campaigns or therapy-like interventions. Further up the ladder is **informing**, where power holders provide information to citizens to increase their awareness of a particular issue or decision. However, there is no opportunity for citizens to provide feedback or influence decision-making. **Consultation** follows, where citizens are asked for their opinions but ultimately have no power to affect change. Consultation involves seeking feedback and opinions from citizens on specific issues or decisions. However, the power holders retain full control over the decision-making process, and the input from citizens may or may not be considered.

Placation represents tokenism, where power holders provide the illusion of participation but ultimately make decisions independently. Citizens are given a symbolic role, but their influence is minimal, and decisions are predetermined. Thus, citizens are given a false sense of participation through symbolic gestures such as public hearings or surveys, but these are symbolic roles where their influence is minimal, and decisions are predetermined. The higher levels include **partnership**, where citizens work alongside government officials to make decisions together; delegated power, where citizens are given actual decision-making authority. Partnership denotes a more substantial level of participation, where power holders collaborate with citizens in joint decision-making processes. Citizens have some influence, but power remains shared unequally, with the final decision-making authority resting largely with the power holders. **Delegated** power indicates a level where power holders transfer decision-making authority to citizen groups or organizations. Although citizens have significant control over certain decisions, the ultimate power still resides with the power holders, who delegate authority selectively.

Finally, **citizen control**, where community members have complete control over decision-making processes. Here, power holders act as resources and facilitators, but citizens have the final say and are actively involved in shaping policies and outcomes. The Arnstein ladder highlights the importance of moving beyond tokenism and superficial forms of

participation toward meaningful engagement and shared decision-making power. In the context of the current study, the Arnstein model can be applied to analyze the level of citizen participation in water governance decisions affecting water governance. This analysis can help identify the current power dynamics, the strengths and weaknesses of the existing system, and the potential for enhancing participation and collaboration between the stakeholders involved.

Potable water supply governance involves political, organizational, and administrative processes that allow residents to express their interests in the development and management of potable water resources (Musingafi et al., 2014). Novel ways are required to persuade the appropriate institutions and authorities in charge of water management to concentrate their efforts on longer-term policies, plans, and initiatives that will prevent water competition (Krampe, 2017). The approach adopted for potable water supply governance impacts the degree of improvement and progress within a local area (Hosea, 2022). In this study it would be beneficial to collect data from residents, municipality, involved game lodges and governmental sector such as the Department of Water and Sanitation. These latter stakeholders are mandated by the Water Services Act to provide for the rights of access to basic water supply and basic sanitation and the Department of Tourism given their recent interventions to ensure water efficiency in accommodation establishments. Despite the above, there remains limited knowledge concerning competing water use in game lodges and the impact it has on water withdrawal and distribution for surrounding residents given the impact of climate change.

2.5 Global water governance in the hospitality and tourism industry

Globally, published studies have suggested that water demand is relatively high in the hospitality industry where accommodation is offered for tourists (Pinto, 2017; Grossling, 2015; Dinares & Sauri, 2015). According to Barberán et al. (2013), water consumption in accommodation establishments can be as much as three times the average consumption of people living at home. The problem with the high amount of water consumed in accommodation establishments is the unsustainability that can jeopardise the hospitality industry particularly where there are water shortages (Ramazanova et al., 2021; Styles et al.,

2015; Hadjikakou, 2015). Water scarcity has been particularly apparent in many destinations suffering from unreliable water availability causing drastic declines in tourist arrivals e.g., Bali, Goa, and Kerala (Dinarès & Saurí, 2015). More studies are needed to show the links between mass tourism and water scarcity in tourist destinations.

Globally, maintaining sustainable development in the hospitality industry is so significant that it has led business initiatives to develop green policies and green technology to reduce the impact of high-water use (Han & Yoon, 2015). "Sustainability refers to the ability of a destination to maintain quality of its physical, social, cultural and environmental resources and natural capital" (Balkaran & Maharaj, 2013, p. 6). However, according to Alonso and Ogle (2010), water usage in the hospitality industry has been largely ignored despite the growth of efficiency solutions towards sustainable development. Effectiveness as to the adoption of policy for conserving natural resources in the hospitality industry has been successful in Europe, Australia, North America, and New Zealand (Mensah & Blackson, 2014). Significant fines are imposed on individuals or entities that violate environmental regulations, highlighting the importance of prioritizing the adoption of water efficiency measures in the hospitality industry across all countries to promote sustainability.

According to Kelly and Williams (2007), water efficiency refers to the adoption of measures and practices that influence the reduction of water consumption practices that, in turn, allow hotels to enjoy several benefits, such as cost savings, positive publicity, and high guest satisfaction. Both Jorge (2014) and Kelly and Williams (2007) indicate that the implementation of the chosen water efficiency measure is an economically worthwhile way to increase the availability of water for environmental, economic, and aesthetic purposes for tourism destinations. Thus, water efficiency involves integrating the economic, environmental, and socio-cultural factors to ensure that the high-water demands are met, and wastage minimised to manage a sustainable water supply (Vila et al., 2018). There are different factors that influence the implementation of water efficiency measures including demographic factors, purpose of the trip and geographic location (Bohdanowicz & Martinac, 2007). This study will draw on geographic location by analysing the extent of

water efficiency measures adopted by game lodges in the rural periphery as opposed to hotels found in the urban periphery.

The adoption of green policies provides not only an operational tool but also it has proven to be a good marketing tool to attract new consumers and to retain existing consumers (Han & Yoon, 2015). The use of green technology to maximise natural resources has also been extensively adopted e.g., use of aerated faucets and dual flush toilets for water savings (Mihalic, 2016; Hoogendoorn et al., 2015; Wyss, et al., 2014). The mechanism of the dual-flush toilet involves using two buttons to control the amount of water used for flushing. Pressing the smaller button releases a smaller volume of water, suitable for liquid waste, while pressing the larger button releases a larger volume of water, appropriate for solid waste. This design helps conserve water by providing an option to use only the necessary amount of water for each flush. Using aerators saves 50% of water by adding 50% air composition (Rahman et al., 2017) into the water stream and disperse it. Note this latter development in Figure 3. The installation of an aerator to an older tap can reduce water loss by 6 liter per minute (Barberán et al., 2013). The aerators can be installed in bathrooms taps and kitchens sinks where the taps are frequently used (Styles et al., 2015; Barberán et al., 2013).

Figure 3: A tap without or with an aerator. ***Source:*** *Conservation Mart (2013)*

At the core of greening has been the implementation of the concepts of reuse, recycle and reduce, often referred to as the 3Rs of sustainability in accommodation establishments (Fennell, 2008). There has also been extensive literature from high income countries such as the United States of America (USA), Europe and Asia highlighting that diversifying water sources such as the use of greywater together with rainwater harvesting as alternative water

sources is among the effective water efficiency measures to reduce water usage (Verma & Chandra, 2018; Dinarès & Saurí, 2015).

The high consumption of water in the hospitality industry is viewed as unsustainable with a need to increase water efficiency measures to reduce water volumes without stressing the natural environment (Hadjikakou, 2015, Cole, 2012). Studies reveal that due to the water intensive facilities to offer guests high standards, the higher graded (from 3 - 5 star) accommodation establishments may translate to high water usage (Mbasera et al., 2016; Logan, 2015). This suggests that grading of accommodation establishments is more associated with quality service rather than with environmental practices and the adoption of sustainability initiatives (Rogerson, 2013). Further studies are important to ascertain the uptake and adoption of water efficiency measures in both the rural and urban environments.

High water use associated with 3 – 5-star accommodation establishments due to demands for facilities such as spas and pools can create water scarcity for residents surrounding these establishments (Ryan & Stewart, 2009). Opponents to the idea of sustainable luxury argue that consumption driven by anything other than meeting basic needs is the core force behind the environmental and social problems that have prompted the need for sustainable development (Blevis et al., 2007; DeWeese-Boyd & DeWeese-Boyd, 2007; Robins, 1999). In this case, it is also argued that luxury is inherently rooted in social inequality and thus by nearly all definitions of sustainability, luxury cannot be sustainable (Blevis et al., 2007; DeWeese-Boyd & DeWeese-Boyd, 2007). Proponents of sustainable luxury further argue that a shift towards luxury is motivated by authenticity of location and experience rather than conspicuous consumption, meaning that luxury can be more sustainable (Ryan & Stewart, 2009; Robins, 1999). There is a need for more studies to determine the validity of these arguments and how surrounding residents view water consumption by game lodges.

2.5.1 Water governance in the hospitality and tourism industry in Africa

It is widely recognised that in Africa there are sub-regions and countries experiencing water scarcity (Likhacheva, 2019; Becken, 2014). Studies suggest that even though some of the water-saving technologies have been adopted in many of the low-income countries in

Africa, most accommodation establishments are more concerned about profit rather than sustainability (Becken, 2014; Akinboade & Braimoh, 2010). Despite the efforts towards greening in Africa, there are other challenges that need to be addressed. For instance, green technology tends to be expensive (Eshun & Appiah, 2018) and the additional cost of participating in green initiatives contributes to managers' hesitancy towards going green in the hospitality industry (Chan et al., 2017). This leaves many managers developing their own guidelines and instructing their employees about the significance of conserving water (Mbasera et al., 2016; Mensah & Blankson, 2014; Zengeni et al., 2013).

2.5.2 Water governance in the hospitality and tourism industry within South Africa

South Africa, as with many emerging and developed countries, is transitioning towards greater sustainability and this provides a significant opportunity for future growth (Spencely et al., 2002). The South African government identified a need to reduce the overconsumption and the unsustainable use of resources such as water (Logan, 2015). South Africa's Tourism White Paper (1996) refers specifically to the concept of "Responsible Tourism" which is the government's declaration highlighting the importance of complete disentanglement of economic expansion from resource utilization (Giordano, 2013). To engage operators on responsible behavior, the Responsible Tourism Handbook (2002) was developed (Logan, 2015). Among the policies governing the greening of the hospitality industry, particularly regarding reducing water resources, is the South African Government Gazette, White Paper on Environmental Management Policy (Vol. 395, No. 18894) of 15 May 1998 which presents the sustainable development approach to resource management. There is a need for further studies in exploring solutions for governance challenges in water resource management within the hospitality industry.

2.5.2.1 Use of water efficiency measures in the hospitality and tourism industry in South Africa

Like many other countries, South Africa's accommodation establishments have become aware of international tourist's preferences for green accommodation by installing green technologies that are geared towards sustainable water use (Mbasera et al., 2016; Wyngaard

& De Lange, 2013; Rogerson & Sims, 2012). Due to awareness and the paradigm shift at local level, green practices are being embraced by hospitality establishments on water efficiency, energy efficiency, solid waste minimization, and local environmentally friendly purchasing (Ismael & Rogerson, 2016; Sucheran, 2013). Accepting green practices is not just an expense-saving undertaking but an important sustainability practice (Scott et al., 2018; Sucheran, 2013). Rankin and Rousseau (2006) noted that the amount of water used appears to be seasonal with most South African accommodation establishments using 30%–40% more water in summer. Such a difference in water consumption between seasons highlights the importance of adopting water efficiency measures. Given the immense usage of water for a tourist's experience, maintaining a constant water supply is important as it contributes to the viability of the business (Hoogendoorn & Fitchett, 2018).

2.5.2.2 Lack of the greening regulation in the hospitality and tourism industry in South Africa

South African studies have investigated the relationship between sustainable development and water governance, and they have highlighted the absence of enforcement of environmental laws and policies, particularly at the provincial and local government levels. (Fakier et al., 2005; & Lund-Thomsen, 2005). A study by Smith & Leonard (2018) indicated that there is inadequate cooperation, misguided policy direction, and uneven certification standards hinder the implementation of greening rules. Furthermore, there is lack of coordination of effective greening of hotels which has particularly been noted at the provincial and local government level (Smith & Leornard, 2018). This lack of coordination on water governance through greening requires integration of actions to support different industries. Institutional water services and water management have demonstrated poor communication and coordination (Pillay, 2017). According to Alberts et al. (2022), efficient water resource management in any industry requires collaboration between stakeholders and a clear guide to promote sustainable use. There is a need for more literature studies to explore strategies on how best stakeholder relationships and enforcement of greening regulations can be adopted by accommodation establishments in South Africa.

According to Tleane (2011), one of the first strategies to discourage overconsumption of water is elevated prices, therefore water becomes an income-generating commodity used by municipalities. The weakness in this strategy is that higher prices do not really discourage over consumption of water resources (Nyandoro, 2013). Trottier (2008) complained that most research studies focus on water catchments and residents instead of focusing on governance to understand water resource management and politics. Meissner (2013) also agreed with Trottier (2008) as to the importance of governance, highlighting that stakeholder participation is a key aspect in water management, and so this study will follow a similar approach. Given the impact of climate change, even though there are no multifaceted solutions for sustainable management of water resources, the integration of different measures within one strategy might be effective for good governance (Maphela & Cloete, 2019). Based on Pandy and Rogerson (2018), the effectiveness of policy adaptation must encompass strategic partnerships, where collective action involves not only governments but also both large and small businesses. Moreover, it should incorporate individuals from households situated around game lodges.

2.5.2.3 Incentive programs towards greening in the hospitality and tourism industry in South Africa

The hospitality and tourism industry is one of the most significant contributors to South Africa's economy (Tirado et al., 2019; Mensah & Blankson, 2014; Becken, 2014). In recent years, the hospitality and tourism industry in South Africa has shown increasing interest in adopting sustainable practices and greening initiatives due to the significant impact on the environment (Rogerson, 2018; Mbasera et al., 2016; Rogerson & Sims, 2012). Several incentive programs have been introduced to encourage businesses in the industry to adopt environmentally friendly practices. Some examples of these are:

a) The inclusion of water efficiency measures in the Green Tourism Incentive Programme (GTIP) launched by the Industrial Development Corporation (IDC). This offers financial support to businesses within the tourism and hospitality sector that invest in eco-friendly technologies and practices. The program encourages the adoption of renewable energy systems, energy-efficient equipment, waste reduction

and recycling, and water conservation measures (TGCSA, 2017). The GTIP programme is in line with the national Climate Change Response policy stated as the governing framework for the development of sustainable tourism in the nation in the National Tourism Sector Strategy (Department of Tourism, 2012). Furthermore, it encourages partnerships between stakeholders and government departments (Department of Tourism, 2020).

b) The Tourism Incentive Program (TIP) is presented by the South African government through the Department of Tourism and offers financial support to tourism enterprises implementing sustainable practices (Department of Tourism, 2020). The TIP provides funding for projects related to energy efficiency, waste management, water conservation, and renewable energy adoption. The program aims to promote responsible tourism and minimize the industry's ecological footprint.
c) Eco-Certifications and Green Labels: Various eco-certification schemes and green labels, such as Fair-Trade Tourism Tourism (FTT), Heritage Environmental Rating Programme, and Green Key, provide recognition to hotels, lodges, and other tourism establishments that meet specific environmental criteria (Logan, 2015; Sucheran, 2013). These certifications and labels not only enhance the reputation of businesses but also attract eco-conscious travelers.
d) Collaboration and partnerships: The government, non-governmental organizations (NGOs), and private sector entities collaborate to support greening initiatives. An example of this would be the increase of ecotourism between rural communities and game lodges towards sustainable tourism.

It is worth noting that while these incentive programs exist, the uptake and impact may vary among businesses in the hospitality and tourism industry (Alberts et al., 2022). However, they play a crucial role in fostering a culture of sustainability and encouraging businesses to take steps towards greening their operations in South Africa. Consequently, “in 2015 the former Minister of Tourism announced an investment of R557 million ($42.9 million) in a series of new incentive programs to assist organizations with improved sustainability” given the growing environmental concerns (Smith & Leonard, 2018, p. 7). The National Development Plan Vision 2030 (NDP) had previously highlighted that one of the

weaknesses of the South African economy is the increasing pressure on water supply brought on by demographic trends and the tremendous pressure on natural resources, particularly water. (NPC, 2011). Mukheibir and Sparks (2003) agreed with a range of measures that were needed for the imposition of water resources management including education, green technology, voluntary adherence, pricing strategies, or mandated water consumption limitations. Therefore, more studies are needed to analyse the extent to which accommodation establishments have adopted water efficiency measures. This research will add to the corpus of knowledge on measuring progress towards adoption of water efficiency measure towards sustainable tourism and governance of water resources in South Africa.

2.5.2.4 Promotion of green certification in the hospitality and tourism industry in South Africa

There are a few stakeholders in South Africa's hospitality industry that offer recognition, certification, or rating programs to implementing sustainability changes (Smith & Leonard, 2018; Rogerson, 2012; Wocke & Merwe, 2007). Accommodation establishments "can be nominated to receive awards or choose to become members of the programs that promote sustainability initiatives including the FTT, the Heritage Environmental Management Company and the Federated Hospitality Association of South Africa (FEDHASA)" (Smith & Leonard, 2018, p. 8). Even though the aim of international certification programs is to increase sustainable development, having separate rating programs results in inconsistencies in the certification criteria and varying standards in implementing green initiatives (Rahman et al., 2017). Despite the rise in the recognition of hotels for their sustainability efforts through separate awards by ecolabelling organizations, such as the FTT (Sucheran, 2013), the added expenses associated with participating in green certification programs like FTT contribute to managers' reluctance to embrace environmentally friendly practices in the hospitality industry. The financial burden of engaging in these initiatives becomes a factor that hinders managers from adopting green practices (Logan, 2015; Sucheran, 2013).

Government rules, regulations, tourism certification programs, and efficient and effective environmental governance are necessary for the hotel industry to implement green initiatives. (Rogerson & Visser, 2020; Musavengane, 2019). Involving government in the

hotel star rating systems was proposed to help improve inconsistencies in the hospitality industry that could have a major impact on the tourist experience (Mahony, 2007). The merge of sustainability initiatives with star grading could possibly not only benefit marketing but minimise the ecological impacts associated with natural resources, particularly considering the global popularity of the star grading system. Further studies are needed to establish the feasibility of coupling sustainability initiatives certification assessment tools with the star grading agencies such as TGCSA.

2.5.3 The development and growth of the hospitality and tourism industry in South Africa

Since the democratic transition, the hospitality and tourism industry became a prominent avenue for development in South Africa following the end of apartheid in terms of poverty alleviation and in achieving macro-economic stability (Stoffelen et al., 2020; Rogerson & Visser, 2014; Koelble, 2011). South Africa's popularity as a tourist destination increased after the country's political change in 1994, from approximately 700 000 foreign arrivals in 1980 to approximately 1-million foreign visitors to the country in 1990. It was noted that between 2001 and 2010 that the number of foreign visitors grew annually at an average of 7.0% from approximately 5 million to 11 million. Between 2011 and 2013, international visitor arrivals to South Africa increased at an average yearly growth rate of 7.4%, exceeding the global average of 4.5%. (Lehohla, 2010). Due to the growth of the hospitality and tourism industry, it was projected that South Africa will reach up to 1.8-billion arrivals annually by 2030 (Makumbirofa & Saayman, 2018; Seyfi et al., 2018). The increase in tourist arrivals since 2016 has directly contributed 9.3% to the gross domestic product (GDP) in South Africa, which amounts to ZAR 127 billion (Mhlanga, 2018). In 2014, approximately 60% of the accommodation establishments had been graded by the TGCSA (Smith & Leonard, 2018). The upgrading of accommodation establishments began before the 2010 FIFA Soccer World Cup which led to a radical change of 75% of hotels being graded as three, four or five stars (Giordano, 2013; Rogerson, 2013). Most of the newly constructed accommodation establishments were three, four- or five-star star graded. This led to a drastic reduction in the number of one to two-star graded accommodation establishments (Rogerson & Kotze, 2011). The growth in the hospitality industry resulted in

an increased GDP which can be translated to capital-intensive development projects for possible employment opportunities. It is estimated that 4.5% of the South African population is employed in the hospitality industry which also assists in reducing the country's high unemployment rate (Makumbirofa & Saayman, 2018).

The three possible factors that have led to the significant growth in the hospitality industry and to an increased number of tourist arrivals in South Africa could be (1) globalisation of the hospitality industry; (2) market segmentation, resulting in differentiated forms of hotel property developments and (3) geographic location. Published reports support these three factors as reasons for maturation in the hospitality industry. Thus, with the hospitality industry becoming increasingly internationalised, there was a global trend towards classifying hotels using the star rating system (Cronjé & du Plessis, 2020; Niewiadomski, 2016). Generally, the star system is used to demonstrate the level of services, amenities, and infrastructure offered by the hotel (Sufi & Singh, 2017; Machete, 2015). Indeed, most customers prefer to use hotels from three- to five-star grading for comparable service quality (Rogerson, 2014; Minazzi, 2012). The study by Rogerson (2013) did, however, indicate that most hotels across sub-Saharan Africa are predominantly ungraded, which is a critical aspect that requires improvement within the hospitality industry. Therefore, Africa needs to ensure that accommodation provisions are upgraded for service quality.

The hospitality industry in South Africa is part of the tourism industry and accommodation establishments are graded by the Tourism Grading Council of South Africa (TGCSA) (Mhlanga, 2018). The TGCSA was established in 2000 and is the only globally recognized tourism rating organization in South Africa, and thousands of accommodation providers utilize its grading services. (Tourism Grading Council of South Africa, 2014). The TGCSA has 11 categories according to which establishments are graded and they work on a voluntary basis with an applicable annual fee payable (TGCSA, 2017). Classifying hotels has gained popularity as it allows hotel owners to benchmark their investment in terms of the quality they offer and to predict improvements in hotel environmental practices (Maravić, 2017; Sufi & Singh, 2017; Tefera & Govender, 2015). Because of the competitive nature of the hospitality industry, Tefera, (2015) argued that the star rating is used to mainly

control tariff and taxes. Approximately 60% of accommodation establishments were graded by the TGCSA in 2014 (Smith & Leonard, 2018; Parliamentary Monitoring Group, 2014). There are limited studies, especially in the global South, that demonstrate how star grading is affiliated with environmental practices, particularly looking at the need in conserving natural resources, most particularly water, which is the focus of this study. Research demonstrates that the star rating system is more attached to pricing rather than quality (Mathur, 2019; Minazzi, 2012). It is therefore important for the hospitality industry to have concern for sustainability initiatives to maintain a high level of environmental quality.

Competitive pressure brought more diverse guest accommodation entrants into the hospitality market (Rogerson, 2013). According to Machete (2015), there was a growth in the number of independent entrepreneurs offering small local guest accommodation, such as guesthouses. The growth in the hospitality industry is attributed to an increase in ownership of foreign hotel chains and the rise of other luxury hotel types (Rogerson, 2013). However, Sucheran (2013, p. 24) indicated that "in South Africa, there is little international ownership of hotels and lodges, and most of the hotel chains are owned by South African conglomerates". To portray market segmentation, Sucheran (2013) stated that South Africa's main hotel chains have grown rapidly giving as examples the Hilton Hotels Corporation, Protea Hotels, Signature Hotels, Tsogo Sun, Three Cities Group, Sun International, and City Lodge Hotels. However, Rogerson (2013) indicated that several other foreign hotel chains established operations in South Africa following the democratic transition in 1994. Sheraton (3 hotels), Hilton (3 hotels), Hyatt (3 hotels), Rezidor (6 hotels), Mercure (3 hotels), and the Taj group (1 hotel) are among the worldwide hotel groups that have opened locations in South Africa. The consequence of heterogenous hotel categories has led to South Africa categorising hotels into six diverse sets of accommodation offerings, namely, game or Nature lodges, hotels and lodges with formal services, guest houses, B&Bs, country homes, and other types of lodging; self-catering (both private and shared); backpackers' and hostels' lodging; and caravan and camping lodging (TGCSA, 2017).

The geographic location of South Africa is uniquely suited to special travel markets due to the diverse locations within the country (Cronjé & du Plessis, 2020). According to Ivanov &

Ivanova (2017, p. 10), “the geographical location of the country determines its climate, distance from tourist generating markets and perceived political stability” which contribute to its attractiveness to tourists. Pandy & Rogerson (2018, p. 8) indicated that, based on coastal and inland areas in South Africa, there are six segments of tourism, depending on the travellers' motives. The six segments listed were: “(1) nature tourism which is an anchor of the international tourism economy of the country, (2) cultural and heritage which is a new focus for tourism promotion in South Africa mainly to international markets, (3) beach tourism which is the largest component of domestic leisure tourism, (4) business tourism which in terms of the formal economy is dominated by domestic travellers; and two new niches in the national tourism sector, namely golf tourism and cruise tourism, both of which are attracting an increasing number of international leisure travellers to the country”. All three aforementioned factors provide evidence that they are suited to accelerate the growth of the hospitality industry. Therefore, there is a need for initiatives to maximise water resources to minimise shortcomings that may be due from water scarcity.

2.6 Global sustainability strategies employed by game lodges

Even though there is not a single, agreed definition for game lodges, the common phenomenon globally is that a high number of nature-based accommodation establishments are in or near protected wildlife areas, which demonstrates the need for game lodges to maintain sound environmental standards and practices (Koeble, 2011; IFC, 2004). Another important feature about game lodges is that owners are involved in environmental conservation by preserving the biodiversity of indigenous fauna and flora in rural settings (Van der Merwe & Saayman, 2017). To blend with the natural environment, the buildings in most game lodges are made of permanent hard material structures such as stone, natural unprocessed timber poles and thatch for environmental sustainability (Koeble, 2011). Figure 4 indicates that nature-based lodges are in all five main geo-regions including Southeast Asia, Africa, Asia, Central and South America, and the Pacific (Ryan & Stewart, 2009; IFC, 2004; TIES, 2004). According to Grobler (2015), game lodges are most prominent in South Africa, Tanzania, Uganda, Zambia, Zanzibar, Zimbabwe, Botswana, Kenya, Mauritius, Mozambique, Namibia, Rwanda, Seychelles, and Indian Ocean Islands. Asia also has game lodges in India, Maldives, Nepal, Sri Lanka, and Bhutan while South America has several

game lodges in Argentina, Chile, Ecuador, and Peru. In contrast, European countries have shown relatively minimal investment in game lodges (James, 2018; James et al., 2017; Cirer-Costa, 2012; Urtasun & Gutiérrez, 2006; Whitworth, 2017).

Notably, there is not a single global term referring to game lodges as indicated in the United Kingdom where game lodges are commonly referred to as wilderness lodges (Ryan & Stewart, 2009). In other countries in Asia, North America, Latin America and the Caribbea and in Australia, nature-based accommodation establishments are commonly known as ecolodges (Sadiq & Adil, 2021) and the origin of the name ecolodge is based on a nature-dependent and environmentally friendly accommodation (Mafi et al., 2020). In Australia game lodges are further known as luxury resorts and green luxury due to consumer desire for adventure, prestige, and social interactions in a natural setting (Moscardo & Benckendorff, 2010). The present study focuses on game lodges in South Africa, also known as safari lodges in most African countries, due to their location in a pristine natural environment with a wide range of wild animals, with most lodge owners preserving the biodiversity of indigenous fauna and flora (Van der Merwe & Saayman, 2017; Rogerson, 2013; Cheung, 2012).

The sustainability of nature-based accommodation establishments such as game lodges is largely dependent on the overseas travel market (IFC, 2004) and it is mainly affluent tourists who can afford nature-based accommodation establishments and enjoy luxury within a natural environment (Ryan & Stewart, 2009). While the average daily rate for nature-based accommodation spans $40 to $500 per night for each room; the majority are moderately priced and provide rooms from between $61 and $200 per night per room (IFC, 2004). Tourists travel from both domestically in the US and globally is a key global market, followed by tourists from Australia, Japan, and New Zealand to a lesser extent, as well as Europe (particularly France, Germany, the Netherlands, and the United Kingdom), Canada, and Europe (IFC, 2004). The significance of this is that low- and upper income countries such as South Africa benefit from tourists from high income countries, thereby contributing to poverty alleviation.

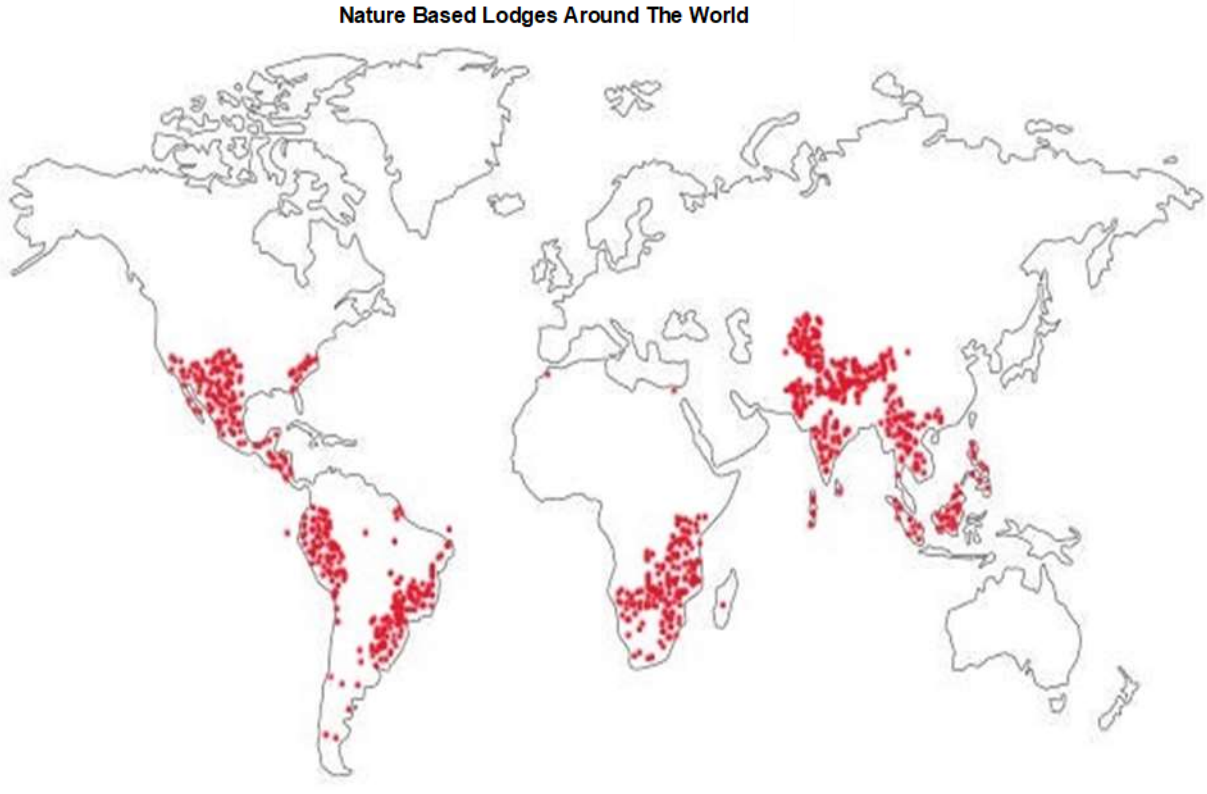

Figure 4: Global distribution of nature-based lodges. ***Adopted*** *from TIES (2004)*

In the likely event of a tourist decline, the hospitality industry is significantly affected, and particularly the poor from reduced employment opportunities (Croes & Rivera, 2015). Therefore, the tourism and hospitality industry are viable tools for reducing poverty and the industry should be kept sustainable to ensure that developing countries maintain and improve their income.

2.6.1 Sustainability strategies used by game lodges in South Africa

The increase in the number of game lodges in South Africa can be related to (1) private wildlife production also known as game ranching or game breeding (Otieno, 2016; Josefsson, 2014; Mkhize, 2014), (2) game life utilisation and (3) hunting. Game ranching became more viable after the Game Theft Act of 1991 (No. 105 of 1991) was enacted, which allowed private ownership of game, so long as there was adequate enclosure or

fencing (Snijders, 2012). Game ranching has increased, particularly in relation to livestock farming and it is estimated that the breeding and sale of game animals contributes almost R4.328 billion annually (Taylor et al., 2016). Several studies suggest that most game lodges in South Africa are engaged in wildlife utilisation while others combine game as a secondary activity to their main agricultural enterprise (Otieno, 2016; Mkhize, 2014, Cousins et al, 2008).

The Game Theft Act of 1991 enabled landowners to keep animals as a commodity by allowing them to hunt animals on their property and sell meat for human consumption. (Snijders, 2012). Wildlife game utilisation offers tourists a photographic experience and commercial wildlife products such as curios (Stone, 2015). Therefore, utilisation of wildlife in marginalised areas has played a huge role in contributing to the agricultural sector outside of crops and livestock (Mkhize, 2014). For most tourists, the focus is on observing wildlife, especially the renowned 'Big Five,' with the hospitality experiences provided by game lodges considered secondary in importance. (Moscardo & Benckendorff, 2010; Weinstein, 2010; Wight, 1997). However, the level of luxury experienced in game lodges creates an ecological footprint as game lodge guests tend to demand long showers, spas and pools which contribute to a high-water demand in comparison to other hotel categories (Moscardo & Benckendorf, 2010; Ryan & Stewart, 2009). Moreover, the discovery of a positive correlation in game lodges between water consumption per bed per night reveals that heightened water usage is not solely tied to destinations with high tourist volumes. This suggests that factors beyond tourist influx, such as operational practices or infrastructure, may significantly influence water consumption patterns in these establishments. Understanding these dynamics is crucial for implementing effective water conservation strategies across various types of lodges, regardless of their tourist traffic. Additionally, a positive correlation was found between water consumption per bed per night in game lodges, indicating that elevated water use is not solely linked to high tourist volume destinations (Song et al., 2018; Gautam et al., 2016; Deng & Burnett, 2002). Wildlife that is available in game lodges also requires water for survival and these further increases demand for water, taking into consideration both its outdoor and indoor uses. (Grobler, 2018).

2.6.1.1 Water governance strategies used by game lodges in South Africa

In a study undertaken within South African, Koelble (2011) indicated that the game lodge used over 140 000 litres of water daily and a further 9 000 litres were required to maintain dam and pan levels within the property. Thus, quantifying water consumption (water demand) and accounting for water uses is crucial in preventing water shortages (Tortella & Tirado, 2011). Logan (2015) also reported on the luxurious game lodges that provide lavish guest experiences from facilities such as spas, private pools, and large rooms but comparatively little thought has gone into the topic of water efficiency measures applied in various 3-5-star graded game lodges or how they maintain water efficiency measures in a remote setting. Instead, most focus has been on other kinds of lodging facilities, including resort hotels and city hotels (Pinto, 2017; Scott et al., 2017; Dinarès & Saurí, 2015; Grossling, 2015).

Chan and Baum (2007) pointed out that there is an unfortunate lack of empirical data on water efficiency measures in nature-based accommodation e.g., game lodges and this was confirmed by Kwan et al. (2010) despite the growth and demand in the nature-based accommodation. Some adopted water efficiency measures in nature-based lodges are shown in Table 1. There are few studies in South Africa that reveal that higher graded accommodation establishments have the potential to effectively adopt new technology for water efficiency (Han & Hyun, 2018; Chan et al., 2017; Fortuny et al., 2008). It is against this backdrop that this study will focus on analysing water efficiency for 3-5-star graded game lodges in South Africa.

Game lodges are of interest to sustainable community development, because they are micro, small- and medium- enterprises that can generate a variety of positive economic development impacts in remote rural and biodiverse areas (Akinboade & Braimoh, 2010). In most sub-Saharan African countries, nature-based lodges in remote peripheral rural areas near mainly poor farming residents, market themselves as ‘eco-tourism destinations’ (Cheung, 2012; Massyn 2012; Massyn & Koch, 2004). However, for tangible competency in understanding environmental sustainability issues, weak practical human and social applications contribute to game lodges being viewed as ‘socioeconomically unsustainable’

(Perkins, 2005; Mbaiwa, 2005; 2003). In addition, in most low-income countries, those residents who are employed are relatively unskilled, live in remote areas and often earn below minimum wages (Massyn, 2007). In contrast, Supradist (2004), cited in Moscardo (2017), indicates that the high-income countries offer better training and career opportunities for their workers which accelerates economic growth for developing countries. To improve the wellbeing of residents, a community-based approach is used by game lodges in offering jobs and obtaining locally sourced produce for use by guests (Koeble, 2011; Mbaiwa, 2011; Langholz, 2006; IFC, 2004). The custodianship of the environment and the development of the residents by game lodges is an attempt to integrate global investments in the hospitality industry.

2.6.1.2 Sources of water for South African game lodges

Water availability is based on location and available infrastructure (Smakhtin et al., 2001). In many developed cities, the availability of the water supply is dominated by a centralised approach managed by municipalities who should continuously make water available to residents and meet water demands (Hurlimann, 2011). Within the South African context, water supply involves three sources, where "77% is sourced from surface water (e.g., dams and rivers), 14% from return flows (e.g., sewage and effluent purification) and 9% from groundwater (e.g., boreholes)" (Haldenwang, 2009, p. 3).

Water that is below the surface in aquifers fill the gaps and spaces in between rocks, soil, and sand and is known as groundwater. Around the world, groundwater is increasingly used for domestic, industrial, and agricultural uses (Villholth & Giordano, 2007). Groundwater typically forms through the concept of recharge from rainfall and surface water (Oke & Alowo, 2021). Water sources for hotels in urban and semi-urban areas are through a municipal supply, in contrast to game lodges that are mainly found in remote areas where water is collected from natural sources such as rain, rivers, dams, and groundwater (Grobler, 2018). Considering various water uses in the hotel industry, water sources vary in quality and their uses in terms of potable and non-potable uses (Scarfiello, 2015).

2.6.1.3 Water quality in game lodges in South Africa

Water quality is the beneficial state of water for consumption by humans, plants, wildlife, and aquatic species (Mohamed et al., 2019). Physical, chemical, and biological factors are the three main categories into which water quality may be divided (Swamee & Tyagee, 2007). The physical and chemical characteristics (such as pH, temperature, total dissolved solids (TDS), electrical conductivity, turbidity, chloride, sulphate, nitrate, fluoride, concentrations of sodium, potassium, magnesium, and calcium) and the overall management of water quality monitoring are the foundation for microbiological content (Mpenyana-Monyatsi & Momba, 2012; Rivett et al, 2012).

Physical quality pertains to the characteristics of water quality that may be ascertained through physical means, including turbidity, pH, and conductivity (DWAF, 1998 b). *Chemical quality* describes the kind and number of dissolved materials, including metals, salts, and organic compounds. *Microbiological quality* is used to describe the existence of microscopic organisms including bacteria, viruses, and protozoa that are invisible to the human sight (DWAF, 1998 b). Ensuring water quality in water sources is crucial for safeguarding drinking water, supporting recreation, and maintaining a suitable environment for wildlife (Said et al., 2004). Field monitoring assesses these aspects, offering essential data to water authorities for making recommendations and future actions (Mohamed et al., 2019). Water quality assessment can be performed using a water quality index (WQI) or statistical approach useful for comparative purposes and has many variants (Bordallo et al., 2006; Cude, 2001; Smith, 1990). The WQI approach is simple, quick, does not require standardizing the water quality variables, and only requires a small number of water quality variables to assess water quality; yet it is not utilized as an exact indicator of the level of contamination in the water source. (Said et al., 2004). According to Ali (2003), the WQI approach is more objective and repeatable whereas the conventional statistical approaches are less applicable than the WQI classification approach due to complications that arise if different data sets are not assessed simultaneously (Said et al., 2004).

In South Africa, water quality from different water sources is governed based on International Standards Organisation (ISO) standards, which prescribes the benchmarks

being referred to as the South African National Standard (SANS) 241:2015 permissible limits for safe drinking water. To measure the potability of water, South Africa relies on the drinking water quality standard to ensure that water does not pose a significant risk to health (SABS, 2015). According to Fernandes-Whaley et al. (2015), to ensure that water is within the prescribed benchmarks, it should be tested for microorganisms as well as other physical and other inorganic contaminants. The Department of Water Affairs is the ministry mandated to maintain and evaluate water quality in terms of the requirements of a user or categories of users e.g., domestic, agriculture or industrial use, to maintain sustainability in accordance with National Water Act No. 36 of 1998 (RSA, 1998; Act No. 36 of 1998). The National Water Act promotes the restructuring of water resources to fulfill the requirements of the populace while also advocating for efficient water utilization, ensuring access to ample quantities at a minimal cost (Funke at al., 2007).

In the hospitality industry, to guarantee comfort and quality of service, water should be of good quality (Pinto, 2017). This necessitates the need for regular water quality audits to safeguard the safety of consumers and so water treatment is required for disinfection to a suitable and acceptable quality for consumption (Edokpayi et al, 2018). For game lodges where water is also required by wildlife, water sources including wastewater discharge needs to be managed accordingly. Thus, for effective water quality analysis in game lodges, Grobler (2018) indicated the three major locations where water can be collected for analysis: a) The source e.g., dam or river, highlighting the importance of knowing the processes used to purify water; b) After treatment e.g., tap where water is released for consumption; c) groundwater sources e.g., boreholes and wells, which are crucial for both residential and agricultural usesHowever, very few studies within the South African context have investigated suitable water quality for wildlife.

Table 1: Water efficiency in nature-based lodges.

Author	Country	Solutions for nature-based lodges
Kooijman et al., 2021	Dublin	-restoring the environment, -verdant living roofs Ecotourism - intelligent technology - Participation in the community
Lee & Tortajada, 2018	Singapore	-strengthened research on processes that provide more clean water -Developed water processes included: Watershed management, water quality analytics, groundwater, decentralized water treatment technologies, chemical reactions, redox technologies, desalination, water reuse systems, sludge and brine management, automation and robotics, and industrial water technologies.
Tenney, 2021	England	-nature-based education, particularly in early childhood,
Mandic et al., 2021	Mediterranean region	-Policy on management of capacity and environmental protection
Zaenuri et al., 2021	Indonesia	-partnership in sustainability efforts -collaboration with the public and private sectors.
Donoso et al., 2014	Latin America and the Caribbean	- Water users are encouraged by government laws to implement water-saving practices in order to improve their technical and financial efficiency. -increased subsidies that reward reduced water applications
Wolf et al., 2019	Australia	environmental education, training on water efficiency measures and sustainable tour experiences
Makopondo et al., 2020	Kenya	- Constructed wetlands serve as economical alternatives for treating wastewater
Logan, 2015	South Africa	-South Africa's Responsible Tourism Manual emphasizes tourism businesses addressing environmental impacts. - Maintain a water treatment facility on the premises. - Indigenous gardens

2.6.1.4 Competing priorities between game lodges and surrounding residents

Common water sources between game lodges and residents can vary depending on the specific location (Zhuang et al., 2014). In the case of game lodges in Kenya, a study by Makopondo et al. (2020) highlighted the possible application of created wetlands in game lodges and resorts for wastewater treatment and conservation. This suggests that game lodges may have their own wastewater treatment systems, which could include constructed wetlands, to manage their water waste. This approach can help address the issue of hotel and resort waste, both solid and liquid that may be released into prohibited locations, including water systems. (Makopondo et al., 2020).

On the other hand, residents in African urban areas, including Kenya, rely on a combination of improved and unimproved water sources. Nyamai et al. (2020) reported that residents in urban areas in Africa depend on sources such as piped water, boreholes, wells, vendors, and surface water. Piped water is categorized as a major source of improved water in sub-Saharan Africa. In some cases, both game lodges and residents may rely on the same water sources. For example, Zhuang et al. (2014) carried out a study close to the Dabaoshan mine in Southern China and discovered that both the locals and the mine's neighbors relied on the Hengshi and Chuandu Rivers for irrigation and drinking water and the local game lodges. However, it is important to note that the study focused on heavy metal contamination in the water sources near the mine, which may not be representative of all game lodges and residents in other regions.

To address the competing priorities and ensure sustainable water resource management, collaboration and coordination between game lodges and surrounding residents are crucial. The availability and access to water resources can be a competing priority between game lodges and surrounding residents. In rural areas, including those where game lodges are often located, centralized water supply systems may be inadequate or unaffordable due to remote locations and limited financial resources (Makopondo et al., 2020). This can result in challenges for both game lodges and residents in accessing sufficient and clean water for their needs. Makopondo et al. (2020) recommended specific implications for policy and practice that support environmentally friendly enterprises and sustainable hospitality for

both stakeholders. These recommendations include measures to improve water access and sanitation for both game lodges and residents, as well as the implementation of sustainable water management practices. In conclusion, collaboration and coordination between game lodges and residents is essential to address these competing priorities and ensure fair access to potable water for everyone stakeholders (Zhuang et al. (2014).

2.7 Global water management in the hospitality industry

Guest requirements in all hotel categories depend upon an adequate, high quality water supply (Ramazanova et al., 2021; Cole, 2014; Kasim et al., 2014). However, the 4-5-star category hotels (see Table 2) were identified as the largest water consumers when compared to the lower category hotels. Large water consumption in the 4-5-star hotels is due to water-intensive facilities and large facility sizes required in offering high comfort standards to guests (Ramazanova et al., 2021; Gautam *et al*., 2016; Pinto et al., 2016; Dinarès & Saurí 2015). According to Vila et al. (2018), two policies can serve as the foundation for water management: supply and demand management.

It is important to note that while there is limited data on water uses or comparing water consumption in game lodges, available data include different hotel types. The high-water consumption in higher category hotels suggests a need for serious water efficiency measures. A guest room, including the bathroom where there is a shower, bathtub, and toilet, for hygiene and sanitary purposes, are indicated as major users of water in hotels (Dinarès & Saurí, 2015). Overall, guest rooms have been identified as the biggest users of water for personal and sanitary hygiene, as well as cooking areas, as well as laundries and kitchens in hotels (see Table 2). The public areas where guests share a facility, such as swimming pools, jacuzzies and spa facilities and the gymnasium, including service areas such as dishwashers are indicated to also use large quantities of water. Maintenance of interior irrigation is stated to be high when compared to the amount of water used in cafeterias, lounges, banqueting rooms, management change rooms, for housekeeping duties and for golf, for those hotels with such facilities. In game lodges, it has been identified that maintaining an adequate water supply and water points is more required for the upkeep of game and livestock (Grobler, 2018).

2.7.1 Global quantities of water used in hotels

The hospitality sector is expected to experience an annual increase in water demand of 5% to 20% because of increased travel from overseas, population growth, and hotel category advancements. These factors combined have the potential to turn water scarcity into a significant regional issue (United Nations Environment Programme and World Tourism Organization, 2012). Research has indicated that the direct consequence of high water demands in the hospitality industry can lead to supply difficulties in peak seasons and can further cause water shortages and the degradation of the water supply particularly in destinations which are prone to the effects and consequences of climate change (Grossling et al., 2012; Garcia & Servera, 2003). A water supply shortage in the hospitality industry is mostly because it is challenging to measure the amount of water used by the hospitality industry, since water used by visitors (for lodging, additional services, or other purposes) is counted and included in domestic use (Tortella & Tirado, 2011). The findings of Rhee and Yang (2015) regarding direct water use for tourists highlight the importance of employee awareness in the implementation of water efficiency measures. Employees play a crucial role in helping hotels control water-related costs, as their engagement and understanding of water conservation practices are key drivers in achieving these efficiencies.

Based on Styles (2015, p. 2), hygiene operations including showers and baths account for approximately 30% to 40% of hotel water use. In most guest rooms it is indicated that “45% of the water goes to the wash hand basin, 33% to the shower and 22% to the toilet. Cold water is mainly used in the wash handbasins (38%), toilets (35%) and showers (27%). In the case of hot water, the greatest consumption is in hand basins (58%), followed by showers (42%)”. The daily laundry, bedding, and towels can consume about 100 litres per guest per night whereas food preparation, in a luxury kitchen, accounts for 22% of water use (Styles et al., 2015). Furthermore, Barberán et al. (2013, p. 3) indicated that “alongside the water consumed by guests, there is also a fixed consumption associated with cleaning and maintenance”.

Deng and Burnett (2002) investigated the water usage in Hong Kong hotels by using the Water Use Index (WUI). The Water Use Index is calculated by dividing the annual water

consumption in a hotel by the total floor area of the hotel. The findings (see Table 3) supported that highly categorized hotels consumed more water than the lower categorized hotels due to the pleasure approach and this, together with the laundry facilities, influences the water consumption of a hotel (Styles et al., 2015). Available literature reflects a great deal of variation between countries on hotel water consumption.

Table 2: Hotel water use.

OPERATIONAL AREAS																			
			Public areas					Service areas						Guest room	Maintenance				Sport areas
Source	**Country**	**Hotel quality**	Swimming pools	Spas	Gymnasium	Reception	Lounges	Management change room	Cooking area, e.g Restaurant/Kitchen	Cafeteria	Banqueting rooms	Dishwashers	Laundries	Personal and sanitary hygi	Exterior irrigation	Interior irrigation	Housekeeping duties	Air conditioning system	Golf
Pinto, 2017	Portugal	4-5	1	1	1				1				1	1	1	1		1	
Gössling, 2015	Spain	2-5			1		1		1	1	1			1					
Barberán, 2013	Spain	4			1	1	1	1	1					1					
Scott et al., 2018	Canada	3-5												1	1				1
Kelly & Williams, 2007	Canada	4-5	1										1	1		1			1
Dinarès & Saurí, 2015	Spain	1-5	1	1	1				1			1	1	1		1	1		
Gautam et al., 2016	India	5	1	1					1			1	1	1			1		
Ismael & Rogerson, 2016	South Africa	3-5										1	1	1					
Hocauglu, 2017	Turkey	5	1		1			1	1				1	1	1	1			
Deng & Burnett, 2002	Hong Kong	3-5	1	1						1	1	1	1	1					
Bohdanowicz & Martinac, 2007	Europe	3-5	1	1	1	1	1	1	1				1	1	1			1	
Mensah & Blackson,2014	Ghana	3-5												1	1				
Khonje et al.,2019	Malawi	2-4							1				1	1	1				
Mbasera et al.,2016	South Africa	3-5								1		1	1	1					
Total			**7**	**5**	**6**	**2**	**3**	**3**	**8**	**3**	**2**	**5**	**10**	**14**	**6**	**4**	**2**	**2**	**2**

Gautam et al. (2016) reported that European hotel chains have an average water use of 440 litres per guest per night whereas the recommended daily water intake for each guest in Canada and the United States of America is 500 liters or less.

Styles et al. (2015) indicated that the average water use in Hilton hotels (4-star and 5-star) is reported to average 216 and 516 litres per bed per night, with the average of 226 litres per guest per night in B&Bs, which are lower-ranking hotels. Findings by Murakawa et al. (2007) indicated that an average amount of hot water poured into the bathtub is about 200 litres, with a total of hot- and cold-water consumption per room ranging between 160.2 and 278.7 litres per day. The report does not, however, provide information as to whether the fixtures used were water efficient or conventional. On the other hand, Gautam et al., (2016) reported that water usage per guest per night is considered adequate if it is less than 540 liters, and exceptional if it is less than 480 liters per guest per night in luxury hotels. The average amount of water used in Barbados, in the Caribbean region of North America was found to be at 863 litres per bed per night (Barberán et al., 2013). There are currently limited African studies indicating the quantities of water used in hotel operations and whether the hotels are within the allowable benchmarks, particularly for game lodges.

The findings of Zhao et al. (2016) revealed that hotel chains belonging to smaller or medium-size operations presented reduced levels of water consumption compared to independent hotels due to the introduction of efficient processes in water management. According to Kelly and Williams (2007), there are also considerable differences in water consumption between coastal and inland areas. The demand in coastal areas is higher due to mass tourism, beach activities, and additional showers after swimming, including other lavish uses. It is also indicated that water consumption appears to be seasonal: for example, water consumption would be 30%–40% higher in summer, with a minimum amount of hot water used (Barberán et al., 2013). Being conscious of water consumption becomes critical when looking at extra ways to conserve water. It is estimated that leaking taps can increase the utility bill by up to 5% on average, with estimated water losses of up to 13 986 litres (Styles et al., 2015).

To create better water governance, it is essential to identify the relationship between water demand and water consumption. The phrase "water footprint" (WF) was first used in scientific research to examine the connections that go unnoticed between human consumption (water use) and international trade in the management of water resources (Hoekstra, 2009).

Table 3: Water Use Index in Hong Kong hotels. ***Source:*** *Styles et al. (2015)*

Hotel Category	**Average Water Use Index (m^3/m^2)**
Three-star hotel	3,3
Four-star hotel	4,1
Five-star hotel	5,1
Hotel with in-house laundry	5,1
Hotel without laundry facility	3,6

The idea aids in comprehending how trade patterns, global water governance, and consumption are related to one another (Hoekstra, 2011). Measuring the consumption and contamination of freshwater resources is necessary to analyze the ratio of water accessible for human use to that required for human appropriation, to understand the repercussions (Hoekstra & Chapagain, 2011; Gleeson et al., 2012). The WF is a measure of the water used, both directly and indirectly, by producers and consumers. The WF is a temporally and spatially explicit indicator that displays the locations of pollution and water use as well as their volumes (Hoekstra, 2016).

2.7.2 Global water saving methods used in hotels

Tables 4 and 5 reflect empirical evidence from different studies indicating the success of various initiatives in reducing water use within the hotel industry (Gössling et al., 2019; Styles et al., 2018; Verma & Chandra, 2018; Mbasera et al., 2016). The investment associated with water saving technologies have been found to have low pay back periods and there is also financial profitability

by the reduction in pressure on water sources by either conserving water through reuse or increasing the water supply. It was found that approximately up to 90% of savings can be attained from technology changes with the minimum gain of at least 30% (Gatt & Schranz, 2015). A study by Fortuny et al. (2008) demonstrated that many water efficiency measures that are relevant to hotels for use by guests have a short payback time, estimated to be between 0.1 to 9.6 years. Whereas, in her study, Scarfiello (2015) highlighted an intriguing work concerning the instance of water saving initiatives for hotels in the city of Zaragoza (Spain) showing that water saving technologies diminish water use and, thus, contribute to a monetary benefit. This demonstrates the cost-effectiveness and sustainability of water efficiency measures, particularly in assisting water constrained destinations and game lodges based in rural areas in maintaining their water supply. There are different water saving measures detailed below to assist operations within the hotel industry including game lodges.

2.7.2.1 In-house technology

In-house technology can be applied in all areas where water is used, such as guest rooms, public areas, the laundry, kitchen, and management areas (see Table 4). There has been a vast suite of green technology innovations, devices, efficient appliances, processes, and tools aimed at reducing water consumption by replacing the conventional methods (Han & Hyun, 2018; Grossling, 2015). Water-flow control technology, such as the use of water restrictors, water usage meters, smart meters, and auto-sensing water devices reduce the quantity of water used in hotels by controlling the water flow, which saves up to 26% of the water used (Chan et al., 2017). Another specific instrument that could be valuable, to measure the water utilized, is a gadget known as a Water Pebble (Figure 5). The Water Pebble must be put close to the plughole of the shower, where it estimates and remembering the measure of water utilized. Red light cautions time is up when the measure of water required is surpassed. Almost 17% of indoor water use can be saved using the Water Pebble.

Figure 5: A Water Pebble used to monitor the amount of water used. ***Source**: Scarfiello (2015)*

Table 4 indicates that the towel/linen reuse programme has been the most acceptable water saving strategy in reducing water use (Han & Hyun, 2018; Ismael &Rogerson, 2016; Dinares & Sauri, 2015; Barberan et al., 2013; Charara et al., 2011; Kelly &Williams, 2007). Low flow showerheads, dual flow toilets, aerated taps and water efficient washing machines are listed as highly utilised water efficiency measures. This agrees with the results of studies where low flow shower heads and dual flush toilets, including aerated taps, have been among the most used water saving methods (Verma & Chandra, 2018; Styles et al., 2015; Grossling, 2012). According to Scarfiello (2015), the tank type of toilets as shown in Figure 6 used roughly 19 L to 26.5 L per flush whereas, the dual flush toilets use 6 L for a standard full flush for solids removal and a reduced flush of 3 L for liquid and paper. The large flush button is for a full flush of water (6 L) whereas the small flush button is for a half flush (3 L). On the other hand, the replacement of toilets with ultra-flow toilets, costs $3250, with a payback of 2.1 years, with water savings of up to 681 374.121 litres per year (Amran, et al., 2017).

Figure 6: A conventional toilet and a dual toilet flushing mechanism. ***Source:*** *Scarfiello (2015); ESC (2021)*

In addition, sink taps represent a critical level of water utilized in rooms and preparation areas. The installation of aerating taps (50% air and 50% water) and low-flow showerheads, as opposed to highflow showerheads, is indicated to result in savings of $1.50 per room per month (Figure 7). Using aerated taps and showers addresses the need to utilize less water, indeed, while traditional taps and showers used between 9.5 and 15 L of water per minute as opposed to 6 to 10 L water per minute (Scarfiello, 2015).

Figure 7: Difference in water flow between a non-aerated tap and an aerated tap. ***Source:*** *Visser (2021)*

A study by Amran, et al. (2017), showed that the installation of low flow shower heads costs $3 060, with the annual water savings of up to $5 244, with a payback over seven months. Low flow showerheads have restrictors (see Figure 8) that limit shower flow to a 10% - 40% water savings (Rahman et al., 2017).

Figure 8: A restrictor being fitted onto a showerhead. ***Source:*** *Pham (2021)*

Based on Amazonas et al. (2018, p. 8) "sustainable technologies and practices applied in hotels" can offer annual savings of $14 000 at a cost of $16 000 with a turnover investment in 14 months – figures that probably differ from country to country. Fortuny et al. (2008) shown that many water-saving strategies that are pertinent to hotels have low payback periods (0.1 to 9.6 years), which makes them financially appealing. Water efficiency measures are an investment in hotel rooms and facilities that largely reduce water costs particularly in water-constrained destinations (Rhee & Yang, 2015). The use of water efficiency measures suggests a need for implementation to decrease water bills and wastage.

As opposed to conventional hotels, new hotels need to consider innovative building designs that allow for water conservation such as Water-efficient plumbing fixtures include waterless urinals, ultra-low-flow toilets and urinals, low-flow showerheads, sensor-equipped sinks, dishwashers, and washing machines (Verma & Chandra, 2018; Sucheran, 2013; Kasimu, 2012; Kell & Williams, 2007).

Good management practices applied in gardens and golf courses include drip irrigation systems, drought tolerant cultivars and mulching to prevent rapid evaporation in gardens. In addition, water features should be avoided to save water, whereas reducing pool sizes is also counted as beneficial (Sucheran, 2013; Grossling et al., 2012; Tang, 2012). According to Grossling et al. (2012), night covers should be considered by hotels as a water conservation method that prevents evaporation and

keeps the pools clean without the need to refill the pool frequently. In a study by Cominola et al. (2015), water meters are an emerging suite of technologies that modify consumer behaviour and may be a more efficient water management tool for monitoring water use by providing water consumption data. The use of water meters is a constructive model that ensures that water use was tracked, and it influences consumer behaviour to substantially contribute towards reducing hotel water consumption (Hocauglu, 2017; Kasimu, 2012; Tang, 2012; Deng & Burnett, 2002). According to Grossling et al. (2012), considering the landscaping options in terms of drought-tolerant vegetation and preventing evaporation by mulching and using drip irrigation methods can additionaly reduce water demands in gardens.

Tap water typically comes from either surface water (lakes, rivers, reservoirs) or groundwater (wells, boreholes) (Shahina et al., 2020). Treating tap water assists in removing impurities and ensure its safety for human consumption. Water providers e.g., municipalities are required to perform regular testing for various parameters such as pH, turbidity, dissolved oxygen, chlorine levels, and the presence of specific contaminants (Su et al., 2022). Common treatment processes include filtration, disinfection (usually with chlorine or chloramine), and sometimes additional steps such as coagulation, sedimentation, and activated carbon adsorption (Prasert et al., 2023). These processes help remove contaminants, including bacteria, viruses, chemicals, and particulate matter.

Table 4: Water saving methods per hotel activity in different areas.

Source	Country	PUBLIC AREAS				GUEST ROOM								LAUNDRY		KITCHEN				MANAGEMENT			
		Use of glasses in water basins	Coffee machines with water recirculation system	Tap with infrared	Awareness advice on request fo moderate water consumption to clients and employees	Use of efficient room applianc	Tap with thermostat/infrared sensors	Installed low-flush toilets	low-flow showerheads	Dual flush toilet	Urinals	Tap aerators for basins	Use of place card for a towel–linen reuse programme	Outsourcing launderette	Onsite laundry having water-efficient washing machines.	Eco efficient Dishwasher	Cooking practices/Equipment	Tap aerators	Flow controlled sinks	Staff awareness training and ar environmental management programme with an environme	Water use inventories	Green certification scheme/Policies	Implementing an informal environmental management programme
Charara et al., 2011	Barbados							1	1			1	1		1					1		1	1
Kelly & Williams, 2007	Canada							1	1			1	1		1	1							
Han & Hyun, 2018	Korea	1				1							1										
Mbasera et al., 2016	South Africa & Zimbabw												1									1	
Barberán et al., 2013	Spain							1				1											
Mensah & Blackson, 2014	Ghana					1			1	1		1	1							1		1	
Kasimu, 2012	Malaysia									1			1										
Styles et al., 2015	Europe			1		1	1	1	1	1		1	1	1	1	1							
Tang, 2012	Malaysia										1												
Verma & Chandra, 2018	India							1	1	1	1	1	1							1		1	
Sucheran, 2013	South Africa							1	1	1		1	1							1		1	
Dinarès & Saurí, 2015	Spain		1		1			1	1	1		1	1		1	1							
Grossling et al., 2012	Norway							1	1	1	1	1				1	1	1	1		1		
Ismael & Rogerson, 2016	South Africa	1			1	1		1	1	1	1		1		1								
Deng & Burnett, 2002	Hong Kong						1		1											1	1	1	1
Alonso et al., 2010	Australia									1					1	1							
Eshun, 2018	Ghana							1	1			1											
Bruns- Smith et al., 2015	USA							1	1	1	1				1								
Chan et al., 2017	Hong Kong						1		1						1	1							
TOTAL		**2**	**1**	**1**	**2**	**4**	**3**	**11**	**13**	**10**	**5**	**10**	**11**	**1**	**9**	**7**	**1**	**1**	**1**	**5**	**2**	**6**	**2**

Sources of surface water could be more vulnerable to pollution from agricultural runoff, industrial discharge, and from residue resulting from corroded pipes, while groundwater sources are generally considered to be cleaner (Shahina et al., 2020). Understanding these vulnerabilities is crucial for developing effective water management and governance strategies that ensure the safety and sustainability of both surface and groundwater resources.

2.7.2.2. Alternative water sources

Water efficiency can also be accomplished by instituting alternative water source storage aimed at conserving water (Sjöstrand et al., 2019; Pereira et al., 2012). *Alternative water sources* refer to any source of water identified to offer a supplement or replace (substitution) to the centralised water supply (Hurlimann, 2011). Most alternative water sources are used for non-potable uses (non-consumption purposes) for toilet flushing, cooling system use, laundry, and outdoor uses, such as garden irrigation (Campisano et al., 2017; Leong et al., 2018). The increasing pressures on potable water supplies coupled with increased climatic variability have increased the need for alternative water sources, particularly in semi-arid regions, to compensate for water restrictions and unfavourable water supply shortages (Zimmermann et al., 2018; Hurlimann, 2011). According to Marinoski et al. (2018), alternative water sources offer the potential for potable water savings and a reduction in sewage. There are several alternative water resources, including freshwater reservoirs and single-purpose dams (Choi et al., 2018). However, for hotels, including game lodges, the best proposed water-saving alternatives could include the use of decentralised water systems (onsite systems) such as greywater recycling systems, rainwater harvesting systems and groundwater from boreholes (Campisano et al., 2017; Leong et al., 2018). There is, however, an indication that in other developing nations alternative water sources may be used as the major source of water, due to poor infrastructural development (Hurlimann, 2011). According to Scarfiello (2015), alternative water sources are nowadays an opportunity to provide non-potable water use even though they were previously considered for use only in the dry parts of the world. There is a gap in the literature on the actual costs of these systems and payback periods for hotels. Since alternative water sources permit a reduction in water supply demand the expenses associated with water treatment are justified (Scarfiello, 2021). Alternative methods to conserve water or to increase the water supply

used by most hotels include greywater recycling technologies and the rainwater harvesting systems whereas groundwater or borehole systems are the most underutilised systems used by hotels (See Table 4). Tang (2012) and Charara et al. (2011) reported the collection and reuse of the water condensed from air conditioning system, but this is not a popular method used by hotels to conserve water. Most of the uses of alternative water applications include landscape maintenance and irrigation, as well as toilet and urinal flushing according to the available water quality. Zengeni et al. (2013) stated that about 27% decrease in water consumption per guest per night, equivalent to approximately 1 045 cubic meters per year, might be achieved by investing in water efficiency solutions like rainwater collecting and grey water reuse. The findings emphasize the importance of investing in such technologies to achieve meaningful reductions in water consumption.

2.7.2.2.1 Rainwater harvesting

Figure 9 indicates a rainwater harvesting (RWH) system involving a process of collection, storage, and treatment of rainwater for non-potable use (Campisano et al., 2017). The success of an RWH system as a sustainable water supply depends on the amount of rainfall received over that area (Gada, 2018). Rainwater harvesting systems have received attention as a notable alternative water source given the ease of collecting rainwater (see Table 5). However, Haque et al. (2016) indicated that the performance of the RWH system is likely to be impeded by reduced rainfall patterns whereas Leong et al. (2018) suggested that there are limited savings associated with rainwater systems due to the small roof area and dependence on rainfall.

Countries such as Asia and Australia have largely implemented the use of RWH as a sustainable water management system in semi-arid cities to increase water supply (Campisano et al. 2017). Furthermore, in Brazil, the government has a legislative mandate that encourages the use of RWH systems (Teston et al., 2018). According to Scarfiello (2015), the Flemish Government in 2005 established that it would subsidise and make mandatory that rainwater harvesting systems using a water storage tank of 3 000 L were obligatory for all constructions with a roof surface of at least 75 m^2. In a comparative study done by Marinoski (2017) in different building types including households and hotels, even though RWH systems supplement potable water, there was no reduction in sewage production.

Campisano et al. (2017) reported that the use of RWH has spread across Africa. However, its application is mainly considered for rural and poor residents. The capital costs associated with these systems in relation to plumbing, particularly where pumps are used, were found to be high (Teston, 2018; Campisano et al., 2017). International experience suggests that RWH is a feasible alternative water source even though the high costs of the system may be a barrier that scales down its adoption as a water management system (Campisano et al., 2017; Fisher-Jeffes et al., 2015). Further research is essential for creating models that are environmentally and economically viable, particularly for developing countries.

There have been other varying opinions concerning the water quality of RWH systems - while some studies report that harvested water meets potable standards (Imteaz et al., 2022; Alim et al., 2020; Campisano et al., 2017), According to other research (e.g., Alim et al., 2020; Hamilton et al., 2019; Jongman & Korsten, 2018) the levels of chemical and/or microbiological pollutants in drinking water frequently surpass international norms. It has also been established that the quality of water from the RWH is dependent on the geography, weather, proximity to sources of pollution, type of water tank (above or below ground), and water handling and management practices of the area under consideration. (Imteaz et al., 2022; Alim et al., 2020; Campisano et al., 2017).

2.7.2.2.2 Wastewater recycling system

Wastewater is water treated to satisfy the water demand through reuse and require separate pipelines from the potable water supply (Galkina & Vasyutina, 2018). Wastewater has two categories: greywater and blackwater, classified according to the level of contamination and the requirements for treatment for reuse (Al-Khatib et al., 2022). Blackwater is wastewater collected from toilet excrement that contain faecal matter and urine. Biological, chemical treatments and disinfectants are used for treating blackwater (Zheng et al., 2020). Greywater is wastewater from sources without any inputs of faecal contamination from toilets (Rodda et al., 2011).

Figure 9: Photograph of above-ground polyethylene water tanks and diagram of underground rainwater tank. ***Source**: Islam et al. (2013) and Scarfiello (2015)*

A schematic diagram for greywater treatment process is shown in Figure 10 and indicates wastewater collected from the bath, shower, laundry, and kitchen use. The inclusion of kitchen water as greywater is not preferred due to a high content of oil and food residue (Zhu et al., 2018). The installation of a greywater system requires the use of two-pipe systems (to avoid cross-contamination) that allow for redirecting water from showers, bathtubs, sinks, and washing machines for uses like irrigation and toilets that do not need to be drinkable. Greywater is treated and reused for non-potable applications such as irrigation and there is some controversy as to whether it can be used for toilet flushing due to health concerns associated with microbial contaminations (Jjemba et al., 2010). Furthermore, greywater is promoted mainly for use in landscape irrigation involving inedible plants while edible crops may require the use of potable water to ensure consumer safety. Some studies prove that wastewater has benefits to plant health due to diluted quantities of beneficial nitrates and sulphates, which some experts claim are better for gardens than pure tap water (Handreck, 2008). Bathing wastewater is least polluted, and it is recommended that biodegradable soaps and detergents be used to reduce toxicity and impact of harsh chemicals on the system and to promote efficient chemical breakdown (Boyjoo et al., 2013).

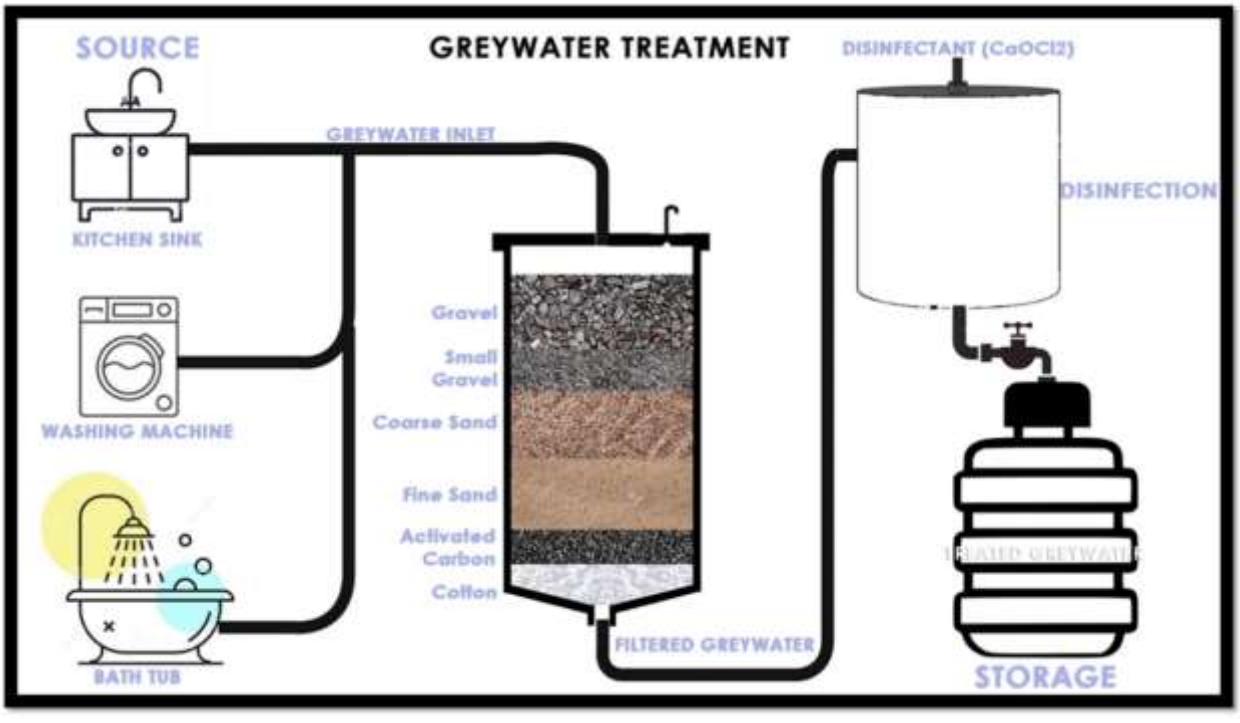

Figure 10: Diagram of greywater treatment to filter dissolved biological matter. ***Source:*** *Gautam et al. (2021)*

According to Zhu et al. (2018, p. 2), on-site greywater recycling systems have recently been introduced in the commercial market, where "Israel, Malta, and Singapore are the top three countries in water reuse and reuse 80%, 40%, and 33% of total wastewater". These examples demonstrate the feasibility and benefits of integrating greywater recycling technologies to enhance water sustainability and resource efficiency on a national scale. Table 5 indicates that greywater recycling systems are the second-most preferred alternative water sources. Greywater use has the potential as an alternative water source but there are no regulations governing the usage of greywater and so its use is "practiced on an informal basis to supplement irrigation water, either in urban gardens in middle- to upper-income suburbs or in food gardens in lower-income informal, peri-urban and rural areas" (Rodda et al., 2011, p. 1).

Most of the concerns about grey water use involve the odour and hygiene aspect of the water, but both these aspects are eliminated if bacteria have not been given the time to reproduce and the water is re-used as soon as possible (Hargreaves et al., 2019). Adequate treatment of grey water prior to

reuse is important to reduce the risks of pathogen transmission particularly for indicator bacteria such as *Escherichia coli* and to raise the effectiveness of the disinfection that follows (Winward et al., 2008). Water purification involves physical, biological, and chemical means (Shannon et al., 2008). The greywater system minimises energy and water treatment costs (Kavvada *et al*., 2018). Proper installation of the system is necessary to ensure its successful operation (Zhu et al., 2018). A study by Atanasova et al. (2017) demonstrated the appropriateness and the economic feasibility of the greywater system in the dry Mediterranean hotel facilities offered an opportunity for the implementation of alternative water supply solutions.

The greywater system has the potential to provide up to 95% of water for non-potable applications like toilets and irrigation (Kelly & Williams, 2007). A new system in the market includes a dual flush toilet with a sink and greywater system in one mechanism that implements greywater recycling - see Figure 11. The compact design allows a reduction of water consumption by up to 74%. There is limited information of the pricing associated with such a system within South Africa, which presents a gap that the current study could address.

Figure 11: A dual flush toilet is a sink and greywater system in one. ***Source:*** *Pham (2021)*

2.7.2.2.3 Groundwater sources

Groundwater is the water located underground inbetween soil, sand and rock called aquifers (Musingafi, 2012). Groundwater can be accessed through wells or boreholes and is mostly used for landscaping activities in hotels to meet water demands (Tang, 2012). To operate, boreholes are fitted with either wind-powered pumps, solar pumps (see Figure 12 below), hand pumps, or diesel engine pumps (Schnegg & Kiaka, 2017). Groundwater is regularly refilled by rain and while this occurs naturally, the potential outcomes of overexploitation (depletion of ground water) include the lowering of the groundwater table, land subsidence, disintegrating groundwater quality, and saltwater interruption (Bierkens & Wada, 2019). The depletion of groundwater shows the extent of how non-renewable ground water sources can be affected by climate change and require a need for many other complementary water sources to ensure an adequate water supply.

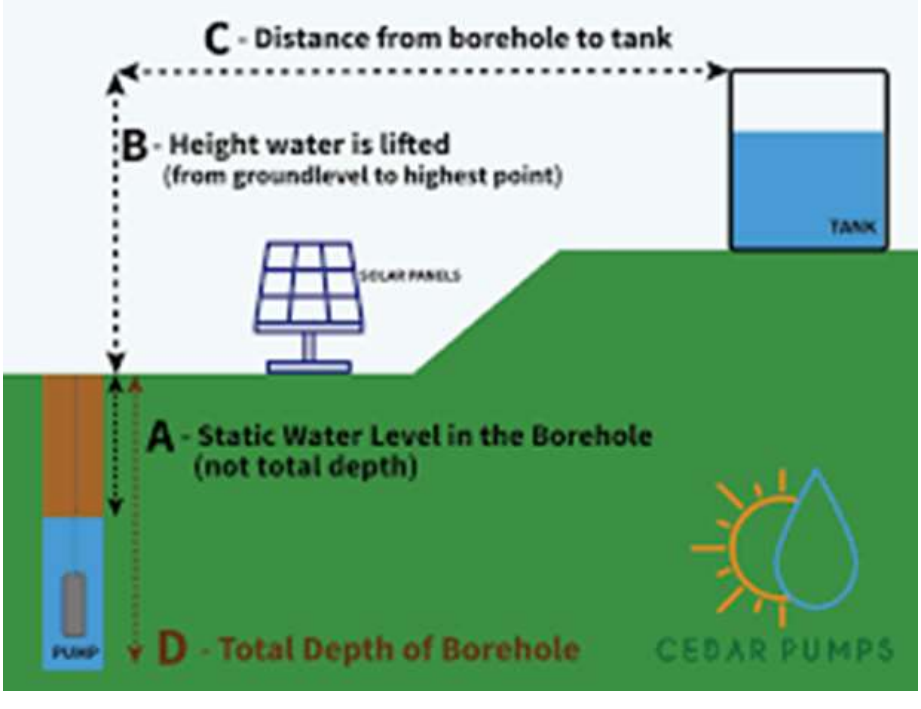

Figure 12: A borehole solar water pumping system. The storage tank is located higher, and the solar panels are located near the borehole. The pump controller is below the surface to pump the water up into the tank. ***Source:*** *Cedar Solar (2021)*

In South Africa, groundwater was included in the 1998 integrated water resource following the National Water Act's enactment (Act No. 36 of 1998; RSA, 1998). Before the inception of the Act, most landowners owned and maintained boreholes. (Du Toit et al., 2012). Currently, groundwater has been recognised as a regional bulk-water supply instead of a site-specific resource, particularly in rural areas. (Du Toit et al., 2012). Consequently, borehole water sources are the main water sources for most rural residents (Taonameso, 2019). Evidence suggests that the groundwater system can easily become contaminated by waterborne pathogens affecting water quality (Edokpayi et al., 2018). Ground water also contains chemicals and trace elements that may be either harmful or beneficial depending on their concentration as suggested by the South African National Standard for drinking water (SANS 241-1:2011). The borehole water supply needs to be treated and the process is costly (Hurlimann, 2011). According to Africa's Finest (2014), the groundwater systems of game lodges usually become polluted by human waste due to lack of effective sewage systems, unless proper engineering is applied to maintain non-contaminated water. Additional concerns pointed out by European hotels is that the installation of new technologies or systems that are regarded as costly, even though there is an indication that within a few years, the savings from water conservation would balance the cost of new systems. (Claver-Cortés et al., 2007).

Table 5: Alternative water sources and outdoor water conservation methods.

		ALTERNATIVE WATER SOURCES				GARDEN AND GOLF COURSE			BUILDING		SWIMMING POOL		WATER FEATURES
Source	Country	Greywater Recycling Technologies	Rainwater Harvesting	Water Wells /Bore Holes	Collection and Reuse of The Water Condensate From the Air-Conditioning System	Drip Irrigation Systems, And Sprinklers w Timers	Mulching	Landscaping Options Xeriscaping, Drougl Tolerant	Innovative Building Designs	Water Meters	Reducing Pool Sizes	Night Covers/fiittings	Avoiding
Charara et al., 2011	Barbados		1		1	1							
Kelly & Williams, 2007	Canada	1	1					1	1				
Hocauglu, 2017	Turkey	1	1							1			
Mbasera et al., 2016	South Africa & Zimbabwe		1	1									
Deng & Burnett, 2002	Hong Kong	1								1			
Scarfiello, 2015	Belgium	1	1			1	1	1					
Kasimu, 2012	Malaysia								1	1			
Styles et al., 2015	Europe	1	1					1					
Tang, 2012	Malaysia		1	1	1	1				1			1
Verma & Chandra, 2018	India								1				
Cole, 2014	Bali			1									
Dinarès & Saurí, 2015	Barcelona	1				1							
Grossling et al., 2012	Norway	1				1	1	1			1	1	1
Sucheran, 2013	South Africa	1	1			1	1	1	1		1		1
TOTAL		8	8	3	2	6	3	5	4	4	2	1	3

2.8 Global factors influencing water consumption in the hospitality industry

The hospitality industry uses a considerable amount of water in its daily operational services for housekeeping, kitchen, laundry and use in guest rooms (Angulo et al., 2014). The output includes total water demand met, volumetric reliability, total runoff, and average cost per kilolitre (Fisher-Jeffes et al., 2015; Maheepala et al., 2013; Neumann et al., 2011). By implication, the service quality in the hotel needs to be measured according to regulatory standards to ensure satisfaction to guests. There has been a growing trend in water efficiency efforts taken to reduce the environmental impact in the global hotel industry while maintaining comfort for guests. Conserving water has become more than a trend, but rather a necessity, resulting in the growth of water efficiency measures for any green-design building, including hotels (Lozier, 2016). It has also been shown that the ratio between the volumes of water used by guests using the available water efficiency measures or technology should satisfy customer needs and not affect the quality of services (Jorge, 2014). Therefore, the implementation of water efficiency measures is associated with water savings and does not decrease guest service standards.

Scaffielo (2015) identified that water management involves increasing water efficiency measures through fixtures, equipment, systems, and processes to reduce water use and losses. The study identified that the efficient management of water resources involved educating employees and guests about water efficiency to encourage water-saving. The efficient management of water resources involves also understanding the amount of water consumed and the identification of water-saving standards, and the technical improvements that should be implemented (Vila et al., 2018; Scaffielo, 2015). Thus, there is a need to increase water efficiency measures to reduce the volumes of water used which could lead to water scarcity (Hadjikakou, 2015).

Han and Kim (2010) found that guests were willing to put up with small inconveniences to support green projects. However, low-flow showers were the most unfavourable due to low water pressure. A study by Song et al. (2018) also found many negative reviews of low-flow shower heads and suggested that hotel operators should be urged to put up some notice with information on water efficiency so that visitors are not as displeased with the reduced water pressure. Additionally, educating visitors about the hotel's green initiatives through guest training can encourage participation in the green practices of the establishment, especially in word-of-mouth advertising.

Even though these suggestions may make it convenient for guests to participate, the inconvenience levels may negatively contribute to the hotel image and hotel type, particularly if expectations are high in terms of services rendered. Therefore, all technology features should be carefully considered.

In the hotel industry, water consumption is influenced by several factors, which can mainly be classified into operational and physical parameters (Cruz-Pérez et al., 2022; Chan et al., 2017; Pinto et al., 2017). The size, structure, and design of the building (including current architectural and construction practices), the building's age, its location in relation to the climate and geography, the installed water systems, the kinds and quantities of locally available water resources, and water-use regulations are among the physical characteristics shared by most buildings. (Cruz-Pérez et al., 2022). However, in the study by Pinto et al. (2017), the amount of water used was not found to be significantly influenced by the weather. Therefore, it makes sense to anticipate that the type of property will influence the amount of water used.

Water use is further impacted by operational elements in hotels (Barberán et al., 2013). These include various operating plans for establishments like restaurants, laundry facilities, spas and swimming pools, business, and recreational centers, and so forth; services provided; changes in occupancy rates; shifts in consumer preferences for indoor comfort; and cultural and resource-consciousness awareness. Since most of these characteristics are of a qualitative nature, some of them, including the degree of environmental awareness among users, may be challenging to measure or assess. (Cruz-Pérez et al., 2022). According to the findings of Barberán et al. (2013), while it is expected that more water consumption is per hotel room, the use of a spa can be a significant substitute for hotel room water consumption. Therefore, visitors who make use of the spa services could use less water in their hotel rooms. Fewer research from other popular tourist locations have been conducted to find out if water use in spa activities can be more economical than the time a person would have spent taking a shower or bath in their hotel room.

As indicated in Table 6, several factors influence water efficiency in the quality of hotel services, the most prominent being *the hotel standard* (Vila et al., 2018; Hocauglu, 2017; Dinares & Sauri, 2015; Tang, 2012; Charara et al., 2011; Kelly & Williams, 2007). A study by Gautam et al. (2016)

found that high standard, five-star hotels consume water at much higher levels compared to the best practice that is globally accepted. Consequently, this suggests the establishment of benchmarks such as an average of 440 L per guest per night to optimise water efficiency. Within the hotel sector, there are significant variances in the types of amenities, making it challenging to develop a comprehensive model that explains how each facility uses resources. Simultaneously, benchmarking is gaining popularity as a verification technique, and game lodges must set acceptable norms for all operational tasks, including water conservation. According to Pinto et al. (2017), replacement of fixtures with high water efficiency is necessary due to the high comfort requirements required in four- and five-star hotels (showers, faucets, toilets, kitchen equipment, and other equipment). Efficiency of water use in the hotels can then correspond to the proportion of water used by a customer to that of a scenario in which less water is required to complete the same chores, meeting the needs of the customer, and guaranteeing the same degree of comfort (Popely, 2018).

Studies have presented many other factors that influence water efficiency in the quality of hotel services including the importance of environmental awareness, pro environmental behaviour, and knowledge on technology use as being important in improving water efficiency (Gabrarda-Mallorqui et al., 2018; Han & Hyun, 2018; Verma & Chandra, 2018; Hocaoglu, 2017; Warren et al., 2017; Kasim et al., 2014, Charara et al., 2011). According to Warren et al. (2017), providing guests with information detailing the hotel's efforts in environmental sustainability, such as information on towel/linen reuse, will increase interest in the hotel and satisfy more environmentally conscious guests who respond by using significantly fewer resources because they were better informed and willing to reduce their water consumption. This supports research findings that guest interest in water efficiency measures was based on knowledge of water efficiency measures such as the use of technical enhancements in the accommodation (Hocaoglu, 2017; Dinares & Sauri, 2015; Kasim et al., 2014; Charara et al., 2011).

Jorge (2014) noted that implementing water efficiency measures requires two major components, technology, and behaviour-related efficiencies. Thus *technology-related efficiency* involves devices adapted to ensure that the amount of water used is reduced, whereas *behaviour-related efficiency* relates to the adoption of recommended practices to reduce water usage. Similarly, Kelly and

Williams (2007) found that eco-efficient or innovative strategies are necessary in managing water resources, given the high water demands in the hospitality industry. On the other hand, Charara et al. (2011, p. 3) emphasised that the use of water efficiency measures should provide good investments without "compromising guest comfort and expectation". Therefore, guests who are informed utilise the available infrastructure or technological capabilities and their expectation is uncompromised in using water efficiency measures associated with reducing water consumption. Among water conservation practices, towel and linen reuse programmes have already been widely adopted by hotels. Most hotels instituted the towel reuse programme to reduce wastewater and moved to a new trend of requesting the reuse of linen (e.g., sheets) only when there is a need.

According to Chan et al. (2017), *economic factors* also influence water efficiency in hotels and water efficiency measures are made more popular by the ever-rising costs of necessities like water supplies. This further suggests that cost-benefit considerations, rather than environmental concerns, are typically the driving force behind water efficiency initiatives. However, the use of water efficiency measures not only impacts on cost savings but allows hotels to profit from several factors, including favorable press, high standards from guests, a competitive edge, staff loyalty, customer retention, and social responsibility. (Chan et al., 2017; Graci & Dodds, 2008). Increased tourist numbers based on *season and geographic location* are also likely to influence water efficiency, which requires a need for awareness for pro-environmental behaviour to reduce the impact on availability of water sources.

Demographic factors, such as age, income, gender, and the quality of life of consumers, all contribute to the service quality demands such that some age groups will use more resources than others in their desire for quality of the travel experience (IFC, 2004). A study by Han and Hyun (2018) found that the *purpose of the trip* affects water efficiency. In the most luxurious hotels, such as game lodges, both genders are likely to use more water despite environmental concerns. This indicates that environmental consciousness and proactive conduct are not limited by gender. It has been found that younger people are the most involved in environmental sustainability efforts, and the reasons provided for this are that they are willing to adopt green attitudes (Verma & Chandra, 2018; Kanchanapibul et al., 2014). In contrast, Kim and Choi (2013) found no discernible link between age and environmental consciousness, noting that elderly individuals also exhibit

ecologically friendly behavior. They are aware of environmental degradation and challenges such as water shortages, demonstrating that environmental awareness and proactive behavior are not confined to younger generations but are also present among older adults.

Table 6: Factors that influence water efficiency in hotels

Source	Country	**Increased tourist numbers / Seasonality and Periodicity**	**Hotel standard**	**Water scarcity due to climate cha**	**Environmental awareness/ Pro-environmental behaviour**	**Economic factors**	**Social power, politics, and cultura issues**	**Mismanagement of water**	**Size**	**Occupancy rate**	**Purpose of the trip**	**Geographic location and Environmental conditions**	**Age**	**Gender**
Vila *et al*., 2018	Spain	1	1	1										
Gabarda-Mallorquí et al, 2018	Spain				1									
Verma & Chandra, 2018	India				1	1								
Kasim et al., 2014	Malaysia				1		1	1						
Warren et al., 2017	Australia			1					1	1				
Hadjikakou et al., 2015	Cyprus													
Dinarès & Saurí, 2015	Spain		1	1	1				1			1		
Tang, 2012	Malaysia		1						1	1				
Charara et al., 2011	Barbados	1	1		1									
Kelly & Williams, 2007	Canada	1	1											
Han & Hyun, 2018	Korea				1						1	1	1	1
Cole, 2014	Bali					1	1	1						
Hocaoglu, 2017	Turkey		1		1				1				1	
TOTAL		**3**	**6**	**3**	**7**	**2**	**2**	**2**	**4**	**2**	**1**	**2**	**2**	**1**

Hotels have a different resource consumption profile than other kinds of commercial structures. (Rhee & Yang, 2015). According to Zhao et al. (2016), water consumption by hotels based on the quantity of beds or the average amount used each night. This was based on the investigation of water consumption modelling and hotel benchmarking that included the additional determinants that Cruz-Pérez et al. (2022) found as: consideration for the hotel standard, the total floor area, characteristics and presence for catering purposes and other water-intensive services or facilities. More studies may be needed to ascertain gender perceptions of water-saving improvement uptake.

2.9 Global theoretical frameworks towards water governance in the hospitality industry

A theoretical framework serves as the structure that can support a theory of a research study by facilitating and explaining the research problem (Abend, 2013). Several global theoretical frameworks have emerged to guide efforts towards effective water governance by considering the economic, political, social, and administrative systems (Bianchi et al., 2021). Effective water governance is crucial for ensuring sustainable water management, addressing water scarcity, promoting equitable access to water, and protecting water ecosystems (Musingafi & Chadamoyo, 2013). These theoretical frameworks provide lenses through which researchers, policymakers, and practitioners can analyze and address the complexities of water governance. The choice of a particular framework depends on the specific context, issues, and goals of water management in each area. With growing awareness on environmental issues, global institutions like the United Nations and the World Bank, have played roles in increasing focus on global water governance, sustainable development goals, and climate change impacts. The major theoretical frameworks in water governance encompass the following:

2.9.1. The Water Governance Framework proposed by the United Nations Development Programme (UNDP)

The Water Governance Framework proposed by the United Nations Development Programme (UNDP) is a tool to help governments, civil society organizations, and other stakeholders to address water governance challenges, ensuring sustainable and equitable management of water resources (De Stefano et al., 2014). The framework is based on the understanding that effective water

governance requires the participation of all stakeholders and the integration of economic, social, and environmental considerations (Jiménez et al., 2020; Baumgartner & Pahl-Wostl, 2013). By adopting the UNDP principles, governments, stakeholders, and civil society organizations, can work together to improve water governance and ensure the sustainable management of water resources (Olagunju et al., 2019). The framework can be adapted to different contexts and used to guide policy development, program design, and evaluation (Daoud et al., 2022). The UNDP is suited for this study given the need to explore social (residents, game lodges and private organizations), economic, political (government structures including the National Department of Water and Sanitation and the Department of Tourism as well as the local municipality,) and the environmental considerations on the effective water governance.

The water governance framework proposed by the UNDP emphasizes the need for accountability, participation, and transparency for effective governance structures (Daoud et al., 2022). The UNDP framework encapsulates stakeholder participation, and the integration of environmental, social, and economic considerations in water management (Moore, 2013). It promotes the principles of equity, ensuring that all individuals and communities have access to safe and affordable water services, regardless of their socio-economic status (Gupta et al., 2013). The several pillars of the UNDP are expanded below:

Equity and inclusiveness refer to ensuring that all people have access to clean and safe water. This includes addressing the needs of marginalized communities and vulnerable groups such as women and children (De Stefano et al., 2014). The framework also highlights how crucial it is for local communities to be included in participatory decision-making processes when it comes to water management.

Efficiency involves optimizing the use of water resources through effective management practices such as reducing waste, improving irrigation systems, and promoting conservation measures (Jiménez et al., 2020). This pillar also emphasizes the need for integrated water resource management that considers multiple uses of water such as agriculture, industry, and domestic consumption. Efficiency emphasizes the need for efficient water use and management practices to optimize water resources and minimize wastage. This includes promoting water-saving

technologies, improving water infrastructure, and implementing water pricing mechanisms that reflect the true value of water.

Sustainability refers to ensuring that current water use does not compromise the ability of future generations to meet their own needs. This involves promoting sustainable practices such as rainwater harvesting, reusing wastewater, and protecting ecosystems (De Stefano et al., 2014). Sustainability is also a central pillar of the UNDP's proposed framework. It recognizes the need to protect and conserve water resources for future generations by promoting sustainable water management practices.

Integrated management: Water governance should be based on an integrated approach that considers the entire water cycle and the interdependence of water resources and ecosystems. This includes measures such as watershed management, water pollution control, and the promotion of water reuse and recycling (Olagunju et al., 2019).

Multi-level governance: Water governance should involve all governmental levels—national, regional, and local—as well as the commercial sector and civil society organizations (De Stefano et al., 2014).

Adequate financing: Adequate financing is necessary for effective water governance and should include a mix of public and private funding sources (Jiménez et al., 2020).

Legal and institutional frameworks: These should be in place to support effective water governance, including laws, policies, regulations, and institutions (Daoud et al., 2022).

Overall, by prioritizing these aspects, the UNDP framework aims to guarantee that everyone has access to inexpensive, clean water while simultaneously safeguarding and conserving water supplies for future generations. The UNDP framework provides insights that can inform the design of effective and context-appropriate water management strategies.

2.9.2 The Integrated Water Resource Management (IWRM) framework

The UNDP recognizes the importance of integrated water resources management in addressing the challenges of water scarcity and ensuring the availability of clean water for all (Olagunju et al., 2019; Gupta et al., 2013). The Integrated Water Resource Management (IWRM) framework is an internationally accepted participatory approach that was developed to promote and coordinate the development and management of water resources towards social and economic welfare in an equitable manner without compromising the sustainability of vital ecosystems (Pillay, 2017). Global trends in policy-oriented research have been pushing towards improved water management and water governance through the IWRM framework (Bianchi et al., 2021). Therefore, policy-driven equitable and sustainable practices are important to ensure proper management of water resources, (Musingafi & Chadamoyo, 2013). The IWRM is important given the increasing water demands in many regions, because of demographic changes (urbanization), agricultural, industrial expansion and population growth and other (Salami et.al. 2014).

A significant global commitment to advancing IWRM is evident in Sustainable Development Goal 6 (SDG 6) on water and sanitation. Specifically, SDG 6 target 6.5 urges countries to "implement integrated water resources management at all levels, including through transboundary cooperation as appropriate" by 2030 (Pradhan et al. (2017). Progress toward achieving this target is assessed through two dedicated indicators: SDG indicator 6.5.1, measuring the extent of IWRM implementation (Yeh et al., 2019). According to Sweileh (2020) the capacity of institutions to adjust to changes, the efficiency of legal frameworks governing water administration, the adequacy of resources for managing diverse water challenges (such as natural, human, or economic resources), the technological state are crucial factors collectively contribute to the overall ability to navigate water-related issues.This study will primarily focus on the use of SDG indicator 6.5.1 as a metric for tracking progress in implementing IWRM and as an indicator for evaluating water governance on a broader scale.

In South Africa, the feasibility of the IWRM will be in accordance with National Water Act of South Africa (Act 36 of. 1998). To achieve equitable access to water and the requirement that these resources benefit as many people as possible, the IWRM translates into a policy and program

principle for implementation at the municipality level. (Meissner et al., 2013; Haigh et al., 2010). The 1997 White Paper on National Water Policy, as well as the WSA1 and the NWA, are the first legislative works in South Africa that incorporate the IWRM as a conceptual framework. According to Tleane (2011), the IWRM has become a powerful political force that has defined the global landscape of water management policy.

According to Tleane (2011), the national and municipal levels of government oversee providing water resources and overseeing governance, respectively, under South African legislation. Water resource management is complicated, and Gumede and Dipholo (2014) identified major governance issues that affect infrastructure projects, such as fragmented responsibilities, a lack of coordination, and inconsistencies between regulatory frameworks (Haigh et al., 2010; Meissner et al., 2013). Because of this, a progressive system that outlines the distribution of authority among the levels of government must be precisely specified to prevent fragmented policy management for efficient management of water resources. The primary focus of the research will be on the City of Tshwane's role in supplying water services to rural areas, understanding its relatedness to Dinokeng Nature Reserve can provide insights into broader environmental and socio-economic connections within the region.

Understanding the governance of sustainable water resource management is crucial for addressing the complexities of water utilization and ensuring the long-term availability of this vital resource. The Integrated Water Resources Management (IWRM) approach offers a comprehensive framework for analyzing these challenges. Pillay (2017) utilized the IWRM approach to explore how fragmentation in policy frameworks and institutional setups can impact sustainable water governance. The study conducted comparative examination of South Africa's governmental levels, with a focus on Gauteng district and local municipalities. This study is mainly interested in the second important objective on the management of water resources (policy framework) in ensuring that water resources must be used in a sustainable manner. A study by Tleane (2011) used the IWRM approach to understand the quality and quantity of water resources in determining the nature of water utilisation and the analysis was mainly on local government and the ability of the municipality to manage water quality issues. The uncertainty of securing water supply during certain periods of low rainfall patterns during the year requires

balancing efforts to invest in water efficiency measures (Maphela & Cloete, 2020). Given that South Africa is among nations that may experience severe water scarcity by 2025, effective water resource management is critical (Tleane, 2011). The present study used interviews and analysed the results of sample questionnaires and observations to examine how different private organizations and government administrative structures manage water resources in a rural area against the backdrop of climate change while also ensuring that water is sustainably used. Current governance in water resource management in South Africa suggests a need to engage local government about change (Jankielsohn, 2012). Municipality officials in the City of Tshwane and the Department of Water Affairs and Sanitation assisted in examining how the municipality ensures the efficient management of water resources. Government structures have an important role to play in the effectivce and successful implementation of water management among the hospitality and tourism industries (Amoako, 2022). Research studies in the hospitality sector have shown that the adoption of water efficiency measures can assist in reducing water shortages and contribute to sustainable tourism (Logan, 2015; Sucheran, 2013). This suggests a need to comprehend the variety and intricacy of organizations controlling the usage of water resources to enhance water allocations that can effectively yield the desired outcomes.

2.9.3. The water resource management framework based on the 4R approach

This study used the 4R approach-based framework for water management, which includes innovative reaching (IR3), innovative reduction (IR1), innovative reusing (IR2), and innovative recycling (IR4) to assess water efficiency in game lodges (Kasim et al., 2014). The unique contribution of the study is the use of the proposed framework in a different social and cross-cultural environment such as game lodges. The key drivers of the framework for sustainability through innovation are knowledge and technology. In the 4R framework, size, finance, green innovations and technical knowledge, awareness and managerial capacity are identified as the factors that influence water management practice (see Figure 13 below).

The (IR1), *reducing* approach at the bottom left segment is an approach requiring the least knowledge and technology. It involves behavioural change (proactive behaviour) and the implementation of innovative ways in water saving practices and daily monitoring of all operational

services in hotels. This approach is suitable for hotel types such as hostels, motels, homestay and bed and breakfast facilities. The (IR2), *reusing* approach is fit for hotels with low level of expertise and strong technological aptitude in managing water resources e.g., through purifying grey water and reusing it for activities that do not require potable water for instance outdoor cleaning, flushing in toilets and irrigation. The (IR3), *reaching* approach can be implemented by all types of hotels with managers that can teach and encourage stakeholders including hotel staff and customers to support the water management initiatives. The IR3 approach requires intensive knowledge and technology to reach out to the residents about water issues. The (IR4), *recycling* approach is more suitable for larger hotels with a high environmental management budget due to the requirements to manage high knowledge and high technology into water management.

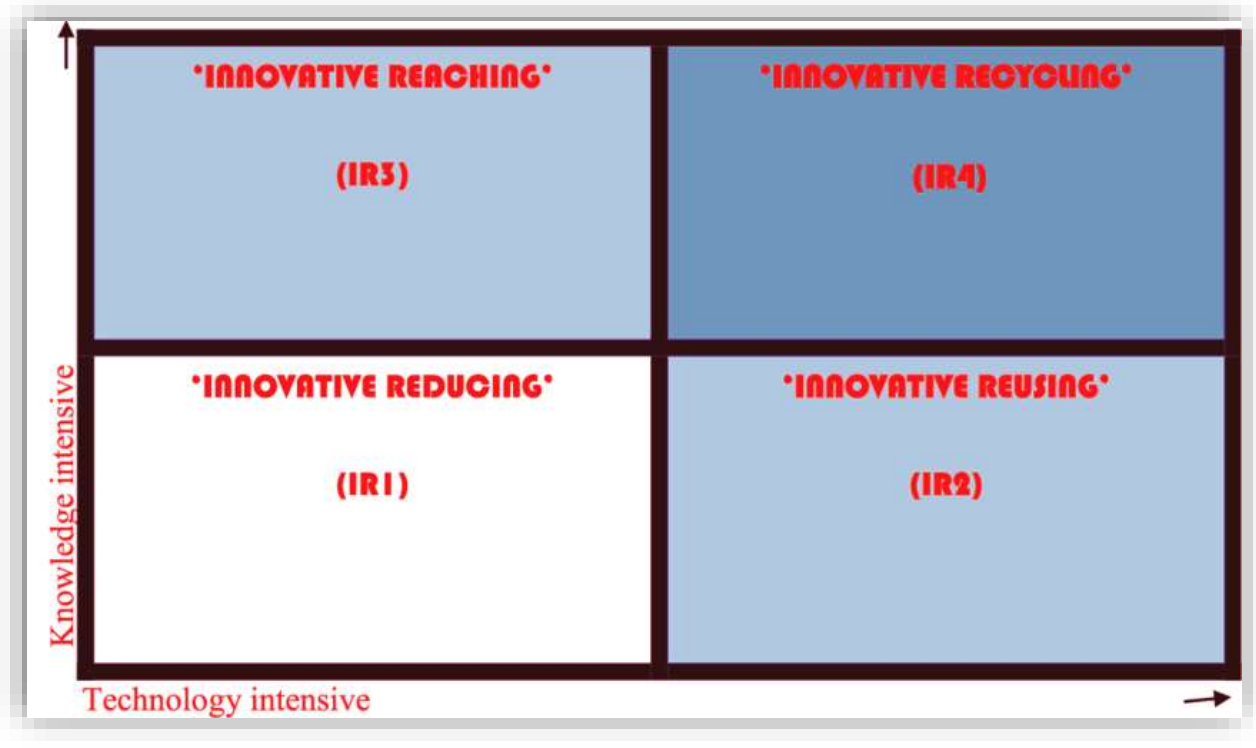

Figure 13: The 4R framework for innovative water management in hotels. ***Source:*** *Kasim (2014)*

Literature describes several different frameworks proposed for assessing water efficiency in the hospitality industry (Abokhamis Mousavi et al., 2017; Kasim, 2014; Charara et al., 2011; Kelly &

Williams, 2007). However, in-depth studies on water policy tools and adoption of alternative water sources is lacking, despite recognition that sustainability through innovation is essential for water efficiency (Kasim et al., 2014). The recommendations for improved water efficiency in game lodges were developed based on the approach by Kasim et al. (2014).

By incorporating location-specific insights, the 4R approach offers a comprehensive framework for sustainable and effective water resource management, ensuring a balanced approach to environmental objectives. Furthermore, the approach has been incorporated into management and risk analysis within the water utility sector, highlighting the significance of water safety plans and risk frameworks for water quality management (Carden & Fell, 2021). In the realm of water distribution network renewal planning, the 4R approach has been considered in devising sustainable water distribution strategies, leveraging smart water grid concepts and information technology solutions for optimized water management (Byeon et al., 2015). Furthermore, it has been integrated into comprehensive water management strategies, emphasizing the need to balance the requirements of people, industries, and ecosystems while ensuring the sustainability of finite water supplies (Christianson & Harmel, 2015). The 4R approach provides a robust and versatible framework for water resource management, allowing for the assessment and adaptation of current knowledge to diverse water requirements, infrastructure, and participant realities.

Carr (2020) and Goffman (2020) argue that the COVID-19 pandemic offered a chance to shift towards sustainable tourism, reducing environmental harm from natural resource overuse. However, despite government initiatives to enhance water governance capacity, the slowdown in the travel industry during the pandemic may have hindered these efforts (Dube, 2021). For instance, the South African Department of Tourism made strides in water governance programs for game lodges under schemes like the Tourism Incentive Programme and the Green Tourism Incentive Program. This underscores the vital role of effective water governance in sustaining industries, emphasizing the need to assess water strategies in 3–5-star game lodges and associated residential areas for optimal resource regulation and management, preventing conflicts.

2.9.4. The Reflexive Governance Approach

Reflexive governance is a type of governance that emphasizes adaptability, collaboration, and experimentation (Mansson et al., 2022). It is a theoretical framework for decision-making that considers multiple perspectives and seeks to address the root causes of complex problems (Feindt & Weiland, 2018). Reflexive governance is characterized by a willingness to learn, to experiment, and to engage in dialogue with all stakeholders (McLoughlin et al., 2020). This approach to governance is often contrasted with more traditional forms of governance that are characterized by rigidity, hierarchy, and a narrow focus on achieving short-term goals (Triyanti et al., 2020).

There are many benefits to using reflexive governance as a theoretical framework for decision-making. For one, it is an approach that fosters innovation and experimentation, two key ingredients for solving complex problems. By working collaboratively and engaging with all stakeholders, reflexive governance can lead to more creative and effective solutions compared to traditional forms of governance (Seijger et al., 2020). In addition, reflexive governance is a more adaptable approach to governance that can better respond to changing circumstances (Lepenies et al., 2018). By being willing to learn, experiment, and adapt, reflexive governance can help societies better deal with the underlying causes of issues and develop lasting fixes (Triyanti et al., 2020). This is particularly crucial in the ever-evolving world of today, where new problems appear on a regular basis.

Despite its potential benefits, implementing reflexive governance can be challenging. This is because it requires a fundamental shift in the way to approach governance. Moving towards a more collaborative, adaptable, and innovative approach to decision-making will require significant changes to the structures, processes, and behaviors that define traditional forms of governance (Lepenies et al., 2018). Another challenge to implementing reflexive governance is the need for a new set of skills and competencies among policymakers and practitioners. Leaders will need to be comfortable with ambiguity, open to learning from all stakeholders, and able to adapt to changing circumstances (McLoughlin et al., 2020). This will require a significant investment in training and development, both of which can be costly and time-consuming (Feindt & Weiland, 2018). Nevertheless, with its potential benefits and ability to help address the root causes of complex

problems, reflexive governance is an approach that should be seriously considered. The adaptability of reflexive governance can lead to more effective and creative solutions to the problems faced by societies.

The reflexive governance approach is a novel mode of governance that seeks to address the limitations of traditional hierarchical and deterministic governance systems by embracing flexibility, reflexivity, and interactivity (Leonard & Lidskog, 2021). It emphasizes the incorporation of diverse knowledge systems and the ability to learn from past experiences (Görg et al., 2016). Reflexive governance is characterized by its responsiveness to societal change, acknowledging the multi-dimensionality of problems and the range of possible futures (Hopkins & Schwanen, 2018). This approach places significant importance on public debate, the monitoring role of the media, and the engagement of civil society organizations and other actors (Boström et al., 2016). It is also seen as a response to risks, aiming to replace traditional governance approaches with more interactive, flexible, and reflexive approaches (Kowalska & Manning, 2022).

Furthermore, reflexive governance is associated with a coevolutionary approach where it adapts to changing dynamics and transitions (Steiner, 2013). It is also linked to inventive interventionism, which draws on legal transplant theories, reflexive law theory, and responsive regulation theory, highlighting their role in corporate social responsibility and globalization (Osuji, 2015). Additionally, reflexive governance may be discussed in relation to risk governance, where rationalities of risk are reassessed and strengthened to prevent future occurrences (Glenn, 2013). Reflexive governance in water management often aligns with the principles of IWRM, which emphasizes a holistic and participatory approach to managing water-related resources. It entails the planned use and administration of land, water, and other resources (Armitage et al., 2012). In reflexive water governance, stakeholders from diverse sectors, including government agencies, local communities, NGOs, and businesses, are actively participating in the process of determining decisions. This inclusivity helps in developing solutions that consider multiple perspectives and interests (Ferrari, 2020).

Reflexive water governance incorporates adaptive planning and management strategies, allowing for flexibility in response to changing environmental conditions, emerging challenges, and new

information (Hopkins & Schwanen, 2018). The idea of adaptive water governance involves flexible, collaborative, and polycentric strategies to enhance resilience in complex contexts (Cosens & Chaffin, 2016; Wyborn et al., 2023). Scholars highlight the importance of adaptive governance in establishing institutions for collective action problems, integrating diverse knowledge sources, and promoting polycentric institutions (Hurlbert & Diaz, 2013; Akamani, 2016). The relevance of adaptive water governance is further emphasized by its focus on public participation, social learning, and legitimacy in water system management regimes (Meerkerk et al., 2013). Recognizing governance system fragmentation aids policymakers in enhancing adaptive features, preparing for water-related risks and disasters (Caniglia et al., 2016). Given the challenges of climate change and water security, integrating adaptive governance is crucial for effective water resource management (Bruch & Troell, 2011). In summary, adaptive water governance and reflexive water governance approaches are highly relevant, addressing evolving challenges and contributing to resilient water management. Open communication and transparency are crucial in reflexive water governance. Making water-related information accessible to all stakeholders enhances trust and accountability, fostering collaborative efforts for sustainable water management (Leonard & Lidskog, 2021; Feindt & Weiland, 2018). This adaptive approach is essential for addressing uncertainties in water management.

The reflexive governance approach in water governance involves a self-critical evaluation of the current administration's accomplishments and unforeseen drawbacks (Boström et al., 2016). It seeks to embrace the heterogeneity and multi-dimensionality of problems in water governance, acknowledging the range of possible futures and societal change resulting from different forces (Hopkins & Schwanen, 2018). Reflexive governance is viewed to be more inclusive and responsive to complex risks in water governance, aiming to address concerns about social-ecological vulnerabilities and fragmented governance regimes (Leonard & Lidskog, 2021). Additionally, it presents challenges in designing adaptive management and transition management in the context of water governance (Voß & Bornemann, 2011). Furthermore, reflexive governance is relevant to infrastructure resilience and sustainability in water governance, aiming to solve socio-ecological vulnerabilities and contribute to sustainable development (Ferrari, 2020). It also contributes to assessment practices in the policy and politics cycles, promoting a more self-critical and self-aware

mode of governance open to multiple societal perspectives for sustainable development in water governance (Meadowcroft & Steurer, 2013). Reflexive governance represents a paradigm shift in governance approaches, emphasizing adaptability, responsiveness, and the incorporation of diverse knowledge systems to address complex societal challenges (Leonard & Lidskog, 2021). Defining globally applicable governance indicators, while retaining relevance to local conditions due to unique governance structures and cultures, proves challenging (Dryzek & Pickering, 2017). These frameworks emphasize an inclusive assessment approach involving stakeholders that is well-designed for stakeholders to contribute local knowledge, fostering engagement and facilitating necessary amendments to policies and regulations.

Previous case studies have provided various aspects of reflexive governance in water management across different regions and contexts. For instance, McLoughlin et al. (2020) emphasized the importance of reflexive learning in adaptive management for environmental water management in the Murray Darling Basin, Australia. This highlighted the need for practitioners to engage in continuous reflection and learning to achieve effective water management goals. Similarily Togerson et al. (2014) depicted that reflexive governance in water management was a key factor in shaping adaptive water governance structures, particularly in addressing challenges such as flooding and sustainable drainage systems.

Moreover, Shah & Rodina (2018) discussed how combining adaptive co-governance with reflexive spaces can reshape water ethics and governance, allowing for radical changes in resource management. This underscores the transformative potential of reflexive governance in challenging existing norms and practices. Additionally, Withanachchi et al. (2018) pointed out the shift towards decentralization and spatial management systems in water governance paradigms, emphasizing the empowerment of local governance for more transparent and equitable decision-making processes.

Furthermore, Voß & Bornemann (2011) highlighted the importance of integrating politics into reflexive governance design to ensure sustainability and guard against power imbalances. This underscores the need for governance structures that are not only reflexive but also politically aware and responsive to ongoing dynamics. Overall, these case studies collectively contribute to a deeper understanding of reflexive governance in water management, emphasizing the significance of

adaptive learning, ethical considerations, decentralization, and political engagement in shaping effective governance frameworks.

2.10. Conclusion

In conclusion, this literature review offered a comprehensive overview of the current state of knowledge in water governance. The findings from the reviewed studies collectively highlighted the remaining gaps and areas needing further research, providing valuable insights for policymakers and practitioners in this field. The review emphasized the practical applications of existing research in effectively addressing evolving water challenges and stresses the importance of integrating scientific knowledge with policy-making processes to establish robust, adaptive, and resilient water governance frameworks. Through a critical analysis of the literature, several key trends and insights emerged, providing a deeper understanding and potential strategies to address the challenges and opportunities in water governance. The next chapter will provide more details on the research methodology used to understand water governance in the study area.

CHAPTER 3 RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides a framework for conducting the study and ensuring that the research is valid and reliable. Research methodology is the systematic process of collecting, analyzing, and interpreting data to answer research questions or solve problems (Creswell, 2014). It outlines the strategies and techniques used to conduct the study, including the research design, data collection methods, and data analysis procedures to ensure the reliability and validity of the research findings (Babbie, 2011). In this chapter, the various aspects of research methodology, including its importance, the types of research designs, data collection techniques, sampling methods, and data analysis procedures are detailed towards drawing accurate conclusions. The strengths and limitations of each approach used are indicated in the sections below.

The comprehensive overview of research methodology will cover various topics, the first section provides the methodological approach and a description of the study area, information on the research approach and research techniques used in the study. The methodological approach provides information on the strategy used to answer the research questions. Then the technique used for analysing data is provided followed by study ethical considerations. The final section provides a conclusion.

3.2 Description of the study area

Hammanskraal is a township located in the northern part of Gauteng Province in South Africa, about 40 kilometers north of Pretoria within the City of Tshwane Metropolitan Municipality (see Figure 14). According to Section 155.1 of the Constitution of the Republic of South Africa, Act 108 of 1996, which states that the municipality has exclusive legislative and executive authority over its territory by virtue of the Municipal Structures Act, Act 117 of 1998, the City of Tshwane is classified as a Category A municipality (Tleane, 2011). The estimated population of Hammanskraal, according to the World Population Review (WPR) 2024, is 123,005. This is an

increase from 76,827 in 2001, with an annual growth rate of 2.07%. Significant obstacles to Hammanskraal's socioeconomic situation include inequality, unemployment, and poverty as well as restricted access to essential services like sanitization, healthcare, and education (Hamann & Horn, 2022). The town is predominantly rural, with many residents being low-income earners relying on agriculture, domestic work, and informal trading for their livelihoods. Agriculture is a significant practice in Hammanskraal involving livestock, poultry farming and crops such as wheat. Large scale farmers are generally subsidised under the irrigation scheme for irrigation water supply (Van Niekerk, 2008; Schur, 2000). According to Nkosi et al. (2014), community gardens in Hammanskraal assist to increase food security in the area and promote sustainable nutrition for residents.

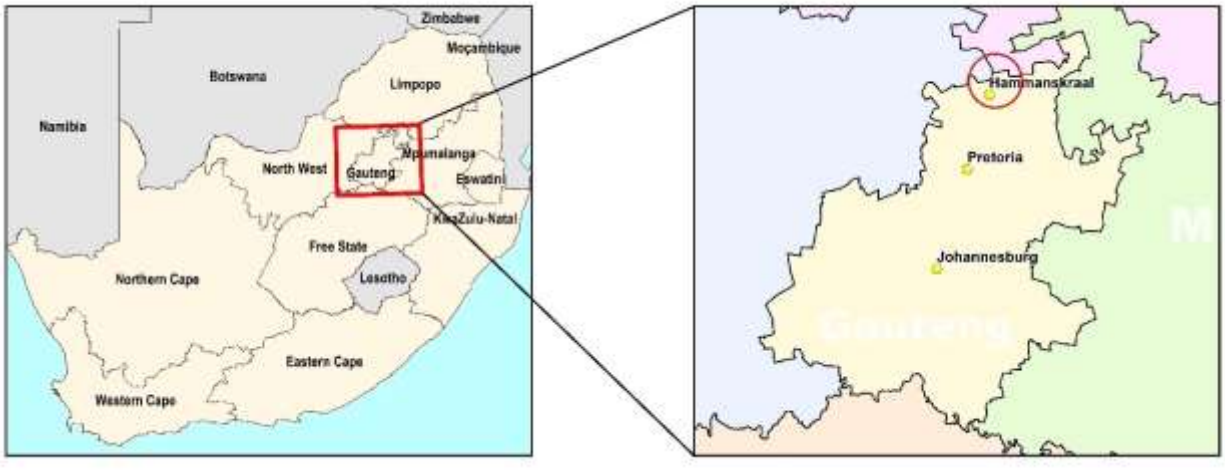

Figure 14: Maps showing the location of Hammanskraal township, in the northern part of Gauteng Province in South Africa. ***Source:*** *Developed by the Author*

A 2021 report by the Gauteng City-Region Observatory noted that Hammanskraal has some of the highest levels of poverty and inequality in the Gauteng province, with many residents living in informal settlements and struggling to access basic services. The report also highlighted the impact of the COVID-19 pandemic on the community, noting that many households experienced a decline in income and an increase in food insecurity (Gauteng City-Region Observatory, 2021). Gauteng was chosen for this study due to the need to advance knowledge towards improving water

management in the area and to inform policymakers with information they need to make informed decisions to improve water governance towards improving the quality of life of its residents.

The population in Hammanskraal comprises equal numbers of men and women with the average age being between 15 and 64 (StatsSA, 2011). Just 35% of the population in Hammanskraal has completed grade 12/matriculation, with only 10.3% of the population obtaining a higher educational qualification. Racially, Hammanskraal comprises of 98.3% blacks, 0.4% coloured, 0.29% Indian or Asian and 0.4% white individuals. In addition, only 51% of the population has flushing toilets that are connected to the municipality sewage system and 30.3% utilise pit latrine toilets - demonstrating the water challenges in the area. According to Swanepoel et al. (2005), Hammanskraal has a poor water supply both indoors and onsite.

The study involved game lodges around Dinokeng Game Reserve (DGR) see Fig. 14, which is located close to Hammanksraal in the northern part of Gauteng with a small section overlapping with the south of the adjacent Limpopo Province (25.370634° S, 28.379726° E). The DGR landscape offers a wildlife sanctuary of mixed Bushveld, Kalahari thornveld, and sourish mixed Bushveld as the main vegetation types (Yiu, 2015). A few of the game lodges are outside the core of DGR.

The inclusion of graded game lodges in the study area see Fig. 14 should highlight possible variation in the adoption of water efficiency measures due to high-water demand and water sustainability. Given the water use by the game lodges close to Hammanskraal (25 graded lodges) as indicated in Fig. 15, 60% of game lodges are 4-star graded while of the remaining, 20% each are 3- and 4-star graded game lodges. The hydrocensus data from the Department of Water and Sanitation indicated that there are 6 boreholes close to the delimited study area (see Figure 14). More handheld ground water census analysis may be needed to confirm hydrological data within Hammanksraal.The areas in Hammankraal which will form part of this study include Mandela Village and Kekana Gardens Village. Mandela Village was described by Pieterse (2012) as an informal settlement that has evolved into a formal township. Mandela Village and Kekana Gardens Village are both the closest to the DGR and water protests over lack of infrastructural development for water have in the past ensued from residents in those areas. Given the water challenges faced by

Hammanksraal residents, it is important to determine if there has been any water competition with the nearby game lodges.

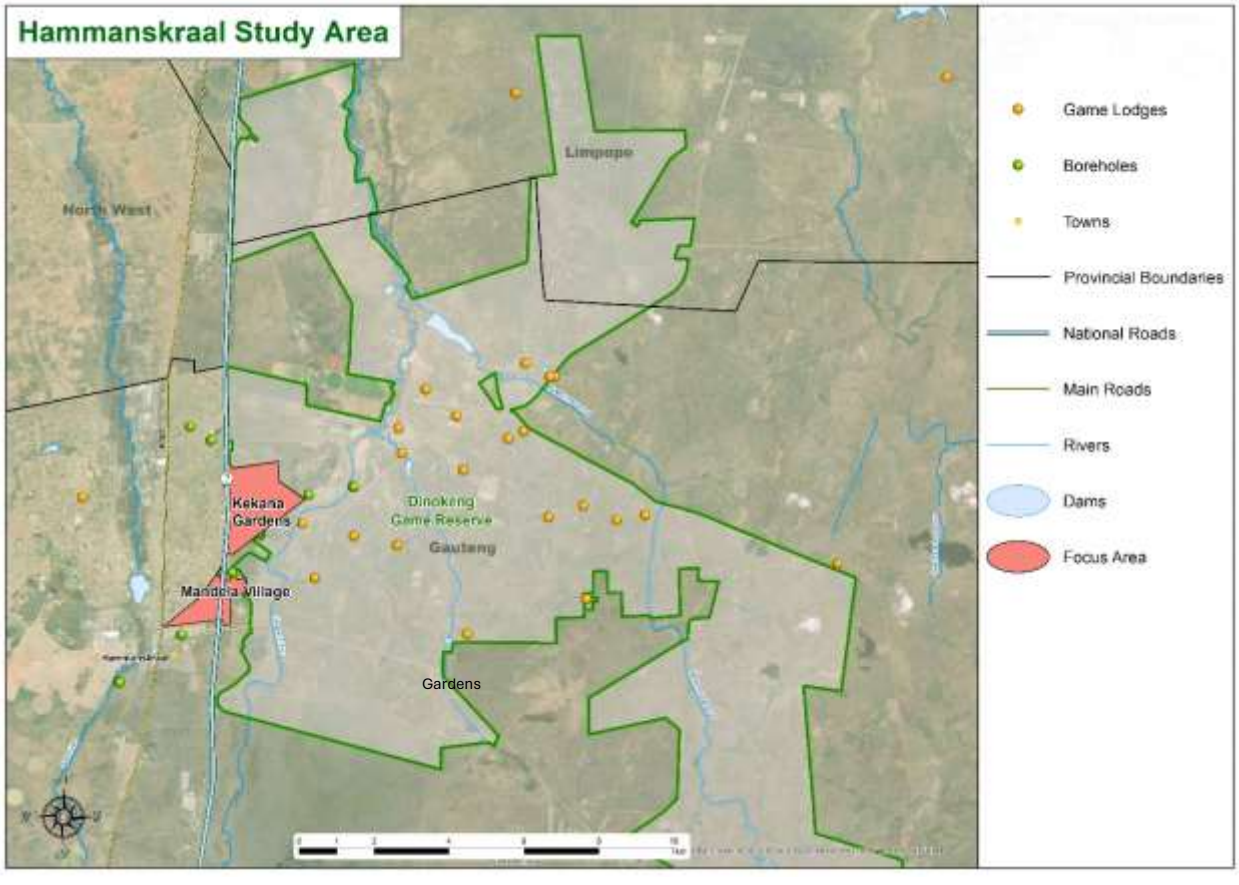

Figure 15: Map of the study focus area indicating Mandela Village, Kekana Gardens and the graded game lodges around Dinokeng Nature Reserve (DGR) and water sources. ***Source:*** *Developed by the Author*

In the past, the wettest months in the study area are from October to April and the driest months are from May to September, with an average annual rainfall of 674 mm (Yiu, 2015). In recent years Hammankraal has experienced several droughts. According to an article published by News24 in November 2019, Hammanskraal was among the areas in Gauteng Province that experienced water shortages due to drought conditions. The article stated that the region had been hit by a severe drought, and that water levels in the reservoirs had dropped significantly which had led to water shortages and restrictions since 2016. A report by the City of Tshwane Metropolitan Municipality in

August 2020 indicated that Hammanskraal was one of the areas that was severely affected by drought. The report stated that the water level in the Rooiwal Dam, which supplies water to Hammanskraal and other areas, was critically low. In a report published by the South African government in October 2020, Hammanskraal was listed as one of the areas that were experiencing water scarcity due to drought conditions. The report stated that the region had received below-average rainfall, which had led to a reduction in the water levels in the reservoirs and dams. In 2021, Hasmmanskraal again experienced a drought, with some areas facing a complete water shut-off. The report further stated that the city had implemented water rationing, and residents were urged to conserve water.

3.3 Methodological approach

A methodological approach or research design refers to the overall strategy that is used in research to respond to the research questions, as logically and unambiguously as possible (Creswell & Creswell, 2018). The research design is “the plan or strategy researchers use to answer the research question, which is underpinned by philosophy, methodology and methods” (Chun et al., 2019, p. 1). The research design encompasses the plan, structure, and organization of the research study, including the selection of research methods, data collection, and data analysis techniques (Sileyew, 2019). The choice of an appropriate methodological approach determines the lens through which phenomena are explored, offering unique insights that contribute to the understanding of complex and multifaceted issues (Tomaszewski et al., 2020). The directional flow of the arrows and the encompassing brackets illustrate in Figure 16 show the methods used in this study to interconnect and inform the philosophical underpinnings based on the theoretical foundations and assumptions behind their methods, ensuring that their approach aligns with the discipline's broader framework to examine the nature of knowledge and reality that the research assumes.

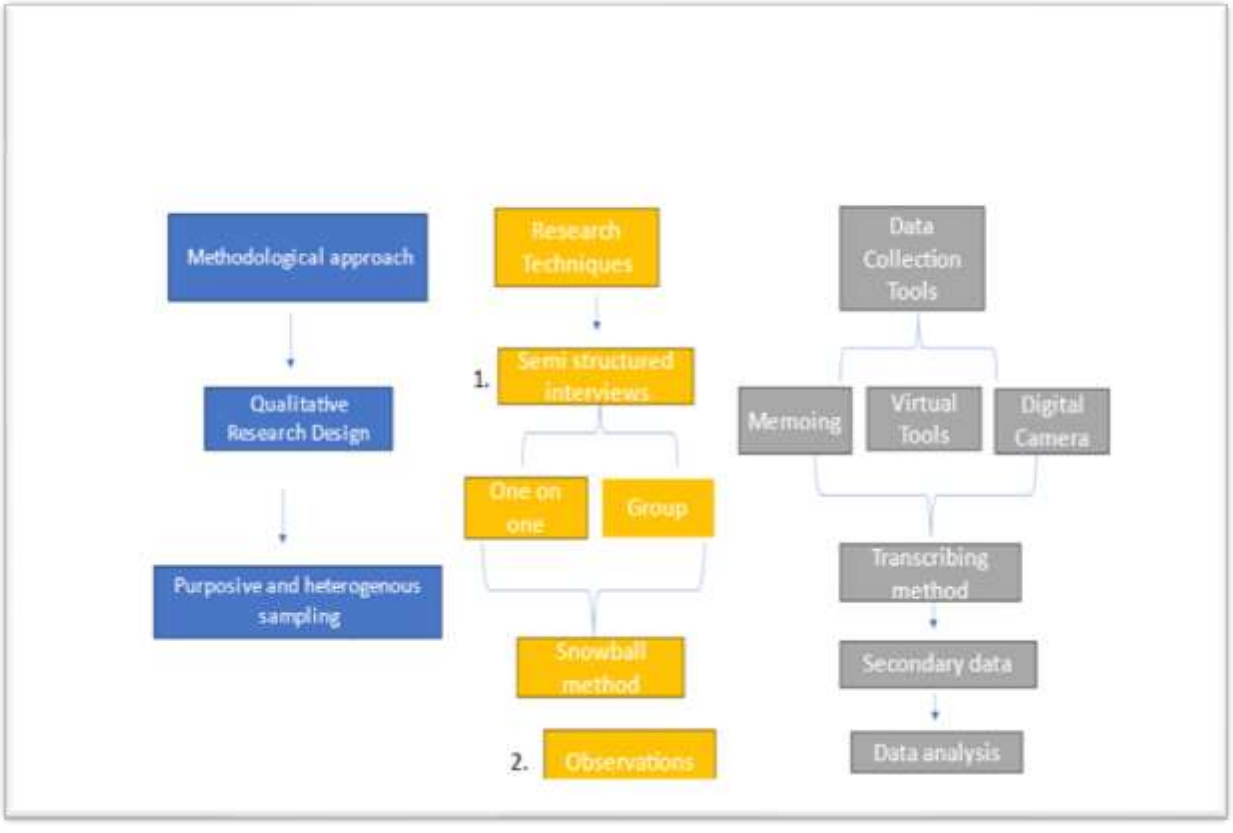

Figure 16: Overview of the research methodology followed in the study. ***Source:*** *Author*

In research, the choice of an appropriate methodological approach is crucial in shaping the inquiry process and generating meaningful insights (Tomaszewski et al., 2020). A methodological approach refers to the systematic structure in which research is conducted (Bernard, 2017). It involves a set of techniques that guide the process of gathering, analyzing, and interpreting data to answer a research question, to ensure reliability, and validity in research (Creswell, 2014). The methodological approach also involves choosing a suitable method that addresses the research objectives (Miles et al., 2014).

While quantitative research provides valuable numerical data, qualitative research offers a unique perspective by delving into the subjective experiences, meanings, and contextual nuances associated with various phenomena, focusing particularly on their role in uncovering rich and in-depth understandings (Sileyew, 2019). This research followed a qualitative research approach given that there was a need explore the complexities of human experiences, social interactions, and cultural

contexts that cannot be easily quantified or reduced to statistical measures. The adopted qualitative research approach emphasizes the need to understand the subjective perspectives, meanings, and interpretations of individuals and groups within their natural settings (Klevan & Grant, 2022). By adopting a qualitative approach, researchers gain the flexibility to explore the multifaceted dimensions of phenomena, allowing for a more comprehensive and holistic understanding of human experiences, social interactions, and cultural contexts (Mozersky et al., 2021). The selection of an appropriate approach sets the foundation for the research process, influencing data collection methods, analysis techniques, and the overall interpretation of findings.

3.3.1 Qualitative research design

A qualitative research approach is a method of inquiry that aims to explore and understand phenomena from a subjective and contextual perspective (Mozersky et al., 2021). The qualitative research approach often involves direct engagement with participants in their natural settings to gather in-depth information and capture the complexities of their experiences (Fusch & Ness, 2015). Qualitative research begins with open-ended research questions that seek to explore and understand the experiences, perspectives, or processes under investigation (O'Hara et al., 2023). Qualitative researchers employ various methods to collect data, including interviews, observations, focus groups, documents, and artifacts (Klevan & Grant, 2022). Qualitative research explores phenomena which may include variables that do not depend on numbers but rely on words for data analysis (Creswell, 2014). It involves collecting and analyzing non-numerical data such as words, images, or observations to uncover meanings, patterns, and insights.

Qualitative research is often used to explore complex social, cultural, and human experiences that cannot be easily quantified (Vears & Gillam, 2022) and so is valuable for exploring complex social phenomena, generating hypotheses, developing theories, and providing in-depth insights that complement quantitative approaches. The outcome of the qualitative research is that it produces results that can be understood even by individuals who are not trained in statistics. Tenny et al. (2021) stated that the qualitative research method is important in questions about the 'how', 'what', and 'why' of the researched phenomenon. Another strength of the qualitative research method is the ability to gather indepth participant's experiences, attitudes, and thoughts regarding the phenomena

of interest (Vears & Gillam, 2022; Sileyew, 2019). The qualitative research method aims to explore complex phenomena, gain insights into the social and cultural contexts, and generate rich, detailed descriptions and interpretations of human behavior and phenomena. Qualitative research reports are typically narrative and descriptive, presenting rich descriptions, quotes, and excerpts from the data.

The qualitative research method is generally based on the conviction that individuals who will participate in the specific study are engaged with the experiences and their encounters will inform the new findings into the study (Creswell, 2014). Due to the detailed answers provided in qualitative research, this method is time consuming but given the quality of information provided it is a useful method to obtain new insights into the study (Tenny et al., 2021). Qualitative data considers themes and patterns that do not need to be quantified to explain relationships that exist (Sileyew, 2019). In qualitative research, there is no fixed or absolute minimum sample size, as sample size is not determined by statistical power calculations like in quantitative research. Instead, sample size in qualitative research is typically guided by principles such as saturation, which refers to the point at which new data no longer yield significant new insights or themes, and the overall research design and research question(s) being addressed (Vears & Gillam, 2022). However, some researchers have provided guidelines and recommendations for qualitative sample sizes based on their experience and expertise.

In qualitative research reaching data saturation is generally considered an important criterion for rigor and trustworthiness, as it helps ensure that the findings are based on a comprehensive and in-depth analysis of the data. According to Guest et al. (2006), data saturation can be identified when new data no longer generate new codes or themes, or when the themes become repetitive and redundant. Similarly, Fusch and Ness (2015) suggest that data saturation can be reached when the new data only confirm the existing codes and themes and do not provide new information. There is no fixed rule for determining when data saturation has been reached, as it depends on various factors, such as the research question, the scope of the study, the data collection method, and the sample size. However, researchers can use different strategies to identify when data saturation has been achieved. Data saturation refers to the point where no emergent of new themes, findings, concepts, or problems are being observed from the data (Sim et al, 2018). Hence, the concept of saturation is found primarily at the level of data collection, separating it from broader methods of

analysis, and thereby from grounded theory as well (Chun et al., 2019). Therefore, using the qualitative research approach was better suited for this study as it allowed the researcher to interact with different participants to gather information on the efficiency of water governance strategies for residents in Hammankraal and the neighbouring 3 - 5 star graded game lodges around Dinokeng Game Reserve, South Africa.

3.3.2 Population and sampling

A population refers to the entire group of individuals, objects, or events about whom a researcher wishes to study or draw conclusions (Stratton, 2021). It represents the complete set of elements with specific characteristics or attributes of interest. Sampling on the other hand, is the process of selecting a subset, or a sample, from the population for the purpose of studying and making inferences about the population. Since it is often impractical or impossible to study an entire population, sampling allows researchers to gather information from a smaller group and generalize about the larger population. Sampling refers to the selection of participants or sources of data that can provide rich and diverse data to help to explore and understand a research question or phenomenon of interest (Berndt, 2020). The choice of sampling method depends on various factors such as available resources, the research objectives, and the nature of the population being studied.

The individuals or units chosen for the sample should ideally represent the population accurately (Thacker, 2020). The goal is to select a sample that is both representative of the population and suitable for drawing valid conclusions. Ensuring the rigor and trustworthiness of qualitative research is crucial (Mhasawade et al., 2021). Researchers employ strategies such as prolonged engagement with participants, triangulation (using multiple data sources or methods), peer debriefing, member checking (validating findings with participants), and maintaining an audit trail to enhance the credibility and dependability of the research (Berndt, 2020). Researchers often use thick descriptions and provide detailed context to help readers understand the nuances of the findings. The research report may also include conceptual frameworks or theoretical perspectives that emerge from the data. The goal is to select a sample that is both representative of the population and suitable for drawing valid conclusions.

Several techniques were used in this study to guarantee the authenticity, reliability, credibility, and validity of the results. A crucial technique was triangulation, which involved using a variety of data sources, including observations, interviews, and document analysis, to cross-verify results and improve their validity and reliability. Different members were involved to examine and review the correctness of the results as part of the member checking process. This procedure makes sure that the conclusions and interpretations made from the data appropriately represent the opinions and experiences of the participants. This kind of participant engagement gives the study more legitimacy and reliability. By pointing out any errors or misinterpretations, participants help researchers improve and validate their results. An audit trail was kept to publicly record the research procedure, guaranteeing dependability, and promoting replication by offering. Peer debriefing with colleagues or subject-matter experts also provided insightful criticism on the technique and results, boosting the study's validity and rigor by pointing out potential biases and offering different interpretations. When combined, these tactics guaranteed a trustworthy, and legitimate research procedure.

3.3.2.1 Purposive and heterogenous sampling

Considering the nature of this study and the objectives set, the study employed a purposive sampling method to select the target population, who have defining characteristics, to participate in the study. According to Birks and Mills (2015), using purposeful sampling allows a researcher to construct theory based on in-depth understanding rather than biased empirical generalizations which may disadvantage the research process. Purposive sampling, which is also known as subjective, judgmental, and selective sampling is a non-probability sampling method that can be used in qualitative and quantitative research to identify and select key individuals or groups of individuals who are proficient and well-informed with a particular phenomenon of interest (Creswell, 2014; Babbie, 2011). Purposive sampling considers willingness of members of the population to participate in the study, and the ability to express their experiences and opinions in an open manner (Zhi, 2014).

Purposive sampling, where participants are selected deliberately based on their ability to provide rich and diverse perspectives, and their relevance to the research questions is applied in qualitative research (Berndt, 2020). Sample sizes are generally smaller compared to quantitative studies, with an emphasis on depth of understanding rather than generalizability (McEwan, 2020). As part of this study, heterogeneous sampling, also known as stratified sampling, was used. Heterogenous sampling allows the researcher to obtain a representative of the population, and it can increase the generalizability of the findings to the larger population (Patton, 2015). This method aims to ensure that the sample is representative of the heterogeneity present in the population, and it allows for a more comprehensive understanding of the research topic (Cresswell, 2014). The researcher can divide the population of interest into different strata to ensure diversity and representativeness in the sample based on specific characteristics and then randomly select participants from each stratum. Participation in the study depended on the ability to communicate opinions and willingness to participate.

For this study, stratified sampling was applied mainly in collecting data from residents from Kekana and Mandela villages because they have running water, flushable toilets, and home gardens, so they could comment on water governance. The procedure simply involved dividing the sample into parts to be a representative sample where data could be collected from different sites of the area in similar proportions based on the street size (Buntin, 2020). For this study the characteristics used included the geographic location by selecting Mandela Village and Kekana Gardens and varied age groups. The advantage of stratification is reduced costs of obtaining data and limits bias by considering the population's demographic composition (Campbell et al., 2020). Stratified sampling allowed the researcher to obtain representativeness of the participants in the selected areas by randomly selecting within each stratum. This approach enhances the representativeness of the sample, allowing for more accurate and generalizable findings about the entire community (Buntin, 2020). Stratified sampling captures the diversity within a population, helping to identify the unique needs and issues of each subgroup. This approach leads to more customized and effective community interventions. The age criteria for participants was the age of 18 years and above for reliable knowledge on water governance in the area. Stratified sampling was applied to increase the accuracy of information collected from the population (Campbell et al., 2020).

To determine the effectiveness of national laws, regulations and policies to address water efficiency and the effectiveness of government enforcement to enable good water governance, the key informants for this study included municipal workers from the City of Tshwane, who were involved with Water and Sanitation Infrastructure Planning, the National Department of Water and Sanitation, under Directorate Water Use Efficiency that specialises in Water Conservation and Water Demand Management, the National Tourism Department, the directorate involved with Green Tourism Incentive Programme. To examine the extent of adoption and implementation of water efficiency measures for the 3-5-star game lodges and residents in the study area, study participants included game lodge managers, maintenance staff, community leaders and residents from Mandela Village and Kekana Gardens. To identify the water governance strategies that were effective in 3-5-star graded game lodges required the participation of municipal workers and residents. To examine governance and collaboration efforts by different stakeholders (government, non-governmental sectors) involved in the appropriation of policies on water governance for game lodge and surrounding residents in the study area, organisations such as the TGCSA and water consultants were also involved.

Table 7: Details of the one-on-one and group semi-structured interviewees. ***Source:*** *Author*

Participant	Place of interview	Type of Interview	Type of informant	Population group	Date of interview	Gender	Company
MV1	Mandela Village	Individual	Community member	Adult	13 May 2022	Female	Resident
MV2	Mandela Village	Individual	Community member	Adult	13 May 2022	Female	Resident
MV3	Mandela Village	Individual	Community member	Adult	13 May 2022	Male	Resident
MV4	Mandela Village	Individual	Community member	Adult	13 May 2022	Female	Resident
MV5	Mandela Village	Individual	Community member	Adult	13 May 2022	Female	Resident
MV6	Mandela Village	Individual	Community member	Adult	14 May 2022	Female	Resident
MV7	Mandela Village	Individual	Community member	Adult	14 May 2022	Female	Resident
MV8	Mandela Village	Individual	Community member	Adult	14 May 2022	Male	Resident
MV9	Mandela	Individual	Community	Adult	14 May 2022	Female	Resident

Participant	Place of interview	Type of Interview	Type of informant	Population group	Date of interview	Gender	Company
	Village		member				
MV10	Mandela Village	Individual	Community member	Adult	14 May 2022	Male	Resident
MV11	Mandela Village	Individual	Community member	Adult	14 May 2022	Male	Resident
MV12	Mandela Village	Individual	Community member	Adult	14 May 2022	Male	Resident
MV13	Mandela Village	Individual	Community member	Adult	15 May 2022	Female	Resident
MV14	Mandela Village	Individual	Community member	Youth	15 May 2022	Male	Resident
MV15	Mandela Village	Individual	Community member	Youth	15 May 2022	Male	Resident
MV16	Mandela Village	Individual	Community member	Adult	15 May 2022	Male	Resident
MV17	Mandela Village	Individual	Community member	Adult	15 May 2022	Female	Resident
MV18	Mandela Village	Individual	Community member	Adult	15 May 2022	Male	Resident
MV19	Mandela Village	Individual	Community member	Youth	15 May 2022	Male	Resident
MV20	Mandela Village	Individual	Community member	Youth	15 May 2022	Male	Resident
KG1	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Female	Resident
KG2	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Female	Resident
KG3	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Male	Resident
KG4	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Female	Resident
KG5	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Female	Resident
KG6	Kekana Gardens	Individual	Community member	Adult	20 May 2022	Female	Resident
KG7	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG8	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG9	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Male	Resident
KG10	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG11	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG12	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident

Participant	Place of interview	Type of Interview	Type of informant	Population group	Date of interview	Gender	Company
KG13	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG14	Kekana Gardens	Individual	Community member	Youth	21 May 2022	Male	Resident
KG15	Kekana Gardens	Individual	Community member	Adult	21 May 2022	Female	Resident
KG16	Kekana Gardens	Individual	Community member	Adult	22 May 2022	Female	Resident
KG17	Kekana Gardens	Individual	Community member	Adult	22 May 2022	Female	Resident
KG18	Kekana Gardens	Individual	Community member	Adult	22 May 2022	Male	Resident
KG19	Kekana Gardens	Individual	Community member	Adult	22 May 2022	Female	Resident
KG20	Kekana Gardens	Individual	Community member	Adult	22 May 2022	Male	Resident
Participant A	MsTeams	Individual	Private	Adult	05 April 2022	Male	Water consultan
Participant B	MsTeams	Individual	Private	Adult	22 July 2022	Male	Water Boards
Participant C	MsTeams	Individual	Private	Adult	06 April 2022	Male	TGSA
Participant D	MsTeams	Individual	Local government	Adult	16 September 202	Female	Tshwane Municipality
Participant E	MsTeams	Group	Government	Adult	19 July 2022	Female	Water and Sanitation
Participant F	MsTeams	Group	Government	Adult	19 July 2022	Female	Water and Sanitation
Participant G	MsTeams	Group	Government	Adult	19 July 2022	Male	Water and Sanitation
Participant H	MsTeams	Group	Government	Adult	28 July 2022	Male	Tourism
Participant I	MsTeams	Group	Government	Adult	28 July 2022	Female	Tourism
GL1	Dinokeng Nature Reserve	Individual	Private	Adult	25 May 2022	Male	Game Lodge
GL2	Dinokeng Nature Reserve	Individual	Private	Adult	27 May 2022	Male	Game Lodge
GL3	Dinokeng Nature Reserve	Individual	Private	Adult	27 May 2022	Female	Game Lodge
GL4	Dinokeng Nature Reserve	Individual	Private	Adult	07 June 2022	Male	Game Lodge
GL5	Dinokeng Nature Reserve	Individual	Private	Adult	07 June 2022	Male	Game Lodge

3.3.3.1.2 Snowball method

Snowball sampling is a non-probability sampling method, which means that not every member in a population has an equal probability of being selected for a study (Bhardwaj, 2019). To select more participants in the study a snowball sampling technique was used. The selection for the snowball technique is informed by the fact that more participants could form part of the study from the initial subjects by virtue of knowledge on the subject, especially through referral to individuals who hold crucial information (Chambers et al., 2020). Based on the additional recruitment of participants in the study, snowball sampling is also referred to as chain-referral sampling, cold-calling, chain sampling and referral sampling as it allows researchers to reach subjects in a particular population that would otherwise be difficult to reach (Cohen & Arieli, 2011; Heckathorn, 2011; Sadler et al., 2010). For this reason, snowball sampling is often used as part of exploratory analysis in uncovering information of which they were previously unaware. It is important to keep the informants anonymous particularly for privacy. For this study, Water Boards were subsequently added as study interviewees because emerging views from residents of Hammanskraal repeatedly made mention of Magalies Water as a trustworthy water supplier who previously rendered the service to them.

3.3.3 Research techniques used for the study

A research technique refers to the specific methods, tools, or procedures that are used to collect, analyze, and interpret data in a research study (Bazen et al., 2021). Research techniques can vary depending on the nature of the study, the discipline or field of research, and the specific objectives (Elshater & Abusaada, 2022). Interviews allow researchers to explore complex issues, understand participants' perspectives, and delve into their experiences or beliefs. Researchers can also involve systematic observation and recording of phenomena in their natural settings (Ernst, 2019). Researchers observe and document behaviors, interactions, or events without intervening or manipulating variables. The selected techniques are crucial in acquiring reliable and valid information, and they provide a framework for conducting rigorous and credible research (Ernst, 2019). For this study, data collection involved semi structured interviews, observations, and secondary data based on the research question and the research objectives.

3.3.3.1 Semi-structured interviews

Primary data collection, where the researcher collects data directly from original sources, was done using semi structured interviews (Wishitemi et al., 2015). In a semi-structured interview, the interviewer has a list of pre-planned questions but is also free to explore topics more extensively and pose additional questions for deeper understanding. These questions act as a starting point for the conversation but allow for flexibility to explore additional areas of interest. Unlike structured interviews, semi-structured interviews provide room for open-ended responses, enabling participants to share their thoughts, experiences, and opinions in a more unrestricted manner. The advantage with the semi structured interview is that it allows the researcher to ask more detailed questions by asking for reasons, to explain their understandings, perspectives, and knowledge about a matter or topic in question, without restricting their recorded explanations (Stuckey, 2013).

In semi-structured interviews, it is important to use language that is clear, concise, and easy to understand and with which to engage (Ernst, 2019). The interview questions were mainly open-ended questions allowing respondents to express their opinion and ideas that could have easily been side-lined (Ernst, 2019). Leading questions were avoided to prevent influencing the interviewee's response which may not provide an accurate representation of their thoughts or experiences. Instead, open-ended questions were used that allowed the interviewee to share their thoughts and experiences in their own words. This approach facilitates a more conversational and interactive dynamic between the interviewer and interviewee, fostering a richer understanding of the topic under investigation. The semi-structured interview questions also enabled the researcher to uncover unexpected insights and delve into nuanced aspects that may not have been anticipated in the initial questioning. Questions also needed to be specific without ambinguity for a meaningful response. When needed, follow-up questions were used for further clarity. The semi-structured interview questions used in the study were sourced from previously conducted studies by Logan (2015) and Sucheran (2013). To improve study reliability, other questions were based on water governance aligned to South Africa’s legislative mandate. Using audio recoding device and taking notes allowed the researcher to record the interviews, which allows for accurate documentation and subsequent analysis of the data (Stuckey, 2013).

The questions were written in simplified English to ensure they could be easily understood, even by participants who not primary speakers of the language (Maurer et al., 2021). Cresswell (2014) noted that it is difficult to analyze open-ended questions statistically because the data must be reduced in some manner. It was up to the researcher's discretion to make sense of the open-ended responses, develop suitable categories and then code the categories for data analysis (Ernst, 2019). The duration of the interviews was minimized whenever possible, allowing between half-hour to a full hour to complete interviews and to avoid major time spent for the participants. Once the interviews were complete, researchers analyze the gathered information by identifying themes, patterns, and emerging insights to uncover rich qualitative data and generate meaningful findings.

Semi-structured interviews increased validity because they gave the interviewer an opportunity to probe and ask for clarifications on concepts whereas reliability depends on the consistency and rigour of the approach (Noble & Smith, 2015). For an instrument to be valid, it must be reliable. Jussah et al (2018) indicated that use of observations in a study can assist to triangulate the data. To ensure the validity and reliability of the instrument, the researcher first relied on existing peer-reviewed studies to inform the design and development of the questionnaire (Chambers et al., 2020). The study followed strategies by Noble and Smith (2015) which are stipulated in Table 8 below.

3.3.3.1.1 Drafting of semi-structured interview questions

Different, tailored, semi-structured interviews questions were developed for each group of participants (i.e., residents, private sector, public sector, game lodges) which had to be drafted considering the socio-economic status such as culture and economic standing of the participant. For example, the municipality and government officials had questions on national laws, regulations, and policies to address water efficiency and government enforcement to enable good water governance. There were questions on the water governance strategies that are effective for all informants. A final set of questions was on the governance and collaboration efforts by stakeholders from both government and non-governmental sectors involved in the appropriation of policies on water governance for game lodges and associated residents in the study area. The interview guiding questions were prepared by the researcher to ensure that the collected data was satisfactory for each

participant. The questions also dealt with the extent of the adoption of water efficiency measures that were implemented by the 3-5-star game lodges and surrounding residents in the study area.

To examine the efficiency of water governance strategies in 3-5-star graded game lodges and residential areas around the study area, the researcher interviewed various stakeholders. The formulated questions for interviews are attached for each stakeholder group (see Annexure C-I). The interviews were scheduled for the Department of Tourism, Department of Water and Sanitation, Tshwane Municipality officials, residents, Water boards, Water Consultants and TGCSA. The Community leaders/Counsellors, FEDHASA could not participate in the study due to their not responding to invitations to participate in the study interviews.

3.3.3.2 One-on-one (individual) interviews

A one-on-one interview is a specific type of interview in which a single interviewer conducts a conversation with a single respondent to gather rich, detailed data (Stofer, 2019). The main purpose of a one-on-one interview is to gather information about the respondent's experiences on a particular subject. In a one-on-one interview, the interviewer and the respondent sit face-to-face and engage in a structured conversation (Mazar et al., 2019). The interviewer typically asks a series of questions while actively listening to the responses. The interview can be conducted in person or virtually. The interviewer concludes the interview by thanking the respondent for their time.

After arranging visits, one-on-one interviews were scheduled mainly with participants from game lodges and the residents. Virtual one-on-one interviews were conducted with officials from the City of Tshwane, TGCSA, and with water consultants and waterboards. Considering Covid 19 regulations, direct one-on-one interviews risked spread of the virus and the researcher had to adhere to the recommendations outlined by the university (Annexure B). Only one interview was arranged for each informant of different groups. For residents in Hammanskraal, one-on-one interviews allowed residents to comment on water governance and share their experiences, including issues of running water and water use such as flushing toilets and other water-related questions. While other residents were welcoming, some residences rejected participation in the study as they were very emotional because the subject of water management highly affected their wellbeing. On the other

hand, the elderly residents in Mandela Village and Kekana Gardens, Hammanskraal were apathetic and did not provide elaborate answers on the experiences they had shared. This contrasted with concept of old people being "the library" as they showed no enthusiasm. Research has also indicated challenges with the elderly who took part in studies although they expressed interest in the study but did not provide good answers and often overcome by emotions when expressing their experiences (Karthe et al., 2015; Rost et al., 2015). For one-on-one interviews, all lasted less than 30 minutes and were briefer for elderly participants who seemed to withdraw and to prefer not to provide detailed answers.

Table 7 indicates that a semi-structured interview serves as a tool for systematically recording and analyzing the data collected during interviews. The table typically includes several columns that capture different aspects of the interview data. There are different columns that capture details about the interview participants, such as their names, ages, genders, location, interview date and other demographic information. The respondents from Hammankraal, areas such as Kekana Gardens (KG), Mandela Village (MV) and game lodges (GL), were named using codes and number for ease of identification given that there were more than 4 respondents from each group. This information helped to identify and differentiate between different interviewees in the data analysis process, as no real names were used, only pseudo names. The information in Table 7 can also be useful for tracking the context of the data and identifying any potential biases or patterns related to the interview location or timing.

A researcher should carefully consider the unique aspects of their study and use their judgment to determine an appropriate sample size that is likely to achieve data saturation and provide meaningful insights. For instance, Guest et al. (2006) suggested that in most cases, 12 interviews per homogeneous group or category are often sufficient to achieve data saturation, but the actual number of interviews needed may vary depending on factors such as research question complexity, data variability, and research context. On the other hand, Hagaman and Wutich (2017) suggested that interviews that are 16 or fewer were enough to identify common themes from relatively homogeneous groups or sites. Yet, larger sample size that range from 20 to 40 interviews provided data saturation and allowed themes to be identified. The researcher worked on the sample size of 20 for each residential area.

The researcher was interested in having interviews with participants from a 3-5 star graded game lodge to understand the paradigm under investigation. The sample size would be informed by the acceptance of each game lodge to participate in the study. However, not all establishments were open to research studies, a phenomenon that is consistent with the findings of Klynhans and Zhou (2012). Information from a travel platform, TripAdviser, indicated that there are currently 25 identifiable graded game lodges along the Dinokeng Nature Reserve. Hotel managers or staff from graded game lodges (3-5 star) were invited to form part of the qualitative study. The general managers or maintenance managers of the selected game lodges were contacted telephonically and informed about the purpose of the study and were requested to consider their participatation in the study. They were also requested to look out for an upcoming email for their consent to participate in the study. The managing body of the Dinokeng Nature Reserve also circulated the letter requesting participation of game lodge managers. As indicated in Annexure A, the covering letter indicated the objective of the study and the assurance of the participants' confidentiality and anonymity, and this was emailed to the respondents who were willing to participate. If the hotel manager or maintenance manager had agreed to participate in the study, a date and time for the interview was set, particularly during the off-peak season when they are not too busy. Overall, only 5 of the 25 game lodges agreed to participate in the study. This sample size was considered sufficient for several reasons. Firstly, qualitative research often focuses on depth rather than breadth, aiming to explore complex human experiences in rich detail (Patton, 2002). The participation of these five lodges provided a diverse range of perspectives and operational contexts, ensuring a comprehensive understanding of water governance and efficiency strategies. Additionally, the selected lodges were representative of the broader population in terms of size, location, and service offerings, allowing the findings to be generalized to some extent. The insights gained from these participants were robust enough to yield valuable and meaningful data for analysis, contributing significantly to the study's objectives.

3.3.3.3 Group interviews

A group interview involves multiple participants, typically between 3 and 10, who are asked the same set of questions (Ewing et al., 2021). Group interviews typically involve a researcher as a

moderator leading a discussion among a group of participants, who are selected based on their relevance to the research topic. Participants are usually recruited through purposive sampling, which involves selecting individuals who have knowledge, experience, or expertise relevant to the research question (Huang et al., 2020). This type of interview is used when the researcher wants to explore group dynamics and gain insights into how individuals interact with each other.

Group interviews can be conducted in person, online or over the phone, and can last anytime from thirty minutes to several hours (O'Sullivan et al., 2015). During the group interview, the moderator will ask open-ended questions and encourage participants to share their opinions and experiences. The moderator will also facilitate discussion among the group members, encouraging them to respond to each others' comments and build upon each others' ideas. Group interviews are often recorded, and the data transcribed and analyzed using qualitative data analysis techniques such as thematic analysis or discourse analysis (Krueger & Casey, 2014). The data analysis aims to identify key themes or patterns in the data and to explore the social dynamics within the group. However, group interviews also have their limitations. For instance, group dynamics can influence individual responses, and some participants may be reluctant to speak up or may dominate the discussion. The quality of the data gathered can also depend on the skills of the researcher as a moderator and the level of trust and rapport established between the participants and the researcher.

Table 8: Strategies to enhance the credibility of qualitative research. ***Source:*** *Noble (2015)*

Truth value	‣ Representativeness of the findings in relation to the phenomena: – The sample of informants and a willingness to share their experiences in depth and over time enabled clarification of findings as an ongoing process. – Semistructured audio recorded interviews allow for repeated revisiting of the data to check emerging themes. ‣ Reflexivity and reflection on own perspectives: – Reflective journal maintained, and decisions documented.
Consistency/neutrality	‣ Achieving auditability: – Emerging themes discussed openly with research team members who had palliative and qualitative research expertise where assumptions could be challenged, and consensus reached. - Establishing a comparison case/seeking out similarities and differences across accounts to ensure different perspectives are represented. – Transparent and clear description of the research process from initial outline, through the development of the methods and reporting of findings. - maintaining a research diary documenting challenges and issues assisted in maintaining cohesion between the study's aim, design, and methods. - Meticulous record keeping, ensuring a clear decision trail and consistent and transparent interpretation of data.
Applicability	‣ Application of findings to other contexts: - Accounting for personal biases which may have influenced findings. - Acknowledging biases in sampling and ongoing critical reflection of methods to ensure sufficient depth and relevance of data collection and analysis. - Demonstrating clarity in terms of thought processes during data analysis and subsequent interpretations3 - Including rich and thick verbatim descriptions of participants' accounts to support findings. -Rich detail of context, facilitates the evaluation of study conclusions

The national departments such as the Department of Tourism and the Department of Water and Sanitation both, in turn. provided the researcher with group interviews where there were more than two participants at a time. The benefits of the group interviews were that it gave the researcher an opportunity to get varied elaborated opinions from participants but also any missing gaps were filled in by the other participant. The individual and group interviews were very formal, but the senior participants seemed to take over and the researcher had to probe answers from other junior participants to contribute to the interaction. The group interviews lasted longer, close to 60 minutes, as compared to individual interviews which lasted, at most, 30 minutes. Published research indicated that group interviews lasted longer, between 50 and 70 minutes (Jeong & So, 2020).

3.3.3.4 Observations

In research, observations refer to the systematic gathering and recording of data by directly observing phenomena, events, behaviors, or processes (Natow, 2020). Observations are a fundamental research method to provide valuable insights into the characteristics, patterns, and dynamics of the observed subject. Observations play a significant role in generating empirical evidence, providing a foundation for further analysis, and contributing to the advancement of knowledge in research (Nassaji, 2020). In addition, observations provide a detailed account of the observed phenomena, including behaviors, interactions, and other relevant characteristics and thereby help researchers understand the reasons behind certain behavior or occurrences. Observations can be used to explore new areas of research or generate hypotheses for further investigation (Lofland et al., 2022). They allow researchers to validate or test existing theories and hypotheses. For qualitative inquiries to understand the dynamics on water governance and water efficiency strategies in 3-5 star graded game lodges and associated residential beneficiation included observations.

Observations in research provide important references that support research findings and enhance the credibility and validity of research as they strengthen the validity of their observations also known as triangulation to compare and cross-reference with other data sources (Creswell, 2014). These references can come from primary observations, published observations, historical observations, comparative observations, or expert observations, and can be used to provide evidence, context, and insights into the phenomenon being studied (Fraenkel et al., 2019). In

addition, observations can provide insights into past events or patterns and can be used to contextualize and support research findings. Observations can be noted down and some captured using a camera to highlight issues. Pertaining to the current study, several notable observations were made to highlight water governance challenges.

One of the primary challenges in water governance is the scarcity of water resources. Observations may reveal reduced water availability, decreasing groundwater levels, and diminished surface water supplies. This scarcity can lead to conflict between different water users such as households and industries. Observations could also indicate the presence of poor water quality, characterized by untreated sewage, which could lead to health issues, including waterborne diseases, affecting the local population. Water governance challenges often result in inequitable access to water resources and lack of effective regulations which creates a governance gap and contributes to unsustainable use of water resources. Observations may reveal disparities in access between different socio-economic groups, with marginalized communities or rural areas facing limited access to clean and safe water. This can lead to social and economic inequalities. Insufficient infrastructure hampers the efficient and equitable allocation of water resources.

Observations might also indicate a lack of coordination and cooperation between relevant institutions responsible for water governance. This includes government agencies, water utilities, community organizations and other stakeholders. Weak institutional frameworks can result in fragmented decision-making processes and hinder effective water governance. Observations might reveal the adaptive strategies towards the impact of climate change through adoption of infrastructure for adequate water storage. Another observation may be the limited involvement of local communities and other stakeholders in water governance processes leading to to a lack of awareness, participation, and ownership, impeding the development of sustainable and inclusive water management solutions. Observations may further reveal unsustainable water management practices, such as over-extraction of groundwater, inefficient irrigation techniques, or inadequate water conservation measures. These practices can lead to resource depletion, competition arising from competing water demands, environmental degradation, and long-term water insecurity. These observations will collectively illustrate the multifaceted challenges faced in areas with water governance issues and provide insights into the areas that require attention and intervention to achieve sustainable water management.

3.3.4 Data collection tools

Data collection tools refer to methods used to gather and compile data from various sources for use in analysis, interpretations, and drawing conclusions (MacIntyre, 2012). Data collection tools allow the researcher to record conversations and gather qualitative data.

3.3.4.1 Digital recording

All semi-structured interviews needed to be digitally recorded and later transcribed in detail. Digital recording of the semi-structured interviews provided direct quotes or evidence to support findings and support arguments in qualitative research. The researcher had to capture memos to make guided data collection. According to Harrell and Bradley (2009), while taking notes can be time-consuming and distracting, digital recordings are the best way to collect detailed information. MacIntyre (2012) claimed that this method ensures that all data collected remains in its original form, without changing information provided by the informants which could create biased results. Markle et al. (2011) argued that qualitative researchers are continually changing their methods as technology improves, allowing for data to be collected, analysed, and presented in novel or other narrative ways and to gain a stronger sense of authenticity or reflection of participants' perspectives.

3.3.4.2 Digital camera

Photographs provide a valuable and versatile tool for researchers to capture and communicate research data. There are several benefits of taking photos in research studies as they provide visual documentation of the research subject, setting, and context (Cardellini, 2017). They allow researchers to capture data that may not be easily captured through written notes or observations alone. Photos can help verify the accuracy of the data collected and can be used as evidence to support the observations and conclusions made by the researcher. Photos help researchers recall and remember details that may be forgotten or overlooked when relying solely on written notes (Cardellini, 2017). They provide a visual reminder of the research subject and context. Photos can be used to communicate research findings to a wider audience as they can be included in presentations, reports, and publications to illustrate the research subject and context. Photos can be used to compare changes or differences over time. They allow researchers to track changes in the

research subject, setting, or context over time. The researcher used the mobile handset to capture the researcher's attention which may be useful to analyse. Thus, pictures evoke deeper parts of human consciousness than can words; exchanges supported by words alone utilize less of the brain capability than exchanges during which the brain is processing images. Photos need to be described and be referenced in the text (Basil, 2011). Photographs should not include human images that allow recognition of the individuals. In addition, all the recordings and photos have been safely stored in a password-protected computer and will be safeguarded for five years.

3.3.4.3 Virtual tools

The researcher used Microsoft Teams (MS Teams), a virtual platform that can be used to conduct interviews as opposed to the use of telephones. Most formal institutions such as government particularly use the MS Team tool for their meetings due to the connection to the internet using laptops. In the consent letter (Annexure A), informants were informed about the option of using the MS Teams as opposed to face-to-face interviews. The researcher indicated on the consent letter that participants in the study would be consenting to use virtual tools for interviews with clear stipulations that their faces would not be used/shown and no informant was requested to show their faces. Microsoft Teams as a tool is easy to use, cost effective, offers security options only allowing relevant people to participate and has data management features which enable the researcher to code and save the interviews (Archibald, 2019). For this study, five virtual interviews were conducted through MS Teams with officials from the Department of Water and Sanitation, the Department of Tourism, TGCSA, Tshwane Municipality and the Waterboards.

3.3.4.4 Memoing

Memoing, also known as summarization or note-taking is a logical write up of ideas, notes, observations, and insights that the researcher learns from data and during data collection (Razaghi et al., 2020). Memoing typically involves paraphrasing and reorganizing information in a concise form, often using one's own words to capture the essence of the original content to create a condensed version of the original material. According to Thornberg (2012), memos allow the researcher to identify theoretically coded relationships to assist during data analysis. Memos do not

have to be in formal writing, but the researcher needs to be able to conceptualize the flow of ideas. A note pad or tablet can be used to memo ideas as they emerge and noted in a table format.

3.3.4.5 Transcribing

All interviews were recorded and subsequently transcribed. Recorded interviews needed to be converted from speech into a written document using the process of transcription. Transcribing qualitative data can be a meticulous process that requires careful attention to detail. Transcribing involved converting spoken recording from the semi structured interviews into a written form verbatim, without omitting or changing any of the original content. Confidentiality needed to be maintained by replacing real names with pseudonyms or other codes to protect the privacy and confidentiality of the participants (Matlala & Matlala, 2021).

Participants were switching between languages, which was then translated by a native speaker. Member checking was conducted to verify the accuracy of the translation and ensure that no information was lost in the process. According to Abfalter et al (2021) proficiency and adaptability in multiple languages, particularly indigenous ones, is crucial for interviews and understanding complex dynamics in local studies. Transcribing the interviews played a crucial role in understanding water management challenges, governance structures, and stakeholder perspectives.

Cross-referencing with original notes was helpful to identify any discrepancies and ensure that the transcribed data are an accurate representation of the original qualitative data. A transcription format was selected to allow verbatim transcription (word-for-word) and edited transcription (cleaned up for readability). Additionally, audio recordings of interviews were transcribed and thematically analyzed to address research questions related to water governance. The voice recordings and virtual semi-structured interviews were transcribed using a voice memo tool which allowed the recording to correspond with the pseudonyms or codes.

According to Belsky (2004) transcribing can require up to six hours for each recorded hour. When transcribing, it was important to accurately capture spoken words and convert them into written text. The headsets or speakers needed to be audible to understand the words in the

recording. For specific respondents, certain phrases of the spoken words were captured to confirm unfamiliar phrases. The transcription was edited for accuracy to match the original recording as closely as possible.

3.3.5 The use of secondary data

Secondary data is used to supplement primary data or to conduct analyses without collecting new data (Ruggiano & Perry, 2019). It is published data, not original data, of the research at hand which involves collecting data from existing sources, such as published reports, databases, online resources, and previously conducted research studies (Yin, 2018). Secondary data can be used for comparative analysis, comparing data from different sources, to identify patterns, differences, or similarities from historical information that is essential to address the research question (see Table 9).

Secondary data is information that has been previously gathered and analyzed by someone other than the current researcher for a different purpose. It can be found in various forms, such as published literature, reports, datasets, and other pre-existing sources (Booth et al., 2012). Secondary data can also be a valuable resource for researchers providing timesaving, cost-effective access to existing data. The additional advantage of using secondary data is being able to get information from different sources. However, secondary data also have limitations that need to be considered when using it in research or analysis, and researchers should carefully evaluate the quality, relevance, reliability, and context of the secondary data before drawing conclusions or making recommendations based on it.

Researchers can leverage existing studies to build upon or critique existing theories. Government Reports, annual reports and presentations can also provide valuable information offering researchers the opportunity to analyze large datasets without the need for primary data collection (Hair et al., 2018). Social media platforms offer a rich source of secondary data for researchers studying online behavior, sentiments, and trends. Secondary data is often more time and cost-effective compared to collecting primary data (Bryman, 2016). The reliability and validity of secondary data depend on the quality of the original source and may not perfectly align with the specific research question.

Researchers have little control over the design and collection methods used in the original data gathering (Booth et al., 2012). The use of secondary data remains a powerful and efficient tool that can be used to address research questions.

Table 9: List of different types of secondary data sources used in present study.

Type of source	Type of publication	Details	Publication Date
Government Data	• South African Government News Agency Report (SANews) • Gauteng Provincial Government Reports • Department of Tourism-current projects	• Water Quality and Monitoring Data • Annual Performance Plan-Dinokeng Projects 2021/2022 • Green_Tourism_Incentive_Programme	28 May 2023 and June 1, 2023 4 June 2023 2017
Municipality Data	• The City of Tshwane Municipality Newsroom	• Power point presentation - a briefing on the Municipality's water situation and the intergovernmental response plan • Media statements	19 November 2019 2023
Non-governmental organization	• Articles relating to water governance • Legal information and proposed measures • Community upliftment projects	• Greenpeace Africa • the Organisation Undoing Tax Abuse (OUTA) • the Environment	5 July 2022 2018 5 June 2023
Social Media Posts	• News reports	• Sunday Times • The Mail & Guardian	2023

Secondary data can be used to support existing theoris and to generate new knowledge. It is important that proper citing is given to avoid contravening ethical issues (Panchenko & Samovilova, 2020). For the current study, secondary data used included published news reports from different newspapers, the Tshwane Municipality, NGOs, agencies, and National government media statements relating to water supply in Hammanskraal, website information on the incentive programme under the National Department of Tourism and tourism related websites on data on water governance.

3.4 Data analysis

Data analysis, also known as content analysis, refers to creating meaningful insights from the mass of data collected in a study (Krippendorff, 2018; Coghlan & Brydon-Miller, 2014). Data analysis is the process of examining, cleaning, transforming, and interpreting data to extract useful information, support decision-making, and derive insights. In data analysis, various methods are employed to extract insights and understanding from diverse types of data, including text, images, audio, and video recordings. These methods aim to identify patterns, themes, and trends within the data to gain a deeper understanding of the content being analyzed (Vaismoradi et al., 2016; Mayring, 2014). Qualitative data analysis involves a systematic and iterative process of organizing, coding, categorizing, and interpreting the collected data (Mezmir, 2020; Williams & Moser, 2019). Researchers identify patterns, relationships, and themes within the data to generate insights and theories that are relevant to the research question.

3.4. 1 Technique for analysing the data

The grounded theory research design was chosen for this research because it is a qualitative research methodology that is based on the idea that theories should be "grounded" in the data collected from the field, even though it can also involve building upon preexisting theories or concepts (Chun et al., 2019). It emphasizes the importance of using inductive reasoning and iteratively developing theories through a process of constant comparison, data coding to categorize data. identifying patterns and themes and selecting additional data sources to further develop or validate emerging theories and analysis (Birks & Mills, 2015). In grounded theory, researchers

continue to collect and analyze data until the theories are fully developed and no new insights emerge, a state known as theoretical saturation.

Data analysis involves examining and interpreting data to derive insights, make predictions, and inform decision-making. The initial step in grounded theory requires purposive sampling for collection and generation of data (see Figure 17). Theoretical sampling then commences from the codes and categories developed from the first data set. Theoretical sampling is used to follow clues from the analysis, fill gaps, clarify uncertainties, and test interpretations as the study progresses. Importantly, theoretical sampling allows the researcher to decide which following data to collect as a theory emerges (Weed, 2017).

Coding is often a necessary part of data analysis. For the present study, coding was done manually using an Excel spreadsheet. The researcher had to develop a coding scheme based on research questions and data itself for categorisation (Weed, 2017). Coding is essential to the development of a grounded theory, and it occurs in stages (Chun et al., 2019). The researcher analysed initial data before any further data collection was undertaken for further data collection. According to Charmaz (2006) in grounded theory initial data analysis informs subsequent data collection to refine and develop emerging theories. For example, involving an official from the water board was informed by data presented by residents in Mandela Village and Kekana Gardens, highlighting specific water management issues that required expert input. *Initial coding* is the first step in the process of analyzing qualitative data to generate theory. This stage involves familiarization with data by thoroughly reviewing and becoming familiar with the data to be coded, including reading through the data multiple times, taking notes, and identifying patterns or themes (Creswell & Poth, 2018; Miles et al., 2014). This stage further helps to establish a comprehensive understanding of the data and sets the groundwork for the coding process. These codes are used to represent the meaning or essence of the data, and they serve as the building blocks for further analysis and theory development. Once the data is coded, it is analyzed to identify patterns or themes in the data. This involves summarizing the data by code, as well as comparing, and contrasting codes. The codes are typically short and descriptive, and they aim to capture the main ideas or meanings conveyed by the data. The constant comparative method was employed to facilitate the analysis of more abstract

concepts, allowing the researcher to continually compare data segments and refine emerging theories (Chun Tie et al., 2019).

Intermediate coding is then performed to define a central category, memoing for theoretical sensitivity, theoretical data saturation, and ongoing comparative analysis. By converting simple data into more abstract ideas, intermediate coding enables the theory to be inferred from the data. The primary data for analysis are responses that are verbatim or documented in the participant's own words. In this analytical phase, categories are reviewed to determine which ones—if any—can be incorporated into other categories. (Saldaña, 2016). This stage involves reviewing and refining the initial set of codes as the analysis progresses. This may involve collapsing similar codes, creating new codes, or revising existing codes based on emerging patterns or themes in the data. The use of secondary data assists the researcher with additional information for data analysis. This stage involves developing a coding framework used to systematically categorize and label the data based on existing theories or concepts.

Advanced coding is when concepts are reduced into highly interrelated conceptual terms as opposed to presenting themes to develop a more objective understanding of the study's subject matter based on the grounded theory research design (Neuendorf, 2017). This stage involves reading literature and subsequent integration for writing up of the theory.

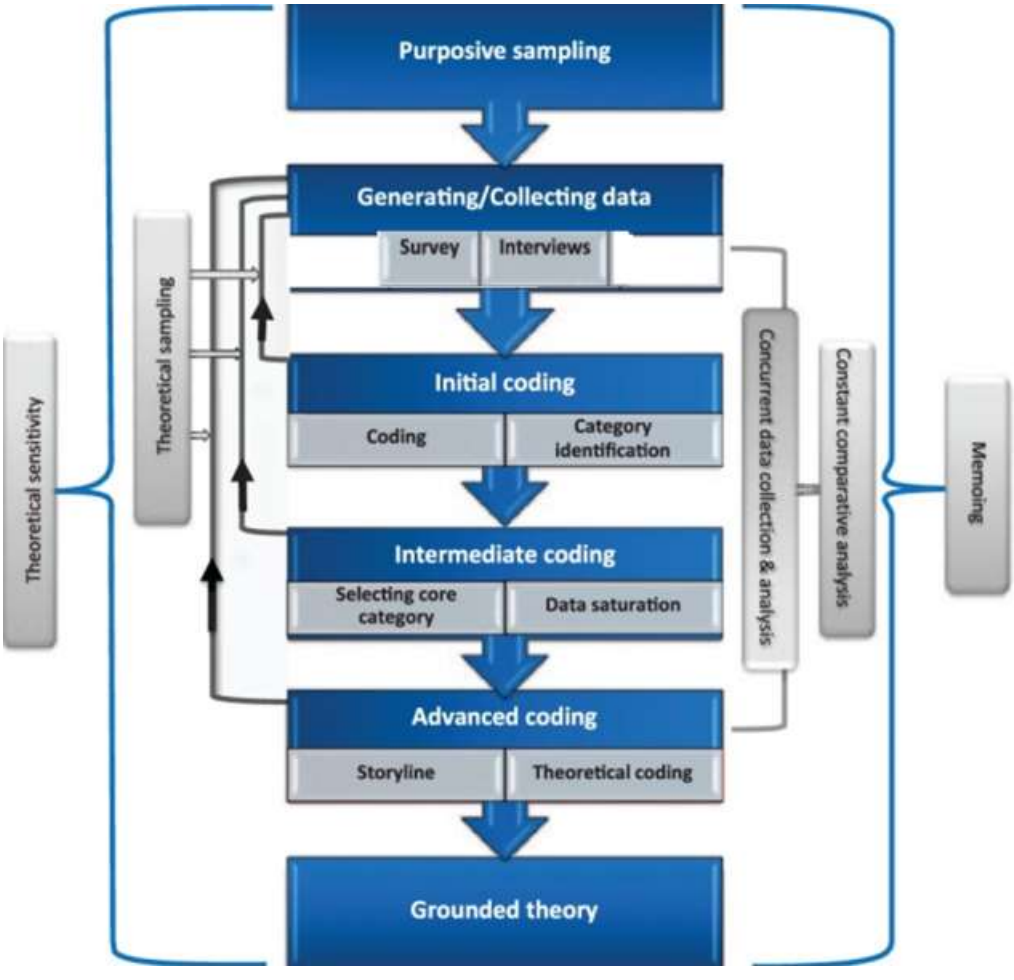

Figure 17: Sequential phases of the grounded theory process the study followed. ***Source:*** *Adapted from Chun et al. (2019)*

3.4.2 The selection and naming of recurring theme

The actual data analysis for this study involved using a table to outline and sort out statements and patterns that were given by participants. The verbal accounts were included to enable the researcher to accurately interpret the responses in each category. Furthermore, observations from photos taken were added according to the emerging themes for accurate interpretation. Following the transcription and coding of the semi-structured interviews, four main themes were determined to be present in this study. The four themes that emerged were as follows:

The first theme identified was *Water Quality Challenge*. The respondents from Mandela Village and Kekana Gardens indicated poor water quality from tankers and taps with both water sources noted as unhealthy for human consumption posing risks to human health. Respondents from both Mandela Village and Kekana Gardens highlighted unsanitary living conditions, negative health impacts on people and livestock due to poor water quality. The poor water quality highlighted a failure to implement governing regulations and procedures ensuring acceptable standards for potable water. Game lodges did not express any challenges with water quality.

The second theme identified was *Water Allocation and Distribution*. This considered equity and inclusiveness for human development and sustainable development goals, with a focus on water and sanitation supply. Water allocation and distribution play a pivotal role in ensuring equitable access to water. Water allocation refers to the process of assigning specific quantities of water to different users or sectors, while water distribution involves the actual transportation and delivery of water to those designated water users. Equity and inclusiveness are crucial considerations when addressing water supply challenges. When approaching water supply challenges, it is important to ensure equitable distribution and inclusiveness in planning, implementation, and management to meet the needs of all individuals and communities, particularly those who are marginalized or vulnerable. The process of allocating and distributing water involves intricate planning, policy-making, and efficient infrastructure to cater for different water users and to avoid water conflicts. The emerging theme assisted the researcher to identify challenges that residents faced regarding water and sanitation services. Inconsistent water supply was highlighted as a challenge for residents in Mandela Village and Kekana Gardens, coupled with inadequate financing for effective water governance. On the other hand, game lodges had systems in place for constant water supplies and to adapt to water shortages.

The third theme identified was *Stakeholder Engagement and Collaboration* with a focus on multilevel governance including leadership, responsiveness, participation, effectiveness, and efficiency for integrated water management. Multi-level governance by different institutions such as the DWS, NDT and the Tshwane Municipality gave account for transparency and accountability towards the need for effective water governance. The DWS facilitated technological research into water-saving devices and equipment. The NDT was involved in the incentive programe on water

efficiency measures for hotels such as game lodges, and the Tshwane Municipality had installed bulk water meters to assist in quantifying bulk water provision to the city towards effective water governance. The Department of Tourism noted that their incentive program had fewer applicants due to its voluntary basis and lack of an enforcement policy. The residents of Mandela Village and Kekana Gardens indicated that limited water access was due to poor municipality management and were not aware of community initiatives for water governance. Few of the respondents had water efficiency measures such as rainwater collection and reuse initiatives as adaptation strategies for water management.

The fourth theme identified was the *Environmental Impact and Risk Management* with a focus on legal and institutional frameworks on innovative technology, policy, collaboration, knowledge sharing, strategy alignment, and incentives for inclusive water governance. The respondents from the Game Lodges noted the importance of adhering to bylaws and applying for a water license to prevent illegal water abstraction. The TGCSA suggested the need for legal and institutional frameworks highlighting the need for an amendment bill by the Department of Water and Sanitation to improve water conservation within the hospitality industry.

Identifying themes allowed the researcher to make sense of complex data and generate insights that can contribute to valuable knowledge in e field.

3.5 Ethical Considerations

According to Resnik (2011), ethics refers to the morally accepted values or principles that govern or guide the behaviour of human beings so that they can differentiate between right and wrong. In research, ethics refers to important considerations that a researcher must consider assuring informants of their confidentiality to protect the participant if there are any potential threats, to accurately disclose the intent of the study and inform participants about the nature of the study before they willingly became involved in the study (Callahan & Hobbs, 2010). It is also important that participants are aware that their participation in the study is voluntary and there is no financial reward for participating. The study adheres to the Protection of Personal Information Act, also known as POPI Act or POPIA, which is a piece of legislation that serves as a guide to make sure

that all South African institutions appropriately gather, handle, store, and exchange the personal information of other entities. without improper or compromise use of the information collected (Kandeh et al., 2018). The participants were contacted via email or phone prior to collecting data to request their valuable participation in the study, except for residents, who were asked to participate on the day of data collection after municipality approval was obtained. The researcher disclosed that the participant's identity would be protected, and that the confidentiality of data would be guaranteed. The City of Tshwane was contacted after ethical clearance was obtained from the University of South Africa to grant permission to conduct research in the city and to request the participation of selected officials in the study. The Department of Tourism and the Department of Water and Sanitation were also be requested for permission to interview relevant personnel. A formal letter authorising the researcher was not given but authorisation was via email from the senior officials who planned for an interview schedule.

3.6 Limitations of the study

The limitations faced during data collection included the absence of water quality tests, necessitating future studies to conduct laboratory testing to assess water conditions accurately. Water governance involves complex and interconnected systems, understanding all the factors and variables influencing water management was challenging, and simplifying the complexity for research purposes may lead to oversights or incomplete analysis. Water governance is influenced by political priorities, stakeholder interests, and environmental conditions. The potential for certain study findings to quickly become outdated was acknowledged. Long-term monitoring and assessment were deemed essential for evaluating the effectiveness of water management and efficiency initiatives, although constraints in funding and time could restrict research scope, resulting in inadequate representation of long-term impacts.

The young adults proved more knowledgeable on water issues than older residents. It appeared that the older residents were more used to unresolved water management issues. The water subject angered many residents, and many had reasons not to participate in the study. Conducting home interviews proved hard in some households as the interviewer could not limit distractions e.g., crying babies, neighbours who interrupted the interview, etc. Wherever possible, interviews should

be conducted in areas free from distractions and loud music. In group interviews, questioning some participants was necessary as some did not voice their opinions. Almost all MS Teams interviews faced technical challenges which required more time. It was crucial to make side notes to remind participants of the last points discussed before moving forward. Access to Dinokeng Nature Reserve required a 4x4 vehicle as the terrain is gravel and rain made the road unpleasant. While the usual daily permit is costly to access Dinokeng Nature Reserve, obtaining permission to conduct the study was granted freely. Obtaining secondary data on water governance was challenging. The number of participants varied from the plan but the participants who formed part of the study gave the researcher insights on different aspects. Given the water management issues in Hammanksraal, findings of this study cannot be generalised as South Africa is home to a broad demographic spectrum. The findings and conclusions of the study may not be applicable or generalizable to other contexts and may not represent the entire country or capture the diversity of water governance practices within South Africa.

3.7 Conclusion

The research methodology section provided a comprehensive overview of the methods employed to collect, analyze, and interpret data. By outlining the research design, sampling strategy, data collection procedures, data analysis techniques, and ethical considerations, the research methodology section establishes the credibility and rigor of the research findings. It allows for transparency for future researchers to replicate or build upon the study. The preceding chapter will provide the details on the results from the research methodology.

CHAPTER 4 RESULTS

4.1 Introduction

This chapter presents the findings of this study resulting from an analysis and interpretation of the data collected through interviews, secondary data, and observations. This study focused on examining water governance and water efficiency strategies in 3-5 star graded game lodges at the Dinokeng Game Reserve in Gauteng, South Africa and associated resident beneficiation.

The findings indicated that most game lodges are situated in remote areas with little to no infrastructure, relying on rivers, dams, and boreholes as water sources. The 3-5-star game lodges were equipped with systems to ensure that they had enough water, including the use of alternative water sources. Considering water consumption, game lodges have extensive water uses resulting in high water consumption in comparison to residents. Most owners of the game lodges fully understood the importance of water efficiency measures and their potential benefits for both their business and the environment, but some could not invest in equipment, technology, or infrastructure due to concerns about the cost. None of the game lodge owners reported inconvenience associated with water efficiency measures. In some cases, other game lodge owners believed having no strict regulations or penalties in place contributed to excessive water usage. Overall, all game lodges were interested in implementing water efficiency measures as water resources may be scarce or vulnerable.

From a resident perspective, the study highlighted the significant consequences of water scarcity and water stress in the study area, which were primarily attributed to severe water shortages. Study results revealed disparities in access to clean and safe drinking water, with marginalized communities in rural areas suffering from inadequate infrastructure and service provision. In the Hammanksraal areas of Mandela Village and Kekana Gardens, the most contentious issue was around the impact of poor water provision for rural residents. Residents had increased their efforts to conserve water through reuse, reduction, and recycling because the municipality in their neighborhood did not provide sufficient water resources. Strategies for ensuring equitable access to clean water, especially for marginalized and vulnerable populations, are necessary towards water governance in promoting environmental sustainability.

The study also highlighted that a lack of government policy, in particular a lack of enforcing legislation, and a weak coalition of stakeholders to encourage compliance in reducing water use, prevented the adoption of water efficiency measures in game lodges. The role of policy frameworks and regulations in shaping water governance and their impact on water resource management was examined for enhancing water governance practices, including monitoring and infrastructure improvements. The lack of clear policies and enforcement of water measures can lead to various negative consequences beyond those mentioned earlier. In the absence of proper governance, issues such as water pollution, inefficient water use, inadequate infrastructure, and social inequalities in access may cause detrimental impacts on ecosystems, human health, and sustainable development. Without robust policies and effective enforcement, there is a risk of unregulated and unsustainable water practices that can compromise the overall well-being of communities and the environment. Although there are policies in place for residents, the inadequate water supply in the area highlighted the need for better coordinated planning from the government, including improved public participation and communication towards better service delivery, to improve the lives of residents and be effective towards water governance. Findings consistently pointed out the growing global water scarcity and stress due to factors such as population growth, climate change, and increased water demand from various sectors, including an increased water use in households.

According to the study, poor water governance results from corruption, a lack of efficient policies, inadequate monitoring and evaluation systems, a lack of water awareness, insufficient efforts to reduce water consumption, and inadequate water management, particularly for residents. Thus, findings demonstrated the importance of a reflexive water governance approach aimed at enhancing water efficiency and fostering sustainable water management in game lodges and related residential areas. Effective water governance often requires involving communities, NGOs, and stakeholders in decision-making processes to ensure inclusivity and transparency. The study further highlighted the need to explore the benefits and challenges of involving communities and other stakeholders in decision-making processes related to water governance. Findings emphasized the role of effective policies and regulations in shaping water governance, including the need for adaptive and integrated approaches to prevent any possible conflicts and competition between various water users.

Understanding the challenges and opportunities in water governance in the study area provides valuable insights into sustainable and equitable solutions to secure a thriving future for both humanity and the environment. The emerging themes leading from analysis of the study data were used to present the results in a meaningful and coherent manner. Sub-themes were particularly useful to structure and categorize information effectively to grasp the complexities of the research questions. Sections 4.2. to 4.5. present detailed findings of the study through identified themes and evidence through photos are provided as supporting evidence to the narrative of the findings.

The first theme on *Water Quality and Supply* is presented in section 4.2 and subthemes were then expanded from this, including water quality challenges in Mandela Village, Kekana Gardens and Game lodges, including water quality monitoring and control.

The second theme on *Water Allocation and Distribution* is presented in the following section 4.3 and includes sub-themes such as water allocation and distribution challenges by the Tshwane Municipality, the Department of Water and Sanitation, and by Water Boards in Kekana Gardens, Mandela Village and Game Lodges.

The third theme is *Stakeholder Engagement and Collaboration* presented in section 4.4 and subthemes involving stakeholder engagement and collaboration involving the Department of Water and Sanitation, the Department of Tourism, Water Management Institution, residents in Mandela Village and Kekana Gardens and Game Lodges.

The fourth theme involves *Environmental Impact and Risk Management* and is presented in section 4.5. Subthemes were expanded from this and included environmental impact and risk management in Mandela Village and Kekana Gardens associated with water governance. Details were also provided on health impacts associated with poor water quality, risks associated with water provision and sanitary infrastructure, as well as illegal water connections and the use of alternative water sources to mitigate water shortage risks. Further aspects of environmental impact and risk management associated with water governance in game lodges are presented. A final sub-theme described the use of alternative water sources in water management and the use of water efficiency measures towards water management. The codes serve as identifiers for specific issues or concepts within the broader subtheme with each code corresponding to a distinct aspect of the challenges associated with themes from data representing distinct concepts or issues. When presenting the results, the codes will highlight and discuss specific details related to each aspect of the subtheme. These themes are followed by a conclusion in section 4.6 briefly describing study results drawn

from a combination of primary data collected through semi-structured interviews, obesrvations and secondary data obtained from different data sources.

4.2 Theme 1: Water quality challenges

4.2.1 Water quality challenges in *Mandela Village, Kekana Gardens and Game Lodges*

The responses of study participants to semi-structured interviews conducted in both Mandela Village and Kekana Gardens revealed that the residents in these communities were dissatisfied with the quality of their water supply provided by the local municipality, the City of Tshwane. Most residents expressed a preference for the Water Board to resume responsibility for water provision, as it was the case in the years preceding 2016 in ensuring the sustainable, equitable, and efficient management of water resources to meet the needs of communities. The main sources of water for these communities were household taps and water tankers (Fig.18). The game lodge owners indicated that they were satisfied with water quality from boreholes as the main water sources.

Figure 18: Photograph of a water tanker that supplies water to residents**.** ***Source:*** *Author*

4.2.1.1 Insufficient Water Treatment in *Mandela Village and Kekana Gardens*

Water sources from Mandela Village and Kekana Gardens were described as providing poor-quality water that was unsuitable for drinking without treatment through do it yourself (diy) equipments, boiling and disinfectants. The water was reported to be discolored, often appearing brown, muddy, or even green.

Visual evidence of water discoloration was further corroborated by study participants. Participant MV 11 emphasized the importance of boiling water before use to ensure safety, indicating a lack of trust in the supplied water quality. Participant MV 12 went as far as to mention that the water quality was so bad that it caused a green lining in their kettle, serving as a visual indicator of the water's unsuitability for human consumption. Poor water quality was indicated by the discoloured water in Figure 19.

In addition to poor water quality, residents of both Mandela Village and Kekana Gardens reported an unpleasant odor in the water supplied to their communities. Participant MV 10, resident in Mandela Village, described the odour as:

> "*foul due to fecal contamination*"

and further stated:

> *"The water quality in this area has reached a state that can only be described as foul due to fecal contamination. This harsh characterization underscores the severity of the problem we are facing. It is not merely a matter of inconvenience; it is a dire situation that poses a serious threat to the health and well-being of the community. The fecal contamination in our water sources is a clear indicator of a breakdown in sanitation and water treatment systems. It introduces a host of contaminants that threaten our health. This contamination is not limited to an isolated incident; it is an ongoing, pervasive concern that affects the very essence of our daily lives. The water discoloration and odors that many residents encounter*

daily are just the visible signs of a deeper crisis. The urgency to address this issue cannot be overstated to restore the water quality to a safe and acceptable level."

Figure 19: Poor quality of water from the tap in one of the households in Hammanskraal. ***Source:*** *Author*

Most residents expressed a need to purify the water before using it, even with disinfectants. However, participant MV 14 went further to express a complete lack of trust in the water quality, stating that they would not risk drinking it even after disinfection and suggested that it could only be used for other household purposes like cleaning. The offensive odor from the tap water was also reported to have negative implications for local businesses, such as car washing.

Many residents in both Mandela Village and Kekana Gardens believe that the lack of prioritization of water purification infrastructure has contributed to their water struggles. Participant MV 20 expressed that improving water quality through investments in water purification plants could resolve the issue. Participant KG 20 pointed out that the poor water quality was costing residents additional expenses as they had to purchase disinfectants like bleach to make the water usable. Additionally, one resident, MV 2, mentioned that a group of residents had developed an innovative

water purification device and were selling it for R350 (see Figure 20). Not all residents may have the means to purchase such devices, so understanding the socioeconomic impact was crucial.

Figure 20: Photograph of a homemade water purification system. ***Source:*** *Author*

Every individual who was sampled indicated that there were challenges with water quality which indicates credibility of the findings. The descriptions of water quality were largely subjective, relying on residents' perceptions. There was no water quality data (secondary data) found for the area. It would have been beneficial for future studies to include objective measures of water quality, such as water quality test results, to provide a more concrete assessment.

4.2.1.2 Water Contamination Concerns in *Mandela Village and Kekana Gardens*

According to participant KG 20, poor tap water quality and its limited usability led to residents predominantly using the water for irrigating non-edible plants, particularly ornamental plants (see Figure 21). The researcher's observation supported this claim, as they noted the prevalence of ornamental plants in the area and the absence of any visible edible crops. Additionally, participant

MV 15 raised concerns about water contamination negatively affecting livestock, stating the following:

> "*The poor water quality is taking a devastating toll on our livestock which has resulted to the death of many our animals. The water they depend on for drinking and sustenance is contaminated, and we are witnessing the heartbreaking consequences firsthand. We must find a way to provide clean and safe water for our livestock to safeguard our agricultural heritage and livelihoods."*

Figure 21: Showing most horticultural plants that are found in the area are ornamental rather than edible crops. ***Source:*** *Author*

The statement by participant D, an official from the Water and Sanitation System Development Section of the City of Tshwane municipality, provided a positive outlook on water quality improvement by highlighting the municipality's commitment to achieving sustainable development goals and mentioned plans to renovate the water treatment plant to prevent the transmission of waterborne pathogens in contaminated water and ensure safe water for consumption. This information was encouraging as it demonstrates the municipality's dedication to addressing water quality issues and its alignment with broader sustainable development goals.

4.2.2 Monitoring and control of water quality in *Mandela Village, Kekana Gardens and Game lodges*

Monitoring and control of water quality is a comprehensive process that encompasses the systematic collection and analysis of data related to the physical, chemical, and biological characteristics of water sources within a specific area. This endeavor aims to ensure that the water supplied for various purposes, including drinking and agriculture meet the established quality standards. The process involves regular sampling, laboratory analysis, and the use of real-time monitoring systems to assess parameters such as pH, turbidity, contaminants, and microbial indicators. Effective control strategies may include the implementation of water treatment technologies, the protection of water sources, and regulatory compliance to maintain and improve water quality. Effective monitoring and control of water quality in an area are crucial for ensuring a safe and sustainable water supply, protecting the environment, and safeguarding public health. It requires a combination of data-driven decision-making, regulatory compliance, and community involvement to achieve good water quality.

Secondary data from different sources as provided in Table 9 from government, municipality, non-governmental organisations and social media revealed consistent results pointing towards challenges on water quality and the need for improvement in Hammanskraal.The South African national government News Agency Report (2023) which supplies government data indicated that there were water quality challenges in Hammanskraal and highlighted the need for measures to alleviate water pollution such as prioritizing proper purification infrastructure, particularly a functional wastewater treatment plant.The municipality data provided by the City of Tshwane's to the Parliamentary committee on Human Settlements, Water, and Sanitation through a power point presentation in 2019 provided a briefing on the Municipality's water situation with special attention to Hammanskraal and the intergovernmental response plan. According to the City of Tshwane power point presentation, the Temba WTP and the Rooiwal WTP in Hammanskraal were the major waster water treatment plants servicing the area which supplemented water. Water for the City of Tshwane was sourced from two water boards, Rand Water (71%) and Magalies Water (1%) including wastewater treatment plant and boreholes (28%). The Temba WTP has a capacity of 120 Ml/d with the potential expansion to increase it with further capacity of 180 Ml/d by 2035. Some of

the reasons for the need to expand Temba WTP included population increase and economic expansion to the municipality boundary exerting pressure on water supply and infrastructure aging to prevent water supply challenges.

The presentation from the City of Tshwane municipality (2019) further suggested that both the Temba WTP and Rooiwal WTP were unable to treat the water to the required standards for safe drinking and that the supply in Hammanskraal faces worsening conditions. This indicates that the wastewater did not comply with water regulations. Waterborne diseases, gastrointestinal issues, and other health risks might be significant concerns for residents who rely on such contaminated water sources. The Apies River was indicated to supply water to the Leeuwkraal dam which supplied raw water for the City of Tshwane's Rooiwal Water Treatment Plant (WTP) had been identified as a source of the problem, as it was reported to be releasing partially treated sewage into the Apies River as it was affected by power disruptions. Complications were further exacerbated when the Temba WTP malfunctioned due to being struck by lightning leading to power outage because of damage to the transformer and connections.

Due to the stated challenges, water quality tests from the WTP could not be included in the report. The presentation did, however, outline that there were previous water quality reports on recurring criteria on ammonia, nitrites and nitrates, phosphate failures, which contaminated the Apies River, which supplies raw water to the Leewkraal Dam. The water treatment plants (WTPs) in Hammanskraal were in a deteriorated state, leading the City of Tshwane to resort to using water tankers as an alternative means of delivering drinking water to residents, including those in the Temba, Kekana Gardens, and Mandela Village areas. This water crisis resulted in a significant health issue, with over 77 people hospitalized due to waterborne diseases as of May 27, 2023 (Mail and Guardian, 2023). Furthermore, a cholera outbreak was confirmed in the area, resulting in 23 deaths. In response to the outbreak, the Department of Water and Sanitation obligated the City of Tshwane to implement emergency measures to supply residents with improved potable water as of June 2023 (Sunday Time, 2023). This was a short-term water improvement strategy to ensure that water quality provision was improved in Hammanksraal.

The information in different news reports (e.g., Sunday Times and The Mail and Guardian, 2023) highlighted a complex situation surrounding the water quality and the waterborne disease outbreak in Hammanskraal. Initially, there were contradictory reports suggesting that the cholera outbreak might have been caused by contaminated food rather than water. However, final news reports linked the outbreak to high levels of *E. coli* in the area based on water quality tests. Water contamination as shown by *E. coli* indicator test results, was attributed to the Rooiwal Wastewater Treatment Plant (WWTP), which was upstream of Hammanskraal and which had suffered from long-term neglect and insufficient capacity. To address this, Magalies Water was tasked with establishing a portable water treatment facility to generate treated drinking water, with the project expected to be completed by March 2024 (Sunday Times, 2023). These efforts aimed to provide better water quality to Hammanskraal residents, making tap water safe for drinking and improving the quality of water supplied by water tankers. Additionally, a report from the Organization Undoing Tax Abuse (OUTA) in 2018 on legal information and proposed measures found after independent water laboratory testing that the water supplied to residents in Hammanskraal was unfit for human consumption. Overall, the secondary data indicated historical factors contributing to the decline in water quality in the area and important measures should be put in place towards improved water management.

It was noted that all game lodge respondents reported that they did not face any water quality challenges. The study participants emphasized the importance of maintaining high water quality standards to ensure client satisfaction and a comfortable experience for guests. It was also mentioned by participants that water quality standards in game lodges were generally good, and filtration systems were rarely needed. According to participant GL 3, boreholes are essential for ensuring a reliable and sustainable water supply while minimizing the lodge's impact on the surrounding environment. Regarding water quality, this participant stated:

> *"It is essential to regularly test borehole water to monitor its quality over time. Routine testing can help identify any changes in water quality and the need for maintenance or treatment. Proper maintenance of the borehole and associated equipment is crucial for ensuring water quality. This includes maintaining the well casing, pump, and any treatment systems in good working condition. Proper management is important to mitigate these*

impacts. Depending on the initial water quality and intended use, borehole water may require treatment and filtration to remove impurities and make the water suitable for drinking, irrigation, or industrial processes. Dinokeng Game Reserve does not have impurities to have need for filtration systems".

4.3 Theme 2: Water allocation and distribution

Water allocation and distribution encompasses a wide range of strategies, policies and techniques designed to efficiently utilize, conserve, and protect water resources. Over time, these infrastructures are susceptible to wear and tear, corrosion, and other forms of deterioration, necessitating regular maintenance and rehabilitation to reduce risks to water supply, quality, and distribution. Thus, a proactive approach to infrastructural maintenance was essential to ensure the reliability, resilience, and longevity to provide water users with sufficient water. Under this theme, resilient, equitable, and sustainable water management practices were considered important in addressing complex water challenges while making informed decisions.

4.3.1 Water allocation and distribution challenges by Tshwane Municipality

4.3.1.1 Inadequate Infrastructure Planning

The results indicated that the municipality faced water allocation and distribution challenges in Mandela Village and Kekana Gardens due to factors such as geographic location, climate, population density, infrastructure development, and governance.

Participant D, the City of Tshwane municipality official, emphasized that access to clean water is a basic right. Water tankers were a temporary solution and were only allowed to provide clean water to residents to ensure unlimited access to clean water during water disruptions from infrastructural damage. A project to restore the WTP was expected to increase water supply capacity for Hammanskraal residents. Participant D further indicated that the Municipality has already installed bulk water meters, to assist in quantifying bulk water provision to the city of Tshwane including

Hammanskraal. The water meters were also meant to inform the municipality where illegal connections were affixed to the municipality infrastructure. Participant D also stated that:

> "*the socio-political dynamics contribute to ineffective implementation of water management which involves water allocation and distribution which results to prolonged interventions. The settlements with running toilets and taps qualify for basic water provision, tankers should not be used. However, where there is informal settlement characterised rapid population growth water supply may far exceed the available water supply where there is insufficient infrastructure. In instances where there is lack of infrastructure water tankers could be used"*.

The PowerPoint presentation delivered by the City of Tshwane to the Parliamentary committee in 2019 underscored the alarming condition of Water Treatment Plants (WTPs) in the city. It revealed that just 2 out of the total 15 WTP facilities were functioning at their maximum capacity. The Portfolio Committee identified several key actions, including rehabilitating the Apies River and Leeuwkraal Dam, expanding/upgrading the Rooiwal WTP, cleaning Hammanskraal's water supply reservoirs, increasing water supply through pipelines, raising public awareness, and deploying water tankers in Temba. Other key measures mentioned by the South African Government News Agency (4 June 2023) involved outsourcing funding for the maintenance and improvement of the Rooiwal WTP, setting up a mobile water treatment facility, and using water tankers to deliver clean water to residents. The estimated cost for the full rehabilitation and upgrade of the Rooiwal WWTW was R4 billion. The Rooiwal WTP upgrade project will be executed in phases, with an emphasis on early interventions to stop or reduce pollution at Rooiwal.

The researcher observed that almost all households had outside toilets (Figure 22). This was an indication that Mandela Village and Kekana Gardens did not fall under the informal category but was a formalised settlement. This indicated the urgent need to address water supply challenges classified in short term and long-term plans for water management.

Figure 22: Photograph of a toilet that is connected to the municipality pipelines for household use in Hammanskraal. ***Source:*** *Author*

4.3.2. Water supply and water challenges by the Department of Water and Sanitation

4.3.2.1 Maintenance Challenges

Water supply and associated challenges are critical aspects of sustainable development and environmental management. Efforts to reduce water loss, wastages, and inefficient use within the water sector are vital components of a comprehensive water management strategy. These initiatives not only contribute to water conservation but also help address the challenges posed by water scarcity. It is crucial for such programs to be effectively implemented, monitored, and adapted as needed to achieve meaningful results in sustainable water resource management.

Officials from the Directorate: Water Use Efficiency under the Department of Water and Sanitation indicated that their mandate was to support water management institutions and local government to achieve efficient use of water by facilitating technological research into water saving devices and equipment. Participant E from government stated that:

> "*South Africa has the highest per capita consumption while we are a water scarce country. There are regulations relating to compulsory national standards and measures to conserve*

water. Among their many focuses has been initiatives to support the minimization of water loss, wastages, and inefficient use within the sector, including the No Drop Programme-incentive based regulatory programme".

The national standards and measures for water conservation is a positive step in water management with the aim to establish guidelines and practices to ensure responsible water usage across various sectors. National standards provide a consistent set of guidelines that can be applied across regions, ensuring a standardized approach to water conservation. This helps avoid confusion and ensures that all stakeholders are working towards common goals. This can lead to more effective and comprehensive strategies. This can include regulations, permits, and enforcement mechanisms, providing a basis for holding individuals and organizations accountable for their water use. Participant F from government stated that:

"*The unit's primary focus is on policy development and promoting compliance with the National Development Plan (NDP) in South Africa. They aim to ensure that all South Africans have access to a clean water supply in their homes for household use and to enhance food security. However, the unit had identified that water insecurity risks were worsening due to the growing impacts of climate change. Additionally, there is a lack of Customer Service Centers at the local government level to effectively handle customer inquiries and complaints*".

4.3.3 Water allocation and distribution challenges in Mandela Village and Kekana Gardens residents

4.3.3.1 Inconsistent Water Supply

The presentation from the City of Tshwane municipality (2019) indicated that natural water sources, such as the Apies River and Leeuwkraal dam were under stress due to pollution. The current levels of water availability were inadequate to meet the growing demand or increased consumption.

The statements from various residents in Kekana Gardens and Mandela Village revealed a range of persistent water challenges in the area. These challenges were ongoing for several years and were characterized by issues related to poor water quality and lack of water supply and sanitation infrastructure. Some key points raised by the residents included:

Long-standing Issues: Residents, such as participants MV 20 and MV 13 indicated that water challenges in Hammanskraal have persisted for an extended period.

Decline in Service: Water supply issues seem to have intensified around 2016, as service delivery deteriorated according to participant MV 13.

Marginalization: Some residents such as KG 20 expressed that they are marginalized and the water needs of certain community members, especially from the black community, was not prioritized by the municipality. Furthermore, criticism was aimed at poor water management and maintenance.

Inconsistent Supply and Sanitary Concerns: Residents reported an inconsistent water supply, with taps running mainly in the afternoons, and frequent water cuts leading to water shortages. This has implications for flushing toilets and personal hygiene. Some residents, such as MV 11 and KG 4 mentioned that dirty water was supplied in the evenings, making it unusable. Water shortages have led to unsanitary conditions in households, with residents resorting to using buckets and drums for water storage with a few residents who can afford Jojo tanks using them for larger storage (see Figure 23).

Figure 23: (a) A Jojo tank supplying water to other residents at a cost; (b) Buckets that are used for water storage and (c) The use of drums which collect rainwater and plastic containers for water storage. ***Source:*** *Author*

Impact on Quality of Life: The lack of consistent and clean water supply affects daily life, including toilet use, showering, and drinking water. It was especially problematic during weekends. According to participant KG 4, a resident:

"Buckets are utilized for toilet flushing, and the presence of indoor toilets poses a challenge due to inadequate water availability for household purposes".

while participant MV 3, a resident also indicated that:

"indoor flushing toilets are not being used to avoid smelly spaces and taking showers was off limits".

All the residents in Hammankraal indicated that they bought water for household use from the water tankers. Residents indicated that the tankers charge R100 for filling up buckets and drums whereas filling Jojo tanks cost between R200-R300 depending on the size.

Participant KG 8, a resident highlighted that:

"if you have no money, you have no water".

According to participant MV 9, another resident:

"despite the poor water quality from tankers the water supplied helped for household uses such as laundry whereas more money was needed to buy bottled water for consumption".

Besides the bad water quality residents also complained of the few water tankers that serviced the whole community.

"water truck would come twice per month". (Participant MV 5, a resident).
"when we are desperate we call them to come service the community and they always come" and furthermore: *"water provided by tankers is expensive and poor quality".* (Participant KG 19, a resident).
"we leave containers outside the gates so we could be in time should they come". (Participant KG12, a resident).

The statements provided by residents effectively conveyed the hardships they face regarding water supply.

Several residents in Hammanskraal raised concerns regarding water supplied by the water tankers and their poor services, alleging corrupt practices in the management and distribution of water in the area. The participants indicated water tanker corruption issues related to high bills, price fluctuations, and profit-making during a water crisis. Statements from residents regarding corruption include the following:

> "*we receive high bills for constrained water access, the 'corrupt' water tanker drivers were not adequately rendering the water delivery service".* (Participant KG 4).
>
> *"price fluctuations on water sold by the drivers of water tankers was a challenge".* (Participant KG 10).
>
> *"the drivers of water tankers made a profit out of a crisis the water they provided was not entirely a community service".* (Participant KG 13, a resident)

These statements indicate that there was misconduct and unethical practices associated with service delivery by water tankers, which are meant to provide a vital community service.

The community in Hammanskraal has been compelled to treat water as a commodity due to various water challenges. Water was not only purchased from water tankers but was also sold among residents, turning it into a tradable resource within the community. Participant KG 6 (personal communication, 20 May 2022) mentioned that residents with Jojo tanks charge a fee (R10 per bucket) to provide water to their neighbors, reflecting the scarcity of clean water. Many residents' resort to buying commercially bottled water for consumption, even though it places a financial burden on their limited income. The presence of infrastructure like taps does not resolve the issue, as water shortages persist due to poor water quality (see Figure 24), as described by participant MV 10.

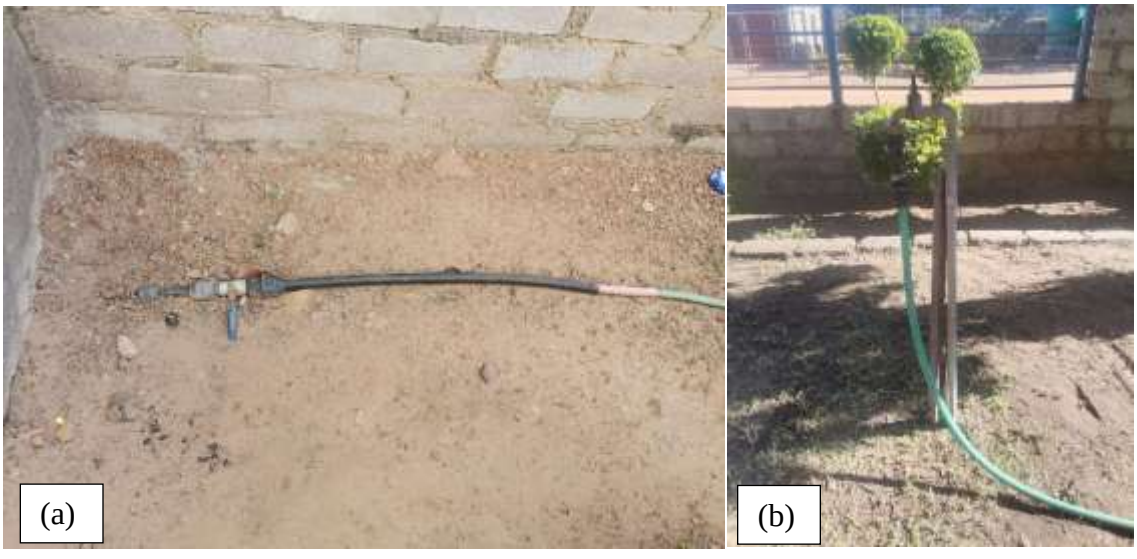

Figure 24: Available pipelines and taps available as infrastructural resources to supply water services to the households in Hammanskraal. ***Source:*** *Author*

Participant A from a Water Management Institution (WMI) indicated the following concerning water challenges:

> *"water challenges can result to emergence of a black market for water particularly in areas where there is failed infrastructure which poses a risk to consumers. Selling of contaminated water and the water costs to residents can distabilise affected areas in various ways over the availability of water and water management practices".*

The residents of Hammanskraal faced significant challenges in accessing clean water, and their accounts through the semi structured interviews shed light on the lengths they go to secure a reliable water source. The following key points were highlighted:

Reliance on a distant tap: Several residents from Kekana Gardens mentioned using a tap situated across the road, which they believed was either operated by the Magalies Water Board or assisted by game lodge owners. The ownership and source of the tap that Kekana residents use to obtain water appear to be a point of ambiguity and the game lodge owners indicated that they had no knowledge on it. This tap served as a valuable and, presumably, a clean water source. However, its

location across a busy highway posed safety risks, forcing residents to make dangerous trips, even with wheelbarrows, to fetch water. Participant B from Magalies Water Board indicated that:

> "the possibility is that any good water supply would be associated with us based on the water supply history in the area,"

This suggests that the tap may indeed be linked to Magalies Water, considering their historical involvement in water supply in the region. However, it was important to note that the specific origin of the tap was not definitively confirmed. Understanding the tap's ownership and maintenance responsibilities are essential for ensuring the sustainability and quality of the water supply it provides to the community.

Alternative Sources: In addition to the distant tap, some residents mentioned buying water from hand-dug wells. The price range for this water was not specified, but it signifies the challenges residents face in securing water for their daily needs. Participant KG 19, a resident indicated that:

> *"water is life, lack of a sustainable supply of water makes life very challenging".*

These accounts reflect the resilience and determination of the residents in the face of water challenges.

While residents in Mandela Village and Kekana Gardens have identified potential sources of clean water, the challenges they encounter in accessing these sources, along with the root causes of poor water supply, underscore the need for sustainable solutions and improvements in the local water infrastructure

4.3.4 Water allocation and distribution in game lodges

4.3.4.1 High Demand vs. Limited Supply

Participants from the game lodges in the area appear to be less affected by water quality and quantity issues compared to the general community as they were responsible for maintaining their

water system infrastructure and have achieved self-sufficiency, primarily relying on boreholes for water supply. Participant GL 3, game lodge owner indicated that:

> *"game lodges needed to have adequate wastewater treatment systems in place to ensure that water discharged back into the environment meets acceptable standards".*

All game lodges around Dinokeng Nature Reserve depended solely on boreholes as a water source. Participant GL5, game lodge owner indicated that:

> *"using ground water through the use of boreholes was a sustainable option ensuring that they had no water concerns stating that as no water means no business for us".*

There have been no reports indicating water shortages on game lodges around DGR. The Annual Performance Plan 2021/22 for the Gauteng Provincial Government did not list water shortage as a threat to the game lodges classified as wildlife tourism in DGR.

From observations it was clear that water was a vital resource for the operation of game lodges, where comfort and sustainability are harmonized to provide guests with an unforgettable experience in the heart of nature. Water-based facilities like swimming pools, outdoor showers, and bush baths contribute to overall water consumption. The inclusion of amenities like swimmimng pools, hot tubs and jacuzzis in these activities may further affect water use. The upkeep of these amenities relies on water which includes landscaped gardens to enhance the game lodge's appeal. While these add to the visual charm, they also necessitate water for irrigation and plant care. Most game lodges also indicated that native and drought-resistant plants were used for landscaping to reduce the need for irrigation. In some instances, game lodges were cultivating agricultural crops in greenhouses or vegetable gardens to offer guests fresh produce.

The game lodges in the area prioritized adequate water supply, recognizing its importance for their operations and guest comfort. While water conservation practices are adopted by some lodges, it was clear that not all have given equal priority to these water efficiency measures. Participant GL 2, a game lodge owner indicated that:

"*water conservation was achieved through various measures such as installing low-flow fixtures, using water-efficient appliances, and promoting water-saving practices among staff and guests. Implementing rainwater harvesting systems allows lodges to collect and store rainwater during the wet season, which can then be used for non-potable purposes like landscaping, cleaning, and irrigation during drier periods*".

4.3.4.2 Inequitable Water Distribution

Collectively, the implementation of these measures by game lodges demonstrated a commitment to water conservation. By combining technology (e.g., low-flow fixtures, water-efficient appliances) with behavioral practices (e.g., water-saving awareness), game lodges can make a significant impact on reducing water consumption and promoting sustainable water use. The game lodges' water supply was more stable when compared to Hammanskraal residents who faces significant water challenges. Participant GL 1, a game lodge owner indicated that they were:

"made aware of neighbouring community water issues through the media".

Participant GL2, a game lodge owner indicated that:

"We provide our employees with water to take home" (see Figure 25).

Another owner, participant GL 4 indicated that:

"the current infrastructure in Hammanskraal cannot supply the growing population to meet demand".

Figure 25: Plastic containers that workers in game lodges take for home use. ***Source:*** *Author*

4.3.5 Water allocation and distribution by Water Board

The follow-up interview with a Magalies Water employee after the interest of community members shed further light on the perception of Magalies Water as a water service provider in the community. While the Magalies Water was acknowledged by community members in Mandela Village and Kekana Gardens for being efficient on water allocation and distribution, some community members expressed a preference for Magalies Water over the City of Tshwane municipal control. The experiences of both community members and Magalies Water employees offer insights into the complexities of water service management in Hammanskraal. The key points from these interviews include:

Efficiency in water supply: Participant MV 2, a Magalies Water employee, expressed that Magalies Water's supply services in the community were efficient. This indicates a positive perception of the organization's performance in delivering water services.

Preference for Magalies Water: Community member KG 13 mentioned a preference for Magalies Water to resume control of water supply services instead of the Tshwane Municipality. This suggests a level of trust and satisfaction with Magalies Water's services.

Long-standing responsibility: Participant B from Magalies Water revealed that the organization had been responsible for water supply services in Hammanskraal since 1996, including the maintenance of wastewater treatment plants. This indicates a significant and long-standing role in the community's water infrastructure.

Challenges in water supply: Participant MV 2 mentioned that there were still water supply challenges in Hammanskraal. While Magalies Water was recognized for efficiency, it was evident that some issues persisted, underscoring the complexity of managing water services in the area. A Magalies Water employee further indicated the following regarding water supply challenges in Hammanskraal:

> "*the ongoing water supply problems in Hammanskraal is historical and that many residents may be unaware of the city council's decision to terminate the contract to operate and manage the Temba water treatment plant. The service contract ended in 2012 and there were no negotiations for renewal. The ongoing water quality problems in the Hammanskraaal of the city of Tshwane, which have brought residents' concerns about water quality to the forefront, cannot be blamed on Magalies Water, the water utility. Magalies Water has operated and managed the Temba Water Treatment Plant since 1996, until the City of Tshwane municipality decided to take over responsibility for the operation and maintenance of the plant in 2012. During the period of about 20 years that Magalies Water has operated there have been no complaints from the Hammanskraal about the water quality of the water produced by the plant*".

The historical context, the termination of the service contract, and the subsequent shift in responsibility for the Temba water treatment plant operations raises questions about the decision-making processes, communication, and the overall management of water resources in Hammanskraal. Addressing the current water quality problems may require collaboration between stakeholders, effective communication with the community, and a thorough investigation into the root causes of the issues. Reports from the Environment (5 June 2023), an organisation that focused on community upliftment projects stated the following:

"*Magalies Water was to set up a mobile water treatment facility (also known as a "package plant") at its Klipdrift water treatment facility, which is close to Hammanskraal, to better serve the needs of the community. The treated drinking water from this will be produced at a rate of 30 to 40 Ml per day and fed into the Hammanskraal piped water distribution system. The piped water distribution system in Hammanskraal and the Klipdrift water treatment works were indicated to be connected. The package plant will be put into operation gradually, 10Ml/day at a time. As soon as the package plant is finished, the city will be able to switch over to providing residents with water from the package plant until the quality of the water from Temba meets drinkable standards once more. The availability of drinking water from the Magalies water package plant will also allow the City of Tshwane to stop using water tankers for water delivery. Regular testing of the water being supplied by the tankers will go along with this and the water treatment facility was expected to supply residents by March 2024*".

The establishment of the mobile water treatment facility was a promising development that aims to provide residents with reliable access to safe drinking water, eliminate the need for water tankers, and ensure consistent water quality. This initiative reflects a commitment to addressing the long-standing water challenges in Hammanskraal.

4.4 Theme 3: Stakeholder engagement and collaboration

Stakeholder engagement and collaboration is an important aspect that involves all relevant stakeholders to achieve meaningful and lasting solutions in water governance. Involving stakeholders and fostering collaboration has several crucial benefits including comprehensive decision-making, equitable resource distribution, and successful implementation of policies and projects while promoting resilience and innovation on water-related challenges. Collaborative efforts can lead to the development of sustainable practices, efficient water use, and conservation measures, ensuring the long-term availability of water for current and future generations.

4.4.1 Stakeholder engagement and collaboration by the Department of Water and Sanitation

4.4.1.1 Insufficient Consultation Practices

The Directorate: Water Use Efficiency (WUE) was established during 1998, with the promulgation of the National Water Act (NWA), 1998, (Act No. 36 of 1998). The Directorate was established primarily to facilitate the realization of the Water Services Act, 1997 and the National Water Act, 1998 to promote effective and efficient use of water and to contribute to sustainable water resources management. Stakeholder engagement and collaboration are critical components for the Department of Water and Sanitation to effectively manage and sustain water resources, provide reliable sanitation services, and address related challenges. By prioritizing stakeholder engagement and collaboration, the Department of Water and Sanitation could build a more resilient, inclusive, and sustainable water and sanitation management system. Engaging stakeholders in policy development ensures that the diverse needs and perspectives are considered. Advocating for supportive policies could strengthen the overall water and sanitation framework, and participant E, a government official from the group interview indicated that South Africa has policies in place to promote effective and efficient use of water:

"policies contribute to sustainable water resources management."

Implementing robust monitoring and evaluation mechanisms helps assess the impact of water and sanitation programs. This information could be shared with stakeholders to demonstrate accountability and progress. Sharing relevant data with stakeholders promotes transparency and allows for informed decision-making. This includes sharing information on water quality, availability, and sanitation infrastructure. Building the capacity of stakeholders, especially at the community level, can help ensure the sustainability of water and sanitation initiatives through training programs, workshops, and awareness campaigns. Participant F, a government official indicated that:

"*as the DWS we are developing and actively applying a water management culture in South Africa. National Water Week and Water Day were some of the observed special days to raise*

awareness about the value of water, the need for sustainable management of this scarce resource, and the role water plays in alleviating poverty and underdevelopment".

4.4.2 Stakeholder engagement and collaboration by the Department of Tourism

4.4.2.1 Limited Collaboration

A balanced approach to resource management is essential for the industry's sustainability and preparedness in the face of environmental and resource-related challenges. An official from the NDT, participant I indicated that:

> *"effective water governance and management are crucial to address water challenges but ensuring cooperation between different stakeholders and enforcing regulations can be complex".*

This highlights that the DWS could provide a more comprehensive overview of its approach to water governance, stakeholder engagement, and regulatory enforcement, ultimately contributing to more effective and sustainable water management initiatives by understanding the diverse interests and concerns of various stakeholders. Comprehensive stakeholder involvement involves identifying the needs, expectations, and potential impacts on water and sanitation initiatives. Establishing clear and transparent communication channels is essential. This includes regular updates, public consultations, and mechanisms for stakeholders to provide feedback. Participant F highlighted that:

> *"lack of integration of social advocacy initiatives within the sector due to reduced funding and human capacity was a limitation for more enhanced collaborative efforts".*

This statement highlights the need within the tourism sector to address limitations in integrating social advocacy initiatives, which are crucial for addressing social and environmental issues. Overcoming these limitations may require increased funding, enhanced human capacity, and a more strategic approach to align advocacy efforts with the sector's goals.

The drought conditions in 2018 served as a wake-up call for the tourism industry in South Africa, emphasizing the importance of water management alongside energy management to ensure the sector's sustainability and resilience in the face of climate change. Participant H, a government employee from the group interview, shared the following:

> "*the drought conditions that took place in 2018, particularly forcing the Western Cape province of South Africa to Day Zero highlighted the low preparedness when it comes to water management by the tourism industry, ... energy seems to be more of a focus resource, yet water is also a crucial natural resource that heavily impacts many industries. Due to loadshedding from electricity shortages in the country there is lot of effort to obtain solar equipment however limited efforts were directed towards water management".*

This viewpoint indicated that the tourism industry's low preparedness in terms of water management. The observation that energy appears to be a more focal resource, with greater attention given to obtaining solar equipment due to electricity shortages from load shedding, underscores the need for the tourism sector to place more emphasis on water management.

Greenpeace Africa (2022) reported on the water crisis in South Africa and disparities in safe water access. The report further indicated that Day Zero in Cape Town, which occurred in 2018, served as a signpost for South Africa's water crisis indicating that not every South African had access to the same quality, quantity, or water infrastructure. Highlighting those different parts of the population have different levels of access to water. This emphasised the need to explore partnerships with technology companies, research institutions, and startups to address water scarcity challenges through innovation. Even though Cape Town was able to prevent "Day Zero", if this water management issue is not prioritised, it may happen again. Measures to be implemented for water management practice require combined structural measures in the medium to long term to cope with and mitigate the effects on the most vulnerable populations because the high recurrence rate of water shortages in different areas is likely to be exacerbated by climate change. By fostering partnerships among government entities, communities, businesses, and international stakeholders, comprehensive and sustainable solutions can be achieved to ensure the resilience in water

governance. This may include collaboration with policymakers to create and enforce regulations that promote water conservation and sustainable water use practices.

4.4.3 Stakeholder engagement and collaboration by water management Institution

4.4.3.1 Communication Gaps

Water management institutions serve as key facilitators in water governance, ensuring that diverse interests are considered and integrated into sustainable water management practices. Through collaboration, coordination, and effective governance structures, these institutions contribute to the equitable and responsible use of water resources (Meilani et al., 2021). Water management institutions are tasked with formulating comprehensive water policies and plans that guide the sustainable use, allocation, and protection of water resources. They thereby ensure compliance with regulations related to water use, quality, and allocation and issue permits and licenses for various water uses, such as agriculture, industry, and municipal supply, ensuring compliance with established rules and standards. They establish long-term goals and objectives for water management, considering environmental, social, and economic considerations. Participant A from a Water Management Institution (WMI) indicated the following regarding water supply challenges:

> "water *supply remains a challenge mainly for rural (tribal areas), agricultural areas and many other municipality areas, 20 years later many municipalities have not evolved in providing enough water to residents. In rural areas where game lodges are based a Water Use License Application (WULA) is essential to allow for abstraction and to ensure that the accommodation establishments have enough water to cope with future potable water demand, and it encourages water stewardship within residents. The WMI work closely with policymakers and relevant authorities to develop and implement water management policies that align with sustainable practices. This involves advocating for the integration of water supply and conservation considerations into broader development plans. Water Management Institutions also work closely with governmental agencies to address water supply challenges and ensuring sustainable water management practices. Their primary focus is on providing clean and reliable water supply to communities, industries, and agricultural sectors."*

This indicates that water management institutions are often involved in planning and overseeing the development of water infrastructure, such as dams, reservoirs, and water treatment plants. They actively promote water conservation and efficiency measures, working extensively with communities, industries, and agricultural users to implement sustainable practices. These efforts aim to reduce water wastage and optimize usage, addressing the challenges of increasing demand and limited water resources. This includes investing in in research and development to find innovative solutions to water supply challenges such as new technologies for water treatment, rainwater harvesting, and water recycling. The findings indicated a significant gap in water management initiatives for Hammanskraal, as no known projects were identified by water management institutions in the area.

4.4.4 Stakeholder engagement and collaboration in Mandela Village and Kekana Gardens

4.4.4.1 Lack of Transparent Communication

Stakeholder engagement and collaboration in water governance for communities are essential components of ensuring sustainable and equitable access to water resources. Effective engagement allows for the inclusion of diverse perspectives, needs, and priorities, fostering a more holistic and community-centered approach. By integrating stakeholder engagement and collaboration into water governance, communities can develop more resilient, sustainable, and inclusive approaches to managing their water resources. This collaborative model ensures that the voices of all stakeholders, particularly community members, are heard and considered in decision-making processes. This will establish effective mechanisms for resolving conflicts related to water use and access within the community. Actively involving community members in decision-making processes related to water governance can empower communities by providing them with information, resources, and opportunities to actively participate in planning, implementing, and evaluating water-related initiatives. Such community involvement could build the capacity of community members to actively engage in water governance processes.

Most residents in Mandela Village and Kekana Gardens indicated that they were not aware of any community water steward groups responding to water management issues. Participant MV 14, a resident indicated that:

> *"the community leaders who are aware of the water crisis never communicate with residents. The local leaders were not helpful in updating the community members on any developments related to water management in the area. At most mainly strike actions take place instead of constructive community meetings*".

This highlights the need to strengthen local governance structures to ensure that community voices are represented in decision-making bodies. Encouraging the formation of water user committees or similar groups that actively participate in local water governance. Involving the community in the development of water management plans and policies will ensure that plans reflect the unique needs of different groups within the community and consider long-term sustainability. According to participant KG 20, a resident:

> *"even though there is appointed councellor there are no solutions people have lost hope on water management in the area. Community leaders rise before elections to earn votes and make promises on resolving community issues, stating that their actions are self-serving, stomach politics. The available community groups are affiliated with political campaigning and less commitment on water management improvements*".

The accounts from residents highlight a disconnect between the community and its leaders, as well as a lack of effective community groups dedicated to water management. There was a perception of political influence and promises that are not fulfilled, contributing to a sense of disillusionment among community members. In relation to this poor water governance within the community, participants contribution was as follows:

"discussions and community involvement on water management was crucial towards sustainability in the area, commitment needed to solve water issue within the community". (participant KG 20, a resident).

"councellor were brushing off the water supply community concerns coupled by poor municipality management". (participant KG 13).

Most residents in Kekana Gardens (KG 13 - 19) believed the municipality was failing them. Participant MV 10, a resident, stated that:

> "the water challenges in the area strongly indicate that there are limited resources available from the municipality to assist community members".

According to participants MV 5 and MV 7, poor management by Tshwane Municipality could be resolved by changing leaders or re-appointing Magalies Water Board. Participant MV 6, a resident stated that:

> "residents experienced apathy and poor water management by municipality coupled by lack of communication to update them on infrastructural developments".

Local leaders could not be reached to participate in the study. The accounts provided by residents highlight a series of challenges related to water management, including perceived poor municipal management, resource limitations, and the need for more effective communication and community involvement. Addressing these issues may require a collaborative effort involving residents, local leaders, and relevant authorities to work towards sustainable solutions for water supply and management in the area.

An official from Tshwane Municipality, participant D, indicated that operations on water management were affected by political and technical issues and exacerbated budgetary constraints and ineffective integration of technology. Statements in this regard include:

> "constant change in leadership affects prioritisation and budget allocation issues".
>
> "operations management affected by vacant posts".

"poor infrastructure which may lead to ineffective water governance".
"services cannot be extended to tribunal or informal settlements".

Informant D's insights emphasize the multifaceted challenges faced by the municipality in managing water services. These challenges range from political issues and leadership changes to budget constraints and technical limitations. The lack of collective engagement and application of water efficiency measures further compound the difficulties in ensuring effective water management and service delivery to the community. Addressing these issues may require coordinated efforts and strategic planning involving various stakeholders, including community members and municipal authorities.

Participant G, a DWS official, indicated that one of their directives was to capacitate municipality officials and stakeholders in developing and evaluating plans to assess the progress of water use efficiency management,

"auditing is necessary to enhance performance standards".

Another DWS official, participant F indicated that there was a need to strengthen existing partnerships with various sector partners:

"collaboration means looking outward on water management approaches. Regional support approaches across the water use sectors, including agricultural, industrial and by municipalities is crucial even though principles and practices tend to vary".

Residents in Kekana Gardens indicated that they benefit from being close to Dinokeng Nature Reserve as there was water tap accessed by crossing over the highway close to the route that leads to Dinokeng Nature Reserve. Participant KG 12, a resident, indicated that:

"most residents use wheelbarrows for carrying their water containers across the highway which is relatively unsafe particularly for children".

Overall, residents were of the impression that game lodges in Dinokeng Nature Reserve did not suffer from water challenges as they may have water management systems in place. Residents in Mandela Village have water meters due to the presence of taps for billing but most members indicated that they were not paying for municipal supply (Figure 26). Residents concurred that the municipality needs to deliver on water services and participant MV 20, stated that:

> "*businesses such as game lodges in Dinokeng can help but it is not mandatory therefore we cannot really collaborate with them in solving water issues in Hammanskraal. The municipality cannot be expecting residents to come up with water management practices whereas having water supplied is a basic human right*".

The sentiment expressed by residents underscores the importance of reliable and safe water access as a fundamental human right and the need for collaborative efforts to address water challenges in Hammanskraal.

Figure 26: Photograph of a water meter - noted only in Mandela Village. ***Source:*** *Author*

In Kekana Gardens there were no water meters even though taps were available. Most residents in Kekana Gardens appeared to lack knowledge about the use of water meters but highlighted that the

installation of water meters would be a solution to the water challenges faced by Hammanskraal residents. A participant commented that

> *"the municipality should install water meters which will efficiently pull clean water from the tap".*

The residents' request for the installation of water meters highlighted their limited awareness of the benefits associated with this technology. Accordingly, water meters serve no role in providing clean water. This emphasizes the significance of public education initiatives and infrastructure development to enhance water management and supply in the region. By effectively communicating the advantages and benefits of water meters.

4.4.5. Stakeholder engagement and collaboration by game lodges

4.4.5.1 Lack of Community Involvement

Different perspectives were provided regarding game lodge's contributions and community expectations on collaboration to water access. While there was an indication by many residents that game lodges provide the community with water bottles and a tap access close to Dinokeng Nature Reserve which helped ease water problems, other residents believed game lodges have no responsibility for water provision towards residents. For example participant MV1, a resident indicated that:

> *"game lodges should be focusing on their businesses and the municipality provide water to the community".*

The acknowledgment of challenges faced by the broader community, particularly in terms of infrastructure and growing population demands, alongside the self-sufficiency and water conservation measures in place at game lodges, reflects a nuanced understanding of the broader water landscape. Some residents appreciated the positive contributions made by game lodges, noting that the provision of water bottles and tap access near the Dinokeng Nature Reserve had

eased water problems for the community. Others, like resident MV1, believed that game lodges should focus on their businesses, suggesting that the primary responsibility for water provision lay with the municipality.

Game lodges could engage in corporate social responsibility initiatives, such as providing water access, as part of their commitment to supporting local communities and maintaining positive relationships. Investigating cooperation via public-private partnerships between game lodges and local municipalities presents a potential avenue for leveraging shared resources and expertise to tackle water challenges. Game lodges possess water sources and infrastructure that have the potential for sharing with the surrounding community, thereby contributing to sustainable development. Promoting open communication among residents, game lodges, and municipal authorities can facilitate the discovery of mutually advantageous solutions and establish a transparent delineation of responsibilities. The differing opinions among residents regarding the responsibility of game lodges in providing water to the community reflect a complex perspective on the role of private entities in local water provision. The availability of water resources, the specific needs of the community, and the capacity of both the municipality and game lodges need to be considered in the local context.

The emphasis on water education for children in communities underscores the recognition of the crucial role that education plays in fostering a deeper understanding of water issues, promoting responsible water use, and building a foundation for sustainable water management. Water education was highlighted as important to children in Mandela Village and Kekana Gardens, informant MV 20, resident stated that:

"*kids need to be taught about water saving, as water challenges may be a long-term problem. To ensure that children were aware of water issues would encourage them to save water, to avoid using tap water for consumption to safeguard their health and to make them understand the seriousness of water issues*".

Water education was viewed by most residents as a proactive measure to address long-term water challenges. Water education for children is a transformative investment in building a future

generation that is informed, engaged, and committed to sustainable water practices. It lays the foundation for responsible citizenship, environmental stewardship, and resilient communities in the face of water-related challenges.

On water management collaborative efforts with residents to address water issues, other game lodge owners were of the view that it was not their place to assist residents on water issues, informant GL 5, game lodge owner stated that “contributing on tax is enough, the municipality should do their work”. Other game lodge owners, informant GL 5 indicated that “corruption was the main reason the water demands in Hammankraal were not being met, local businesses could collaborate to assist neighbouring residents however those funds could be squandered”. According to some resident’s game lodges were in a better position to assist residents, informant KG 8, resident stated that “even their animals get better quality water”. These statements not only highlight the disparities in water access and management but also showcase the potential for community engagement and social responsibility.

The residents' perceptions of game lodges as potential sources of assistance in water provision underscore the severity of the water challenges faced by the community. There was a division in opinion regarding the role of game lodges, with some believing they have a responsibility to help, while others see it as the municipality's duty. Collaborative efforts are suggested but are contingent on addressing concerns related to fund management and corruption.

4.5. Theme 4: Environmental Impact and Risk Management

Environmental Impact and Risk Management are integral components of responsible and sustainable development. As human activities continue to have profound effects on the planet, it becomes increasingly important to understand and mitigate the impact of those actions on the environment. It is essential to assess and understand environmental impacts to make informed decisions and implement sustainable practices to protect the environment. Risk Management is a proactive approach that involves identifying, evaluating, and mitigating potential environmental risks associated with human activities aimed at preventing or minimizing adverse effects on the environment and human health.

4.5.1 Environmental Impact and Risk Management in *Mandela Village and Kekana Gardens* associated with water governance

This section focuses on the environmental impact and risk management strategies in Mandela Village and Kekana Gardens, highlighting the importance of responsible water governance to safeguard these communities and their surrounding ecosystems.

4.5.1.1 Health Impacts associated with poor water quality

Residents reported that consuming water from the tap and water tankers in the past had resulted in health challenges for their community members. Study participants stated that:

> "*the use of water supplied in our area has negative impact to the health of many residents as such the elderly and young children are most susceptible to gastrointestinal issues like diarrhea, vomiting, and stomach cramps, which is wise that water be used for other household uses*". (Participant MV 6)
>
> *"*children in the area are made aware of the water situation in the area and their need to avoid drinking water from the taps". (Participant KG 19, a resident)
>
> *"*consuming water from either the water tankers and taps resulted in skin irritations and tummy aches". (Participant MV 11, a resident).
>
> "water supplied in Hammanskraal is nothing but a health hazard". (Participant MV 13, a resident).
>
> "the water supplied was a health hazard to pregnant women and the livestock they had died likely from the poor water quality". (Participant MV 15, a resident).
>
> "the water supplied to us is dangerous and kids are constantly sick from tummy issues which was the reason for high hospitalization in the area". (Participant KG 19, a resident).

The health challenges reported by residents highlight the urgency of addressing water quality issues in the community. Ensuring access to safe potable drinking water is essential for public health and

well-being. Residents, especially vulnerable groups, should not be exposed to health risks due to water-related problems. Public health and water quality should be at the forefront of efforts to resolve the water challenges faced by the community.

4.5.1.2 Risks associated with water provision and sanitary infrastructure

Some residents in both Mandela Village and Kekana Gardens had dug wells that were excavated by hand for water access. Claims were made that the hand dug wells provided better water quality when compared to tap and water tankers. Hand-dug wells were used to access groundwater that is relatively close to the surface. See Figure 27.

Figure 27: (a) Photograph of clean water from hand dug wells that are connected to jojo tank; (b) Photograph of a covered homedug well that is used as a water supply in a household in Hammanskraal. ***Source:*** *Author*

The digging process involves excavating a hole until the groundwater level is reached. Buckets were used to collect and extract inflowing groundwater. Study participants commented on the homedug wells and the potential hazards associated with these water sources as follows:

> *"groundwater obtained from dug wells was much pure compared to the tap and tanker water, having boreholes in the area will likely yield to even better water quality for residents"*. (Participant MV14, a resident).
> *"handdug wells need to be carefully closed to prevent risks associated with lack of structural integrity".*

The use of hand-dug wells by residents demonstrates their resourcefulness and adaptability in response to water quality challenges. It also highlights the potential benefits of exploring alternative water sources like boreholes to address water quality issues in the area. To maximize these benefits, it is essential to ensure the safety and integrity of these wells and other water sources, especially if they are used as an alternative to the municipality's water supply.

A couple of the residents indicated that the water crisis made them regret their move into the area, particularly considering the investments they have made in building proper house infrastructures. Most homeowners in Mandela Village and Kekana Gardens, Hammanskraal had made substantial investments restoring, expanding, and improving their homes. The unavailability of water has contributed to unsanitary living conditions as indoor toilet systems had to be abandoned for outdoor toilets. Study participant indicated that:

> *"indoor flushing toilets are a health hazard due to lack of adequate water supply. The limited water supply contributes to unsanitary living conditions as toilets cannot be flushed".* (Participant MV9, a resident).
> drinking water quality standards are, *"a social responsibility by municipality".* (Participant A, from the water management institution).

The water crisis in Hammanskraal has not only affected the availability of clean water but has also led to significant challenges and regrets among residents, impacting their investments in property

and overall living conditions. Addressing the water crisis is essential not only for providing a basic human right but also for improving the overall quality of life and sanitation in the community.

4.5.1.3 Risks associated with illegal water connections

Illegal water connections pose various risks and challenges, affecting both the water supply system and the community. The most immediate risk is the unauthorized use of water without proper payment. This can lead to financial losses for water utilities and may result in increased costs for legal water users. Illegal connections may not meet safety and quality standards and can place additional stress on the water supply infrastructure. Increased demand from unauthorized users may lead to a drop in water pressure, affecting the quality and reliability of water supply for legitimate consumers. Illegal connections may involve tampering with water pipes and infrastructure, leading to physical damage. This can result in leaks, system failures, and increased maintenance costs for water utilities. This poses a risk of contamination, potentially leading to waterborne diseases and other health hazards for the community. Persistent illegal connections may discourage water utilities from investing in infrastructure improvements and expansions. This can hinder the overall development and reliability of the water supply system. Informant D, from Tshwane municipality (personal communication, 16 September 2022) indicated the following:

> "*were are facing challenges with the emergence of informal settlements, which have led to illegal connections to bulk water pipelines that severely constrained the community water delivery services. Additionally, due to the rapid population growth in Hammanskraal, water demand has far exceeded supply in the area, requiring increased budget for water management"*.

Addressing illegal water connections requires a combination of regulatory measures, community awareness, and enforcement efforts. Implementing effective monitoring systems, encouraging community participation, and promoting responsible water use can help mitigate the risks associated with illegal water connections.

4.5.1.4 Use of alternative water sources to mitigate risks of water shortages

The use of alternative water sources is a crucial strategy to mitigate the risks associated with water shortages. By diversifying water sources, communities and industries can enhance resilience, reduce dependency on traditional water supplies, and contribute to sustainable water management. The residents of Mandela Village had very limited alternative water sources such as rainwater collection systems attached to their roofs when compared to residents in Kekana Gardens who completely had none. Most residents indicated that they stored water in various containers including drums and buckets with a few households who could afford Jojo tanks. While most of them recognized that rainwater could assist in collecting free water, they could not afford to install formalized structures even though rainwater was collected through containers. Residents mentioned that they limited free running water, reused water in plants and toilets on efforts to use water efficiently. However, participant MV 8, a resident, indicated that:

> *"what can you reduce where there is minimum water anyway. There is no wasteful spending in this area as you cannot reduce dirty water. Water is a limiting factor even in growing crops".*

The residents' efforts to conserve water and manage their limited water supply demonstrate their resilience in the face of significant challenges. Access to alternative water sources and improved infrastructure for rainwater collection could potentially alleviate some of the water scarcity issues in the area. The City of Tshwane municipality participant D indicated that:

> *"there were no plans on providing more water storages for rural residents but only provision for bulk water services, focus is on key aspect of providing good water quality through bulk network".*

Participant G in the DWS group interview indicated that:

> "*there are collaborative efforts in place with municipalities to conduct door to door campaigns to sensitise residents on the need to conserve water. Through these campaigns*

awareness material in a form of brochures and pamphlets are distributed to promote water use efficiency including the importance of preventing water leakages. Live demonstrations are also done on how leakages on taps and toilets can be fixed to minimise leakage".

Implementing a combination of these alternative water sources, coupled with efficient water management practices, can contribute significantly to mitigating the risks associated with water shortages, enhancing water security, and building a more resilient water supply system. It was evident in Hammanskraal that these initiatives are valuable in promoting water conservation and educating residents on the efficient use of water. However, the focus on improving water quality and raising awareness about water conservation does not directly address some of the critical challenges faced by rural residents, such as insufficient water supply and storage. The PowerPoint presentation by the City of Tshwane to the Parliamentary Committee in 2019 indicated a commitment towards water efficiency measures by involving residents through awareness campaigns from different media platforms, educational institutions, and printed material to increase on visibility.

Examples of printed materials are shown in Figures 28 and 29.

Figure 28: An example of awareness material developed to encourage water conservation efforts **Source:** City of Tshwane (2023)

Messages on water conservation conveyed to communities include the following:

Use grey water: Reusing greywater from activities like washing dishes and laundry for garden irrigation and toilet flushing is an excellent way to conserve freshwater.

Report burst pipes and leaks: Identifying and repairing burst pipes and water leaks promptly can prevent water wastage.

Install water-saving equipment: The installation of water-saving devices such as tap aerators and low-flow showerheads can significantly reduce water usage in daily activities.

Dual flush toilets: Dual-flush toilet cisterns allow users to choose between a full flush for solid waste and a reduced flush for liquid waste, saving water with each flush.

Choose drought-resistant plants: Opt for native or drought-resistant plants in your garden to reduce the need for excessive watering.

No gardening watering: Avoid watering your garden during water restrictions or in drought conditions to conserve water.

Broom for cleaning: Instead of using a hosepipe to clean outdoor surfaces, use a broom to save water.

Collect rainwater: Installing rainwater harvesting systems to gather rainwater for non-potable uses, such as gardening and car washing, helps reduce reliance on freshwater sources.

Pool cover: Covering swimming pools when not in use can reduce evaporation and the need to top up the pool with fresh water.

Shower vs. bath: Taking showers rather than baths typically uses less water, especially if you have a water-efficient showerhead.

Turn off taps: While brushing teeth or shaving, turn off the faucet to prevent unnecessary water wastage.

Check for leaks: Regularly inspect taps and toilets for leaks and fix them promptly to avoid water loss.

Material used to inform residents of the need to conserve water is shown in Figure 28.

Consumption

of a water-wasting family against a water-wise family

Consumption of a water-wasting family:		Consumption of a water-wise family:
2 Baths at a depth of 150mm = 180 litres	Bath	1 Bath at a depth of 100mm = 60 litres
2 Showers at 15 litres per minute for 7 minutes each = 210 litres	Shower	3 showers at 6 litres per minute for 4 minutes each (close taps while soaping) = 72 litres
Water used freely = 30 litres	Wash basin	Water used sparingly = 10 litres
20 uses at 15 litres per flush = 300 litres	Toilet	Using a 6 litre/3 litre dual-flush toilet, 15 uses at 3 litres and 5 uses at 6 litres = 75 litres

Figure 29: An example of awareness material developed to provide information on water conservation within homes. ***Source:*** *City of Tshwane (2023)*

The official from the water management institution, participantnt A also highlighted that:

> *"awareness on water was necessary to reduce the demand among residents towards good water stewardship. Our directive included engaging municipalities in the Green Drop process measures to compare the performance results of the municipalities".*

These water conservation practices encourage responsible water usage and are essential in regions facing water scarcity, drought, or water quality concerns. Adopting a combination of these measures can help reduce water consumption at the individual and household levels, contributing to broader water conservation efforts. However, the Department of Tourism indicated that they were not involved in any community-based initiatives on water efficiency measures. The collaborative awareness campaigns and practical demonstrations conducted by the DWS and municipalities represent important steps in promoting water conservation and efficient water use. However, there may be a need for broader involvement of relevant stakeholders, to address the water challenges in the area comprehensively.

4.5.2 Environmental impact and risk management in game lodges associated with water governance

Given the often remote and ecologically sensitive locations of game lodges, water scarcity and conservation are critical concerns. Many lodges implement water-saving measures to strike a balance between providing guests with a comfortable experience and minimizing the impact on the local ecosystem and water resources. The sustainable practices, such as:

a) Collecting rainwater for various uses.
b) Treating and recycling greywater for non-potable purposes.
c) Installing water-efficient fixtures like low-flow toilets and faucets.
d) Educating staff and guests about water conservation.
e) Monitoring water usage and implementing efficient irrigation systems.

These practices not only help game lodges contribute to local water conservation efforts but also serve as examples of responsible tourism and eco-friendly hospitality. Water-saving measures are a fundamental part of achieving this balance.

4.5.2.1 Use of alternative water sources in water management

Game lodge owners mentioned that they have a diverse range of alternative water systems, such as JoJo tanks supplied by boreholes as well as black and grey water systems (see Figure 30 and Figure 31). Participant GL 2, a game lodge owner remarked that:

"*having alternative water systems such as black and grey water systems provided competitive advantage even though such systems were expensive. To make necessary adjustment within the game lodge conducting regular water audits is necessary to identify areas of water waste and recommend improvements*".

These alternative water systems not only enhance water sustainability but also contribute to the lodge's resilience and self-sufficiency. They reduce the environmental impact of the lodge's operations, which is particularly important in ecologically sensitive areas where game lodges are often located. By investing in these systems and implementing water-saving measures, game lodges demonstrate their commitment to responsible and sustainable tourism, aligning their practices with the protection of the natural environment they operate in.

Other owners indicated that they had artificial dams as a backup that they also use for agricultural production (Figure 32). Some game lodges have implemented water conservation measures to reduce water consumption. These practices include installing low-flow fixtures, using water-efficient appliances, and promoting water-saving behaviors among staff and guests. The game lodge owners understood the importance and value of having good water sources. Rainwater harvesting systems have also been adopted, allowing lodges to collect and store rainwater during wet seasons for non-potable purposes such as landscaping, cleaning, and irrigation during drier periods. Among the game owners there was concern that other neighbours within Dinokeng Game Reserve were

digging deeper boreholes and they were also aware of hand dug wells by neighbouring residents in Kekana Gardens. Game lodge owners raised the concern that:

"no water means no business and that is unemployment to neighbouring residents". (Participant GL 1, a game lodge owner:).

"groundwater may be more heavily used than the rate of recharge". (Participant GL 4, a game lodge owner).

"game lodges were conscious of the necessity to adhere to local water regulations, permits, and restrictions to avoid over extraction of groundwater". (Participant GL 5, a game lodge owner).

Figure 30: Photograph of Jojo tank connected to borehole system with a water pump. ***Source:*** *Author*

Figure 31: Jojo tanks used for wastewater recycling and for storing water. ***Source:*** *Author*

Game lodge owners' commitment to responsible water use not only benefits their businesses but also plays a role in supporting the local community by ensuring that water resources are used wisely and sustainably. Informant GL 1, a game lodge owner indicated that:

"*effective water management involves a combination of management and maintenance practices to ensure the sustainable and efficient use of water resources. All game lodges in Dinokeng Game Reserve relied on boreholes to access groundwater therefore monitoring and managing these water sources is critical to ensure sustainable extraction rates and avoid depletion. Regular inspections and maintenance are conducted to identify and repair any leaks in plumbing systems promptly. Raising awareness among staff and guests about the importance of water conservation and responsible water use can encourage more sustainable behaviors*".

The statement emphasized the key elements of effective water management, particularly in the context of game lodges in Dinokeng Game Reserve. These practices benefit the environment, contribute to the lodges' long-term sustainability by maintaining a comfortable experience for guests, minimize the impact on the local ecosystem, and ensure a reliable water supply for the community. This is an example of a business and environmental win-win approach.

Figure 32: Photographs of artificial dams that store additional water that may be used for crop irrigation. ***Source:*** *Author*

Most lodge owners indicated that water from the boreholes was of good quality and could be used for potable uses. Comments on the water quality included:

"only limescale is experienced due to mineral content in hard water". (Participant GL 3, a game lodge owner).

"proper treatment of wastewater is essential to prevent pollution and protect local ecosystems". (Participant GL 4, game lodge owner).

The buildup of limescale in water pipes was indicated as common and not harmful for consumption. The awareness of water quality and the need for wastewater treatment reflects the game lodges' dedication to maintaining the quality of their water sources and minimizing their ecological impact within the sensitive environment of the reserve.

4.5.2.2 Use of water efficiency measures for water management

A collaborative approach among government departments, research institutions, and industry organizations is critical for promoting water efficiency in the tourism sector. While there have been challenges, the commitment to a five-year program may not be sufficient with a need for a long-term focus on sustainability and water conservation.

Comments from government officials and a participant from a water management institution indicated that:

"for accommodation establishments such as game lodges affordability may be a challenge in adopting technology, the price for technology is high. Offering incentives on technology to accommodation establishments and mainly to the graded kind was highlighted as important considering that they are, responsible entities". (Participant H, a Department of Tourism official).

"the incentive program had less applicants because it is on a voluntary basis, there is no enforcement policy. The programme was mainly motivated by the 2018 drought conditions". (Participant H, a government official).

"*game lodges adhering by bylaws is important and they must apply for water licence use to prevent illegal water abstraction. To encourage engagement with guests on water*

management issues the official believed, guests should be encouraged to bring their own drinking water for proactive action to reducing water use". (Participant A, Water Management Institution).

These insights suggest that a combination of financial incentives, responsible guest engagement, and adherence to regulations can play a significant role in water conservation efforts within the accommodation industry.

Participant I, a government official, stated that there has been minimal collaboration effort between other government departments and non-governmental institutions on the uptake of water efficiency measures through incentives. The official further stated that:

"*the indirect link with TGCSA given that the NDT based based their incentive qualifying criteria on the grading of hotels. The Council for Scientific and Industrial Research (CSIR) as a leading scientific and technology research organisation was involved on recommendations for technology that could be accelerated towards water efficiency by hotels. The Small Enterprise Development Agency (SEDA) was involved to support the technology-related activities that were proposed for hotels. The Industrial Development Corporation of South Africa (IDC) was another national institution involved to promote economic growth by ensuring that hotels have minimal water disruptions for their operations. So far Gauteng was on the lead on applications for incentives with the main technology that involves aerated showerheads and the dual flush toilets. There is also technology for water treatment, water harvesting and water recycling to enable the NDT to measure the impact the programme will last up to 2025 (5 years running). Unfortunately, COVID had an impact on the running of the project during the initial stages".*

However, none of the interviewed game lodge owners indicated any knowledge of incentive programs that were available to assist them with the uptake of technology by the NDT.

The official from the TGCSA, participant C, expressed the opinion that government enforcement for sustainable changes was lacking. According to this official, an amendment Bill by the

Department of Water and Sanitation was needed to improve water conservation within the hospitality industry. Comments from this participant included:

> *"no policy in place to encourage institutions to print awareness materials on water savings. The TGCSA has guidelines on water efficiency measures for preparedness to address water conservation".*
> *"cannot enforce something that is not legislated as it is all done on voluntary basis".*
> *"water conservation in the hospitality industry should be part of the requirements for grading".*

However, not all game lodge owners were in support of the grading and water efficiency measures being combined by the TGCSA. Participant GL 5, a game lodge owner, stated that:

> "pressure is on to use less water, too much legislation could cause harm".

Overall, legislation could create a more level playing field, encouraging and possibly mandating establishments to adopt water-efficient practices. Participant GL 4, game lodge owner was of the view that:

> *"environmental education for all environmental activities was crucial for neighbouring residents towards understanding the importance of conserving water".*

There is a need for better communication regarding available incentive programs, and the role of education in raising awareness about water conservation. The game lodges' more stable water supply compared to residents highlights the need for responsible water management, awareness of community water issues, and the potential for game lodges to contribute positively to water conservation efforts in the region.

4.6. Conclusion

This chapter presented study results into the implementation of water governance and water efficiency strategies within the context of 3-5 star graded game lodges and associated residential

beneficiation in the Dinokeng Game Reserve, Gauteng, South Africa. The research aimed to contribute valuable insights for the development of recommendations aimed at enhancing water governance strategies and promoting water efficiency practices among the targeted stakeholders. The study addressed five specific research objectives, each shedding light on different facets of water governance and efficiency in the study area. The findings revealed the current state of reflexive water governance, the effectiveness of national laws and policies, the adoption and implementation of water efficiency measures, effective water governance strategies in game lodges, collaboration efforts among stakeholders, and potential competing priorities between game lodges and residents in the study area.

The results suggested both successes and challenges in the current water governance framework, indicating areas that require improvement and opportunities for positive interventions. The extent of reflexive water governance, as well as the effectiveness of existing laws and policies, has implications for the overall water management in the Dinokeng Game Reserve and similar environments. The adoption of water efficiency measures, identification of effective governance strategies, and collaboration efforts among stakeholders are critical components in the pursuit of sustainable water use practices. The study identified and highlighted various challenges in water governance, such as inadequate infrastructure, inefficient allocation and distribution and lack of coordination among stakeholders. The research emphasizes that successful water governance should focus on long-term sustainability and resilience for both residents and game lodges. The results highlighted the importance of context-specific approaches to water governance to address challenges that have significant implications for water resource management and sustainability.

The insights gained from this study pave the way for the formulation of practical recommendations that can positively impact water governance and efficiency in 3-5 star graded game lodges and their surrounding residents. The impact of water scarcity has directly affected residents, especially vulnerable communities like children and the elderly, who have been exposed to cholera outbreaks due to extremely poor water quality. Considering these detrimental effects, it is crucial for residents and key stakeholders to collaborate with game lodges and government officials to facilitate improvement initiatives and address the current water situation through beneficiation efforts.

Despite difficulties, residents demonstrated resilience through their efforts to preserve water and navigate the limitations of their constrained water resources. Ultimately, the findings contribute to the broader discourse on water governance, emphasizing the need for reflexive and collaborative approaches to address the complex challenges associated with water management in unique environments such as game lodges. The next chapt will provide more details on discussing the results. The discussion section should tie everything together, showing how the research answers the research question, how it fits into the existing body of knowledge, and what it means for future research and practice.

Chapter 5 Discussion

5.1 Introduction

In this chapter the results that were presented in the earlier chapter were interpreted, analysed, and contextualized to shed light on the broader implications and significance of the study. The primary purpose of the discussion is to answer the research questions and explore how the results align with or diverge from prior studies or theories regarding water governance. This section provided an opportunity for the researcher to explain the significance of the findings, discuss their implications, and compare them with previous studies. The discussion section allowed the researcher to evaluate the results, identify any limitations or weaknesses in the study, and propose future research directions. The identified patterns, trends, and outliers present in the data are discussed to elucidate their significance in the context of the research objectives. Furthermore, any unexpected or conflicting findings will be acknowledged, and plausible explanations supported by evidence from the literature will be provided. The researcher would explain how the findings contribute to the existing body of knowledge and whether they support or contradict previous research. It is important to provide a logical and coherent argument, supported by evidence from the study, to convince the reader of the validity and significance of the findings. By placing the findings in the context of the existing literature, the researcher can highlight the novelty or uniqueness of their study and contribute to the ongoing scientific discourse.

The chapter is presented based on the themes that emerged to reveal insights and patterns that help to understand various phenomena from the analysed data. The first theme on *Water Quality and Supply* is in section 5.2, the second theme on *Water Allocation and Distribution* is presented in section 5.3, the third theme on *Stakeholder Engagement and Collaboration* is presented in section 5.4, the fourth theme on *Environmental Impact and Risk Management* in section 5.5 and the conclusion of the chapter is presented in section 5.6.

5.2 Theme 1: Water quality challenge

Water quality is vital for human health, the environment, and economic activities (Bain et al., 2014). The critical importance of water quality for human health, the environment, and economic

activities is a global concern, and it holds relevance for communities like Mandela Village and Kekana Gardens in Hammanskraal. Analyzing the information provided in the context of Hammanskraal brings attention to specific challenges and the urgent need for comprehensive solutions. Access to safe and clean drinking water is essential for maintaining good health, as contaminated water carry harmful pathogens such as bacteria, viruses, and parasites that cause waterborne diseases (Bartram & Cairncross, 2010). These waterborne illnesses, such as cholera, dysentery, and typhoid, have severe consequences, especially for vulnerable populations like children and the elderly (Bartram & Cairncross, 2010). As indicated by most informants from like Mandela Village and Kekana Gardens the water quality in the area is poor and leads to different waterborne diseases. Immediate and coordinated efforts are required to ensure access to clean and safe water for all residents. Furthermore, the importance of water quality extends beyond human health, water is a fundamental resource necessary for all forms of life, and its quality directly impacts the environment (Nephawe et al., 2021). Declining water quality due to expanding economic activities and the uncontrolled human population growth poses multiple health and environmental impacts (Oluwasanya, 2023). It is crucial to ensure that water meets minimum quality standards for various uses to maintain environmental sustainability (Oluwasanya, 2023). In addition to health and environmental impacts, water quality also has economic implications. Many countries have laws and regulations in place to protect water quality, and non-compliance with these regulations lead to fines and legal consequences for industries and individuals responsible for water pollution (Bain et al., 2014). Ensuring good water quality is essential for sustaining economic activities that rely on water resources.

In developed nations, drinking water safety is often taken for granted, but there is ample proof that disease outbreaks can still occur and that they should be properly controlled and avoided. (Bain et al., 2014). Disease outbreaks associated with drinking water have also been reported in affluent nations, highlighting the need for effective preventive measures (Bain et al., 2014). A retrospective analysis of disease outbreaks in affluent nations over the past 30 years provides insights into the causes of these outbreaks and can inform the adoption of more effective preventive measures (Bain et al., 2014). While South Africa has made progress in meeting its water and sanitation service goals, significant deficits remain, particularly in the case of sanitation (Rhodes & McKenzie, 2018). The intermittent water supply plaguing the nation is a damning testament to the abysmal state of

water service delivery. The findings by Loubser et al. (2021) underscore a glaring and persistent failure in addressing the fundamental right to access clean water. This situation is a stark reminder of the dire need for urgent and comprehensive measures to rectify the woeful state of water and sanitation infrastructure. The health and well-being of communities are being jeopardized by the negligence and incompetence that allow such widespread water challenges to persist. This situation underscores a concerning failure on the part of authorities to prioritize fundamental needs, revealing a distressing neglect in guaranteeing access to clean drinking water and basic sanitation for all individuals, irrespective of their geographic location or socioeconomic status.

In the context of agriculture, building resilient irrigation systems is essential for smallholder farmers in South Africa (Kativhu et al., 2020). Such initiatives can aid in alleviating the effects of water scarcity on food cultivation while also enhancing agricultural resilience. Whereas for residents, efforts must be integrated into broader initiatives aimed at achieving sustainable development and ensuring access to water, sanitation, and hygiene services for all (Nephawe et al., 2021). For the tourism industry, including game lodges water is needed for meeting the basic needs of tourists, maintaining tourist attractions, and operation of tourism facilities (Liu et al., 2021). Integrated and collaborative strategies involving various stakeholders are important for effectively managing and conserving water resources across these sectors (Xiong et al., 2022). Overall, it is important to prioritize water resource protection and strike a balance between tourism development and water conservation to ensure the long-term sustainability of the industry.

5.2.1 Water quality challenges from the taps and water tankers in Mandela Village and Kekana Gardens

Water quality challenges from taps and water tankers are significant issues that affect public health and access to safe drinking water (Malla et al., 2019). Establishing systematic monitoring processes for water quality in Hammanskraal is required. This entails conducting regular inspections and evaluations to promptly identify and resolve issues, thus mitigating health risks linked to inadequate water quality. Poor hygiene, sanitation, and water supply can result to a massive burden of ill health (Bartram & Cairncross, 2010). According to Maheshwari (2023) tanker water supply systems have been found to have inadequate services, poor water quality, informal settlements of vendors,

inadequate service features, and high prices charged to consumers. Private water tankers, which have become more prominent in the water delivery supply chain, pose challenges in ensuring water quality and preventing the spread of waterborne illnesses (Joseph & Sibi, 2020). Bacterial contamination in tanker water can be attributed to inadequate water disinfection treatments (Joseph & Sibi, 2020). Pathogens, including viruses and bacteria, have been detected in tanker water samples, indicating its unsuitability for drinking purposes (Malla et al., 2019). The lack of planning and scheduling frameworks for tanker water supply systems leads to untimely water delivery and water quality monitoring issues (Maheshwari et al., 2020). Untimely water delivery was found to have significant consequences for residents in Hammankraal, as they did not have access to clean and safe water when needed.

To address these challenges, it is important to implement measures to improve water quality in both tap water and tanker water. This includes implementing proper hygiene and sanitation practices, ensuring adequate water treatment and disinfection, and regular monitoring of water quality (Joseph & Sibi, 2020; Bartram & Cairncross, 2010). Developing planning and scheduling frameworks for tanker water supply systems can give assistance to optimize operations and ensure timely delivery of water while maintaining water quality (Maheshwari et al., 2020). Regulation and overseeing of tanker water supply systems are also important to ensure compliance with water quality standards and prevent contamination (Joseph & Sibi, 2020). The absence of systematic monitoring could contribute to water quality issues and health risks.

Water quality affects colour and odour if proper treatment is not applied (Edokpayi et al., 2018). The effects associated with water quality may range from acute to chronic depending upon the duration of exposure to a particular water source (Mohamed et al., 2019). Due to the poor water quality both from tap water and tankers in Hammanskraal, the water is non potable for human consumption. Changes in water quality can have a variety of effects on water consumers. Most residents highlighted that water from the tap was either brown or green. Green water could indicate the presence of algae in the water distribution system (Kelly et al., 2020). There is a high incidence of gastroenteritis, liver function impairment and vomiting in populations where algae is ingested (Kelly et al., 2021). Water treatment options are designed to limit algae activity by breaking down algal cells for acceptable domestic water uses (Taviani et al., 2022). Where water appears brown it

is apparent of suspended matter, also called turbidity, that affects clarity and water potability. The persistence of colour forced some residents to use water filters. While no microbial testing or sampling of water supplies was done in this study, the cloudy, muddy, murky water may be associated total dissolved solids in the water and/or with microbial growth in drinking water hence high turbidity maximises the potential of infectious diseases (Kelly et al., 2020). Other scholars can consider this study area for epidemiology considering the health impact of residents due to water quality.

Odour perception is a complex sensation or olfaction perceived by receptors in the nasal cavity to detect different constituents (Kelly et al., 2020). Odour may signal the potential presence of toxic substances that can either be of organic, biological, or industrial origin (Taviani et al., 2022). Odours of a biological origin in a source water may result from the dumping of raw sewage which enhances biological growth (Kelly et al., 2020). The underground nature of groundwater and its limited exposure to external contaminants and environmental factors contribute to its generally lower likelihood of developing odor problems compared to surface waters (Britto et al., 2019; Olago, 2019). Some municipal areas in South Africa banned the use of plastics and phenolic pipe-jointing compounds that produced an odour due to the reaction of residual chlorine and plastics even though there was no association with health effects (Ncube et al., 2012; Chirwa et al., 2010). The odour in the water from Hammanskraal was obvious and unpleasant. One of the residents had mentioned how odour affected their intention of running a solid car wash as the odour was unpleasant and customers would surely object. This indicated the depth of the poor water quality in the area and the compound growth of microorganisms that affects the lives of residents.

The total coliform group of faecal origin suggests that bacterial pathogens such pathogenic *Escherichia coli*, *Yersinia enterocolitica*, *Vibrio cholerae*, *Campylobacter jejuni*, and *Salmonella* spp. may be present in a water sample. Typhoid fever, dysentery, cholera, gastroenteritis, and salmonellosis are among the illnesses that can be brought on by these bacteria. (Mpenyana-Monyatsi et al., 2012). If the distribution system is well maintained and water is treated according to minimum standards, few coliforms should be detectable (Bai, 2022). The onsite boiling of water should not be the case for water collected from taps as the water should have undergone various treatments (Bai, 2022). The response from the municipality highlighting that the wastewater

treatment plant had been fixed in 2019 indicated that further interventions were required to verify if there was social acceptance by residents whose water needs had to be met.

The *Blue Drop*, *Green Drop*, and *No Drop* Certification programs in South Africa are crucial for ensuring the quality of water resources, wastewater management and water conservation (Makuwa et al., 2020). The *Blue Drop* Certification Program focuses on improving municipal drinking water quality. As such the aim of the Blue Drop Certification Program is to recognize and certify excellence in providing reliable and safe drinking water services (Steyn, 2022; Edokpayi et al., 2020). The *Green Drop* Certification Program concentrates on recognizing municipalities that excel in providing effective wastewater treatment services. Wastewater management and effluent quality reports are provided to inform the public and stakeholders about the state of wastewater management (Edokpayi et al., 2020). Whereas the *No Drop* Certification Program was focused more on encouraging efficient water use and management practices to reduce water losses within municipalities (Steyn, 2022). Credible data from these programs provides information through reports to keep the public and stakeholders informed about the state of drinking water services. These references collectively underscore the significance of certification programs in different sectors, emphasizing their role in upholding standards and ensuring quality outcomes.

Most residents have planted ornamental plants because by default water cannot be used to irrigate edible plants which limits agriculture into food security for Hammanskraal residents. Backyard gardens are important for nutritional purposes and to sustain food security in residential areas (Nkosi et al., 2014). The inconsistent water supply for irrigation purposes clearly prevented some residents in Hammanskraal from using the water they regarded as “contaminated” for their crops. Those residents who had edible crops depended on rainfed crop production. These findings confirm those reported by Van Niekerk (2008). The limited access to water forced residents in both Mandela Village and Kekana Gardens to cross over the highway with wheelbarrows to access a water tap along the border of the Dinokeng Nature Reserve, like findings described by Mabe and Chauke (2019). The water challenge in the area seemingly went from bad to worst and it has taken over a decade to see any positive change. There is a need for the municipality to urgently review water services in the area to avoid risks that may lead to damage to the municipality pipeline and possible waterborne diseases particularly considering groundwater extraction e.g., hand dug wells. The

municipality's obligation to address these issues promptly is important to ensure the well-being of the community and avoid waterborne disease outbreaks and infrastructure damage. It underscores the importance of effective water management and service delivery to protect public health and water resources.

The water quality challenges faced by residents in Hammanskraal from taps and water tankers pose significant risks to public health. Inadequate services, poor water quality, and high prices are common issues in tanker water supply systems. Proper hygiene, sanitation, water treatment, and monitoring are essential to ensure safe drinking water. Planning and scheduling frameworks can improve tanker water supply operations, and regulation is necessary to maintain water quality standards. Addressing these challenges requires coordination between health professionals, policymakers, and water supply stakeholders.

5.2.2 Monitoring and control of water quality in Mandela Village, Kekana Gardens and Game lodges

In the persistent context of water supply and quality challenges in South Africa, with specific concerns prevailing in regions such as Hammanskraal, the quality of household tap water becomes a critical focus. The quality of household tap water can vary depending on several factors, including the source of the water, the treatment processes it undergoes, and the condition of the plumbing system in the house (Pearsall et al., 2021). Tap water is regulated and monitored to meet safety standards set by government authorities (Tabor et al., 2011). If municipalities indicate that the water being provided complies with these requirements, it provides assurance to residents that the water is suitable for consumption (Mativenga & Marnewick, 2018). In South Africa, for example, the treated water supplied to homes must undergo routine testing in accordance with SANS 241 regulation issued by the South African Bureau of Standards - that require that drinking water is treated to acceptable levels by water treatment plants to ensure compliance with the standard (Tabor et al., 2011). Implementing planning and scheduling frameworks is important for addressing these challenges, improving the efficiency of water supply operations, and ensuring the sustainable use of available water resources.

The raw water drawn from rivers and dams should be treated before it is supplied to homes by water boards or municipalities. Municipalities are not permitted to supply communities such as water that does not adhere to the quality requirements set by the South African Bureau of Standards (Luvhimbi et al., 2022). It is important to note that the quality of tap water can be affected by factors such as water stagnation in building plumbing systems (Chan et al., 2019). The quality of household tap water should be regulated and monitored to meet safety standards. Water treatment processes and the condition of the plumbing system affects the quality of tap water (Gupta et al., 2015). Water stagnation could lead to water quality deterioration, including the release of lead or the proliferation of pathogens (Ling et al., 2018). Studies have shown that tap water microbiome composition can change rapidly following water stagnation, with an increase in bacterial cell count, which hinders the development of effective biological monitoring strategies (Ling et al., 2018). This highlights the need for further research and monitoring to ensure the safety and quality of tap water.

Factors such as knowledge of water treatment practices, perceptions of water quality at the tap, and socio-demographic characteristics could influence household water management decisions (Pearsall et al., 2021). For example, households may be more likely to treat their tap water if they believe that government or community treatment facilities are ineffective or if they perceive the water quality at the tap to be low (Jain et al., 2014). This was a case in Hammanskraal as most residents chose to treat their water prior to consumption, while others chose to use water for other purposes than consumption. According to Omarova et al. (2019), the quality of water supplied by tankers can vary depending on several factors, including the source from which it is obtained, handling and storage practices, and the maintenance of the tanker itself. The source water directly affects the quality of the water delivered by the tanker, which can come from municipal water supplies, natural sources such as wells or springs, or other untreated source, In some cases, water from tankers may undergo treatment processes to improve its quality, such as filtration, disinfection (e.g., chlorination), or other treatment methods to remove impurities and ensure it meets certain quality standards (Omarova et al., 2019). This emphasizes how knowledge, perceptions, and the quality of water supplied via tankers can all impact household water management decisions, particularly in areas with water challenges such as Hammanskraal. It also emphasizes the importance of treatment processes in ensuring water quality and safety.

In the case of rural areas, there may be challenges in accessing safe water supply which is the case in Hammanskraal. A study conducted in central Kazakhstan found that residents had doubts about the tap water quality and often used alternative sources, including tankered water (Omarova et al., 2019). The study also highlighted that the volume of water consumed was lower among tankered water users compared to tap water users (Omarova et al., 2019). This could be due to factors such as religious obligations, water price, family income, climate conditions, and intentions to preserve water resources (Pindihama & Malima, 2022). In urban areas such as Accra, Ghana, tanker water supply plays a significant role in shaping decisions regarding the distribution of water (Alba et al., 2019). Tanker drivers act as brokers, determining how much water of what quality is distributed and accessed by different individuals across the city (Pindihama & Malima, 2022; Alba et al., 2019). The ability of tanker drivers to coordinate different logistical and social arrangements influences who gets what water at what price which indicates the heterogeneity of water supply infrastructure (Alba et al., 2019). This highlights the impact of concerns about tanker water quality on residents' water source choices, the role of various socio-economic and environmental factors in shaping water consumption patterns, and the unique dynamics of water distribution in urban areas where tanker water supply is prevalent.

To maintain water quality during transportation and storage, adequate storage practices should be followed including protecting the water from exposure to sunlight, extreme temperatures, and potential sources of contamination (Omarova et al., 2019). Regular cleaning and disinfection of the tanker's interior surfaces are necessary to prevent the accumulation of contaminants (Zozmann et al., 2022). Proper maintenance also includes regular inspection of the tanker for leaks or other issues that could compromise water quality and authorities need to set up standards to ensure the delivery of safe and clean water (Pindihama & Malima, 2022; Omarova et al., 2019). According to Zozmann et al. (2022), water tankers can contribute to sustainable access to water by providing water where there is limited access. The water tankers are however comparatively more expensive due to marginalised pricing and not all residents can afford their services. The integration of diverse access points to subsidized piped water aims to foster equitable access to water resources, acknowledging and addressing the heterogeneity in accessibility.

Monitoring and control of water quality plays an important role in water quality management (Losa et al., 2019). There are programs provided for evaluating water quality and identifying trends in water management. For example, in Cienfuegos Bay, Cuba, the development of monitoring programs and the assimilation of integrative approaches have contributed to the improvement of water quality management (Losa et al., 2019). These integrative approaches consider the hydrologic, environmental, and causal factors influencing water quality and enable more effective decision-making. Monitoring and controlling water quality require the use of various tools and approaches including the Water Risk Filter, water quality indices, mathematical methods, artificial intelligence techniques, and monitoring programs (Pindihama & Malima, 2022; Laporte-Bisquit, 2021). By leveraging these tools, stakeholders can make informed decisions, devise effective prevention and control strategies, and ensure the sustainability of water resources (Gupta et al., 2015). Using data on various physico-chemical and biological parameters, they can generate a single numerical value that reflects the overall water quality status at a specific location and time.

This study indicated that the degradation of water quality has negative long-term effects on socio-ecological systems. Additionally, the results showed that scarcity of freshwater is increasingly a problem of quality rather than quantity which corroborate with the finding of Bharuri et al. (2016). The study findings provided a comprehensive lens through which to understand and address the complexities inherent in managing water quality. The water quality challenge is not static; it evolves with changing environmental conditions, emerging contaminants, and human activities. Reflexive governance supports active involvement of diverse stakeholders, including government bodies, research institutions, communities, and industries, in an ongoing dialogue that informs and refines water quality management strategies for adaptability and collaboration towards continuous improvement and responsiveness of sustainable water quality management.

Furthermore, this study reflected on the effectiveness of national laws, regulations and policies on water quality that are essential to indicate if respective objectives are being met at multiple levels towards sustainability. Reflexive governance is rooted in the principles of adaptability, learning, and responsiveness, offers a dynamic perspective that aligns well with the intricate and evolving nature of water quality challenges. The importance of constant reflection on the state of water quality is the responsiveness of regulatory measures towards sustainable water quality management.

The combined use of reflexive governance and the UNDP Water Governance Framework as theoretical frameworks for the theme on water quality encourages stakeholders to engage in an ongoing dialogue, fostering a learning environment where experiences, data, and scientific advancements shape decision-making. Rooted in the principles of inclusivity, accountability, and sustainability, the UNDP Water Governance Framework provided a structured approach to understanding and addressing water quality challenges within the broader context of sustainable water management. The integrated approach of using the selected theoretical frameworks supported the adaptive, inclusive, and sustainable water governance strategies that are essential for safeguarding water quality in complex and dynamic ecosystems.

5.3 Theme 2: Water allocation and distribution

Study findings indicated that water allocation and distribution is not merely a logistical challenge; it is a dynamic process influenced by ecological considerations, socio-economic factors, and the ever-evolving needs of diverse stakeholders. This theme served as a bridge between the broader examination of water quality challenges and the water governance strategies explored in subsequent sections. The UNDP serves as a pertinent and insightful theoretical framework for the exploration of the theme on water allocation and distribution. Rooted in principles of efficiency, equity, and sustainability, the UNDP framework provides a comprehensive approach to understanding and addressing the intricate challenges associated with the allocation and distribution of water resources. One of the key elements of the UNDP Water Governance Framework is its emphasis on equity in water allocation. When applied to the theme on water allocation and distribution, this principle prompts an examination of how water resources are allocated among various users, considering factors such as social equity, economic considerations, and the needs of different stakeholders. The framework encourages a fair and inclusive approach to water allocation, ensuring that vulnerable communities and ecosystems are not disproportionately affected.

Water allocation and distribution is crucial in ensuring sustainable and equitable access to clean water, protecting water resources, and supporting economic development (Qin et al., 2014). Effective water governance infrastructure requires careful consideration of environmental, economic, and social factors, as well as collaboration between stakeholders and investment in

infrastructure development and maintenance (Fedulova et al. 2020). Water allocation and distribution includes policies, structures for water supply, water quality, wastewater management, and water-related infrastructure development in place to manage and regulate water resources and services. Water governance infrastructure is crucial for ensuring sustainable and equitable access to clean water, protecting water resources, and managing water-related risks and challenges (Kang, 2019). It encompasses various aspects such as water supply, water quality, wastewater management, and water-related infrastructure development.

5.3.1 Water allocation and distribution challenges by Tshwane Municipality

Water allocation and distribution challenges pose significant ecological and societal disasters brought on by improper freshwater resource management and insufficient access (Cosens et al., 2021). These challenges can result in deaths from water-related illnesses, and an increasing risk of conflict over scarce water supplies (Adshead et al., 2019). To address these challenges, new approaches to long-term water planning and management are necessary, incorporating principles of sustainability and equity (Cosens et al., 2021; Adshead et al., 2019). One key aspect of these approaches is ensuring guaranteed access to a basic amount of water necessary for human health and ecosystem sustainability (Cosens et al., 2021). Additionally, protecting the renewability of water resources and implementing institutional recommendations for planning, management, and conflict resolution is crucial (Adshead et al., 2019). There is an urgent need to address water allocation and distribution challenges through new, sustainable, and equitable approaches that prioritize human health, ecosystem sustainability, and long-term water resource renewability.

One of the key challenges in managing water resources in the face of climate change is the uncertainty in rainfall patterns, including intensity and duration (Leigh & Lee, 2019). This change has led to the occurrence of extreme hydrological events, such as severe floods and hydrological droughts, with greater frequency, causing significant socio-economic damages (Kumar & Bassi, 2021). While climate models are effective at displaying average temperature changes and simulating large-scale processes, precipitation is a more localized process that is difficult to accurately predict (O'Gorman, 2012). To address the challenges posed by climate change and changing water demand, more funding will be required for initiatives that improve adaptation at various levels, including regional, watershed, and household levels such as technological

advancement (Arnell et al., 2014). These initiatives may include the development of water storage facilities, joint ground- and surface-water use, wastewater capture and reuse towards resilience (Arnell et al., 2014). This highlights the critical challenges posed by uncertain rainfall patterns and the increasing frequency of extreme hydrological events due to climate change. It emphasizes the need for increased funding and the implementation of adaptation initiatives to address these challenges and build resilience at various levels.

To effectively manage water resources and meet the expectations of the people in terms of quality, quantity, and pressure of water supplies, water managers would benefit from having future supply and demand probability functions (Adshead et al., 2019). However, future demand functions have not been extensively researched to date, and decision-makers are interested in identifying reliable options that can be implemented in any future scenario (Arnell et al., 2014). Addressing water allocation and distribution challenges requires a comprehensive and sustainable approach that considers the needs of both humans and ecosystems. By incorporating principles of sustainability, equity, and long-term planning, it is possible to mitigate the ecological and human crises associated with inadequate access to freshwater resources (Leigh & Lee, 2019). Implementing institutional recommendations can further support the development of rational policies and approaches for sustainable water use (Cosens et al., 2021). This emphasizes the need for a proactive and comprehensive approach to water resource management. This includes understanding future supply and demand, addressing challenges in water allocation and distribution, and implementing institutional recommendations to ensure sustainable water use while considering the needs of both human populations and ecosystems.

There is no escaping the fact that the demand and need for limited and vulnerable water supply will continue to expand and so will competition for it. Future predictions are for higher frequency of extreme weather events, and more rapid return flows of water to the atmosphere which increases uncertainty in water availability (Leigh & Lee, 2019). To gain a deeper understanding of the social, political, and environmental ramifications of these intricate interconnections and how they might evolve in the upcoming decades, more research is required. Clearly, water issues will become even more important in the lives and activities of people (Grayman et al., 2012). According to the third United Nations World Water Development Report [United Nations World Water Assessment

Programme (UN WWAP), 2009], at the global level the issue of water is rising in importance with a warning that extremely serious consequences may arise from its current unsustainable and unequal use. Because of this, recent concerns about an impending global water crisis have started to join those about the energy crisis. The relationship between energy and water, as shown by the impacts of water use on energy consumption as well as the impacts of energy production on water consumption, is receiving more and more attention (Lazaro et al., 2023; Kumar & Bassi, 2021). Based on the views of people in Mandela Village and Kekana Gardens the City of Tshwane municipality has an important role in preventing mismanagement as this could impede water security and economic growth. The suggested measure by the interviewed residents includes, 1) *the need to adapt to institutional changes* and 2) *make greater investments towards water management*. This study demonstrated that limitations persist within the country concerning the delivery of water services, rendering it incompatible with the principles of sustainable development.

The population of both Mandela Village and Kekana Gardens had outdoor flushable toilets. This indicates progress in terms of informal settlements evolving into formal townships with connections to the municipality water management systems. A study by Meyer and Reed (2001) indicated that Mandela Village residents depended on pit toilets, also known as latrines. The outdoor toilets and taps from each of the households in both Mandela Village and Kekana Gardens indicated that the municipality made progress in providing sanitation and water services to the residents. The insufficient water supply in Mandela Village and Kekana Gardens is contradicting the South African constitution due to lack of access to sufficient water which renders the flushable toilets and taps useless. Prioritizing the supply of drinking water and affording proper sanitation is a basic human right. According to Aboelnga et al. (2019) and Britto et al. (2019), those residents who lack access to the most fundamental level of service such as water and sanitation should form an important part of governance. Water culture uses in Hammankraal consist mainly of basic needs such as consumption and household use. The international standard on water use guides that everyone should have access to at least 165 liters of water per day, with an upper limit of 200 liters based on daily demands (Chan, 2009). Water consumption for households in Hammanskraal seemed way below the recommended standard. There were not heavy water users such as appliances e.g., washing machines, which indicates that the culture of water consumption in rural areas is minimal considering people's attitude towards water and saving.

While water scarcity can be provoked by various factors, some water supply challenges arise from increased demand due to rapid population growth (Britto et al., 2019). As the number of residents increases, the pressure on existing water resources intensifies, leading to shortages and exacerbating supply issues. The absence of water distribution lines and poor infrastructural development such as failure of wastewater treatment plants could aggravate water challenges in the area. It is important that the temporary measures in place are not extended indefinitely without updating residents. Proper timelimes should be set and met to ensure that the residents are not stranded for extended periods. It should also be the responsibility of the municipality to ensure that temporary water services are provided to residents without residents always probing and paying for every water delivery. The tendencies in Hammankraal reflected a regression from the municipality and is quite unsustainable over time. It is known that rural community members are predominantly low-income earners and therefore paying for water delivery is a heavy burden. The findings of the study agree with those of Harvey (2010), Kudva (2009) and Nilsson (2006) who maintained that peripheral areas experienced disparities in water supplies when compared to urban areas. However, the case of Hammankraal has a centralized water management system whose improvement needs improved planning and prioritization to ensure potable water availability.

What looked to be an acute water crisis for Western Cape in 2018 driving a province to a low water supply termed “Day Zero” with residents’ access to 25 liters daily water supply seemed to be a daily occurrence in Hammankraal (LaVanchy et al., 2019). The water crisis in Hammanskraal requires urgent intervention considering population growth, climate change and aging infrastructure. Support is needed for residents in Hammankraal towards water service options as the current system’s plans are not effectively serving the community. The plans of infrastructural rehabilitation, improved water quality and water efficiency measures considering environmental factors need to be given priority to enable residents to improve in livelihoods towards quality lives.

While the municipality participant mentioned that there are other competing interests due to constant change of leadership within the municipality, it is important that operational parameters on water management are critically considered to ensure continuous development. Such deterioration of water and sanitation systems was reported in Asia (Karthe et al. 2015; Rost et al. 2015) and

South Africa (Bopela, 2017). These authors also indicated that finances resulted to a sharp decline in water provision and maintenance of infrastructure such as the decentralised wastewater treatment plants.

While Cooley et al. (2014) indicated that the United Nations Report of 2006 found water governance is worsening in different parts of the world, Sadoff et al. (2020) highlighted that the world is lagging in its plans to achieve Sustainable Development Goal 6 (SDG 6) and is not meeting the targets under the Millennium Development Goals (MDG) for good water governance. This underscores the ongoing global challenges in ensuring effective water management and equitable access to water resources. South Africa and many other countries have another half a decade to ensure that by year 2030 all countries achieve equitable access to sanitation and water services based on the SDG goals (Sadoff et al., 2020). The SDG 6 goes beyond providing clean water and sanitation but also addressing recycling, treatment of wastewater and ensuring safe reuse of water on a global scale. Therefore, managing and protecting water resources using different aspects of water management is basic to improving social, economic, and environmental development. According to Jiménez and Pérez-Foguet (2010), there is a gap in progress as well as inequality on water access within urban and rural areas. Consequently, SDGs targets require comprehensive knowledge of water availability and the dynamics that surround water use and governance from local up to global levels (Herrera, 2019). To facilitate the implementation of SDGs on water perspective, scientific research and evidence are important in the assessment and policy engagement processes both globally and locally (Di Vaio et al., 2021). This study indicates the importance of research in water management and water governance and highlights the social impacts that result from the costs of inaction to implement water-related goals.

Improving water quality and provision in the City of Tshwane Municipality requires a comprehensive and coordinated approach. Identifying challenges and deficiencies is crucial for developing a meaningful agenda for reflexive governance. Assembling these actions into a reflexive governance agenda can empower stakeholders to collaboratively address water quality and supply challenges. Regular review, adaptation, and inclusivity in decision-making processes will contribute to sustainable improvements in water management in the City of Tshwane Municipality and beyond.

5.3.2 Water supply challenges

Water supply challenges are significant issues faced by government institutions in many countries, including the United States, Nigeria, Ethiopia, and Cameroon (Tantoh & Simatele, 2017). In the United States, urban water utilities face challenges related to supply reliability, financial stability, climate change, growing water demands, and aging infrastructure, while federal funding is available, local governments bear a significant investment burden (Lau, 2023). Ineffective policies and governance and weak institutions lead to water scarcity and pollution (Nwankwoala, 2012). The lack of political will, inadequate funding, and poor governance have contributed to the poor and unsustainable service delivery in the rural water sector (Wada, 2020).

In Africa, challenges in governance, government policies, and priorities have also hindered the achievement of improved rural water supply and sanitation in Nigeria (Nwankwoala, 2012). Similarly, Ethiopia faces complexities in drinking water systems, including lack of water, fluctuations in water distribution network pressure, non-revenue water, source pollution, inefficient governance and policies, and feeble institutions (Beker & Kansal, 2023). The country also struggles with efficiently developing and managing its water resources, which is attributed to factors such as the lack of experts, institutional fragmentation, weak institutional capacities, and absence of accountability that affect both rural and urban areas (Jima, 2023). These publications highlight governance and policy problems, capacity constraints, and the need for greater accountability in the management of water resources. Addressing these challenges is essential to ensuring safe and reliable water supplies for communities. In Cameroon, the government's weaknesses in managing potable water resources have led to increasing health problems, including cholera outbreaks (Buh et al., 2022). The government and local communities need to establish effective management teams to ensure sufficient and safe water supply for the growing population. The current study indicated that significant investments were required to maintain and develop water supply infrastructure.

One key aspect of water governance infrastructure is the role of privatization in water management. Privatizing water resources and services has been a topic of debate and controversy. According to Bakker (Kornberg, 2011), privatization of water has led to governance failures and contributed to the water crisis in many parts of the world. The author argues that corporate governance and

business interests often prioritize profit over public welfare, leading to inadequate access to clean water for marginalized communities. This highlights the importance of considering the social and environmental implications of privatization in water governance infrastructure (Fedulova et al., 2020). A study by Qin et al. (2014) in China indicated the importance of infrastructure development in water governance. The study emphasized the importance of investing in wastewater treatment plants and urban drainage systems to enhance water quality in rapidly urbanizing areas to significantly improve water quality.

Similarly, Fedulova et al. (2020) argued that water infrastructure is critical for ensuring the economic security of regional socio-economic systems. They propose prioritizing the development of engineering and technical infrastructure, including centralized water supply and water disposal systems, to support the functioning and development of regional economies. Azolibe and Okonkwo (2020) found that the quantity and quality of infrastructure, including water supply and sanitation infrastructure, significantly influence industrial sector productivity in Sub-Saharan Africa. They suggested that improving infrastructure, particularly in collaboration with developed countries, can enhance industrialization and economic development.

However, challenges exist in managing and maintaining water infrastructure Kang (2019) highlighted the issues of rapid deterioration and inappropriate management of urban water infrastructure in South Korea. The author predicted that a significant portion of water infrastructure will have deteriorated by 2035, emphasizing the need for effective asset management strategies. Socio-economic measures also play a significant role in water governance infrastructure. This assertion is supported the current study, which positions the deterioration of water infrastructure as a future concern that requires immediate attention and proactive measures to ensure the sustainability and functionality of water systems. Qin et al. (2014) suggested that suitable water management measures, such as installing wastewater infrastructure and implementing socio-economic policies such as industrial structure regulation and economic incentives can improve water quality and reduce the generation of pollutants.

5.3.3 Water allocation and distribution challenges in rural areas

Water allocation and distribution challenges in rural areas have significant implications for both human and the environmental well-being (Davey et al., 2018). Inadequate access to freshwater resources and inappropriate management practices contribute to a wide range of ecological and human crises, including the destruction of aquatic ecosystems, water-related illnesses, and the risk of conflict over scarce water supplies resources (Cosens et al., 2021). As the global population continues to grow, these challenges are expected to become more frequent and more severe (Adshead et al., 2019). As the global population increases, effective and sustainable water resource management becomes even more crucial to ensure equitable access to clean water and protect the environment.

In rural areas of China, water allocation and distribution challenges persist despite ongoing investments in water infrastructure (Li et al., 2018). There is a significant disparity between urban and rural areas in terms of water supply infrastructure and management, negatively impacting rural residents (Kang, 2019; Li et al., 2018). Factors such as climate change impacts, contaminants, economic volatility, water resource shortages, and substandard treatment and supply management further threaten rural drinking water safety (Nephawe et al., 2021; Li et al., 2018). Similar challenges exist in other countries such as Zimbabwe and Ethiopia, where water scarcity affects farmers and impacts food security initiatives (Nephawe et al., 2021). These issues are often characterized by disparities in infrastructure, limited access to clean water, and a range of other factors that hinder the provision of safe drinking water in rural regions. Addressing these challenges is crucial for ensuring water security and the well-being of rural populations.

To address water challenges in rural areas, comprehensive strategies are needed. In China, recommendations include institutional reform, regulation revision, economic instruments, technology innovation, and capacity-building (Yu et al., 2015). Transitioning from rain-fed to irrigation-fed agriculture in rural areas can exacerbate urban water scarcity, highlighting the need for careful water allocation and access planning (Rathore et al., 2023). Additionally, greywater reuse and the implementation of programs like the Rural Potable Water (APR) program in Chile have shown promise in improving water coverage in rural areas (Rodríguez et al., 2020). By implementing comprehensive and sustainable solutions, it is possible to mitigate the impacts of

water allocation and distribution challenges in rural areas and ensure the availability of safe and sufficient water resources for all.

5.3.4 Water allocation and distribution in game lodges

One of the primary water uses in game lodges is to maintain the lodge's water supply (Smith & Fitchett, 2020). Water uses includes drinking, cooking, and cleaning purposes for both guests and staff. In addition, water use for irrigation purposes in game lodges often include gardens, lawns, and other landscaped areas that require regular watering to maintain their appearance. Additionally, game lodges may use water for recreational purposes such as swimming pools. These facilities require regular maintenance and water treatment to ensure the safety and cleanliness of the water. Furthermore, game lodges may also use water for wildlife management purposes. This can include providing water sources, such as artificial waterholes for wildlife in the area. These water sources are important for attracting and sustaining wildlife populations, especially during dry seasons when natural water sources may be scarce (Smith & Fitchett, 2020). The present study indicated that the management of water sources and consumption rates in game lodges is essential for ensuring the sustainability of tourism activities. Importantly the study also highlighted that game lodges have more water uses than communities and some were involved in agricultural production which is water intensive.

Water allocation and distribution in game lodges is a crucial task that requires careful consideration of available water resources, stakeholder utilities, physical limitations, and socioeconomic criteria (Smith & Fitchett, 2020). The availability of water in game lodges is a crucial factor for the sustainability of tourism and the well-being of wildlife (Fitchett, 2021). In a study conducted in the Phinda Private Game Reserve in South Africa, Mearns & Grobler (2016) examined the water sources and consumption rates of six tourism lodges. To maintain the sustainability of tourism, the study sought to establish benchmarks and standards for future water management and use. The findings of the study highlighted the importance of managing water as a critical resource in game lodges, especially in the face of changing weather patterns and persistent drought conditions in Southern Africa (Mearns & Grobler, 2016). A study by Smith & Fitchett (2020) on the other hand highlighted that even though the overall effect on tourism is found to be less severe than

anticipated, droughts may pose a serious threat to the industry in the long run. In line with the current study, game lodge owners need to make more investments to encourage responsible water management practices.

Another study by Makopondo et al. (2020) focused on the possible application of constructed wetlands (CWs) for conservation and wastewater treatment in game lodges and resorts in Kenya. The study identified CWs as alternative nature-oriented wastewater management systems that are being adopted by hotels, game lodges, and resorts locally and internationally. However, the study also highlighted potential challenges in implementing CWs, such as inadequate expertise and technical support, limited space or land availability, and the attitude of hospitality managers towards constructed wetlands (Makopondo et al., 2020). Mwebaze et al (2021) indicated that water managers ought to allocate water based on environmental and domestic water demands with allocation of 90% of industrial demand, 70% of irrigation and 60% of domestic livestock demand. It is however crucial to note that wildlife also requires water pans as water significantly influences wildlife distribution and habitat selection, as evident in studies conducted in diverse regions such as Kenya, the Mojave Desert, and isolated desert areas (Mworia et al., 2008; Harris et al., 2015; Rich et al., 2019; McIntyre et al., 2016). Research indicates that artificial water catchments play a pivotal role in shaping wildlife habitats and movements, underscoring the importance of water availability (Rich et al., 2019). Game lodge owners in Dinokeng Game Reserve used artificial dams as a measure to achieve additional water that could be used to sustain wildlife. This further suggests that water users should apply more efficient water usage practices to ensure high reliability and sustainable water resources management.

While acknowledging the importance of community-based initiatives connecting game lodges with neighboring communities, the responsibility of water management in Hammanskraal cannot solely involve the game lodges. Instead, a more centralized approach which involves placing the responsonsibility on the central, provincial, or local government. The Dinokeng Projects, as outlined in the Gauteng Provincial Government Report 2021/2022, actively engaged in network tourism and infrastructure, could serve as a crucial component of infrastructural development aimed at supporting the Hammanskraal community in alignment with the National Development Plan (NDP).

By exploring avenues within these government-driven projects, there's potential to create economic opportunities for the local community, specifically in water-related areas. This may involve generating employment opportunities in water management, infrastructure maintenance, or other water-centric businesses. Collaborating with local NGOs, governmental agencies, or philanthropic organizations becomes essential in leveraging additional resources and expertise to enhance water access for the community. The emphasis should be on a coordinated and government-driven effort to ensure sustainable and widespread positive impact, rather than relying solely on the goodwill of individual game lodges.

The UNDP framework's call for stakeholder participation aligns with the collaborative nature of water allocation and distribution. By involving a diverse range of stakeholders, including government entities, local communities, and industries, the framework promotes a participatory approach to decision-making that considers the varied interests and perspectives of those involved in water allocation processes. By doing so, they can contribute to the well-being of the community and foster positive relationships with residents.

5.3.5. Water allocation and distribution by water boards

Water allocation and distribution by Water Boards is a crucial aspect of water resource management (Hyun, 2021). These local entities are responsible for local water distribution, operation, and management of infrastructure (Mmbengwa et al., 2014). It involves ensuring equitable distribution of water resources to meet the needs of various sectors, such as agriculture, domestic, and industry use. Effective water allocation and distribution strategies are essential for sustainable water use and to prevent conflict over scarce water supplies (Meissner et al., 2013). The issue of governance and management of water boards is also important in ensuring effective water allocation and distribution. Omondi (2023) highlighted the need for the decentralization of water management tasks to local Water User Associations or Water Boards. There is a need for effective governance and decentralization to ensure equitable water distribution and sustainable water resource management, thereby preventing conflicts over scarce water supplies.

Water allocation and distribution by Water Boards is a complex process that requires careful consideration of factors such as water rights, and governance (Makaya et al., 2020). Equitable distribution of water resources is essential for sustainable water use and to prevent conflicts (Bulled, 2016). However, challenges such as inadequate access, pollution, and governance issues need to be addressed to ensure effective water allocation and distribution. According to Adom and Simatele (2021), the management and maintenance of water reserves by water boards in South Africa have been inefficient, leading to contentious issues regarding ownership and effective governance. The comments from the residents were more favourable to Magalies Waterboard which suggested that water boards may need to be utilised once the renovations for the wastewater treatwater plants that service Hammanskraal have been completed. It would also be crucial to involve experts in wastewater management and adhere to industry best practices to ensure that the water quality standards in the area are improved.

In terms of water allocation models, Wang et al. (2019) considered water rights and water markets for optimal water allocation. However, there are challenges in the water allocation and distribution process. Hoekstra & Mekonnen (2012) drew attention to the fact that many nations mostly rely on imported water supplies, which has a substantial influence on pollution and water use. elsewhere. Inadequate access to water resources and inappropriate management can lead to ecological and human crises, including destruction of aquatic ecosystems, water-related illnesses, and conflicts over scarce water supplies. Corruption, mismanagement, and bureaucratic inefficiencies can also hinder effective water allocation and distribution (Omondi, 2023). This is corroborated with the findings in the current study in Mandela Village and Kekana Gardens where cancellation of the set-up contract from the water board exposed mismanagement on water supply.

Water governance in South Africa faces various challenges, particularly in the management of water resources during droughts, the interactions of multiple social, economic, political, and environmental factors, influenced by the legacy of apartheid (Sutherland et al., 2014). The coordination between water actors at different operational scales, such as local and regional levels, is crucial for building local-level drought resilience (Makaya et al., 2020). However, there are coordination inconsistencies, communication barriers, and undefined actor roles and responsibilities during disasters, which hinder effective drought management (Bulled, 2016). This highlights the

need for integration between and non-formal institutional provisions and national government institutions towards effective water governance. The need for people-oriented management in water resources provides an opportunity for water management institutions to engage with the local community and share ideas (Makaya et al., 2020). Effective coordination, communication, and integration between different stakeholders at various levels are essential for building resilience and improving water governance in the country.

Water insecurity in rural South Africa contributes to major civic actions for improved water infrastructure. Emotional distress, particularly feelings of shame, can hinder community participation in efforts to improve water situations (Bulled, 2016). Many citizens in South Africa remain disconnected from the national water infrastructure, despite water being recognized as a human right in the constitution (Makaya et al., 2020). This disconnect highlights the need to improve water allocation and distribution. To address these water supply-related challenges, a shift from reactive approaches (e.g., providing water aid during droughts) to proactive approaches (e.g., effective water governance systems, risk reduction, and regular maintenance of water infrastructure) is necessary (Bwambale et al., 2019). Additionally, there is a need for improved coordination and communication among water actors, integration between government institutions and non-formal provisions, and increased civic engagement for water infrastructure improvement.

5.3.6 Competing priorities between residents and game lodges

It has been shown that the root causes of conflicts over natural resources are often interrelated, including global economic development, overconsumption, poverty, unequal access to resources, and poor governance (Olsson, & Gooch, 2019). There were no reports on water conflict between the game lodges and residents. However, based on the growing population in the area and the increasing need for water, if the water management situation is not improved for residents of Hammanskraal, conflict could arise from the over abstraction of groundwater from the increased hand dug wells. With multiple users who may gain access to groundwater with other land use purposes other than just domestic uses e.g., agriculture, this could increase pressure on ground water. At present, the residents are not actively involved in agricultural activities. Considering this context, the exploration and utilization of groundwater may represent an important breakthrough for these individuals. Groundwater offers a valuable resource for various purposes, including irrigation

for potential farming endeavors, addressing water scarcity concerns, and fostering sustainable development within the community. Most residents highlighted that the game lodges were privileged to maintain their water as they sourced it from boreholes. Despite the Department of Water and Sanitation's data showing a borehole near Mandela Village, residents did not mention it as a water source and suggested that groundwater from boreholes could be a better option due to poor water quality. The knowledge that the game lodges had better water quality and supply may have been a reason that led to some residents resorting to hand dug walls as water sources. While it is not yet the case, too many ground water users in an area may lead to unacceptably lowered water levels that could hamper the water supply for game lodges in Dinokeng Nature Reserve, particularly considering the high population in the area. It is important that residents understand and know why groundwater sustainability is important and it is equally important that local water laws, regulations, and permits are observed for compliance.

In South Africa, permits or licence system are a requirement for water extraction activities to ensure that boreholes are within socially, politically, technically, and environmentally acceptable standards. The permits consider groundwater abstractions within water management plans to conserve its quality and exert control over groundwater extraction. The National Water Act, 1998 of South Africa links groundwater to land surface which results to inequitable allocation of water. For legal compliance, it is mandatory, however, that all users are validated and registered by the DWS. Auditors are required to examine all records to determine if the water use began before 1998 as those before this year do not require documentation. This study results show that rural residents are coming up with solutions to their water problems however there are no policies to support them up. There may be a need for other studies to explore if groundwater can be considered for use by these residents to diversity their water sources particularly if it will not be every household with their own borehole. Accessing groundwater could represent an effective solution to better water quality particularly if chemical and biological composition tests can be conducted (LaVanchy et al., 2019). South Africa has a regulatory system in place for water extraction activities, with permits and registration requirements. However, the linkage of groundwater to land surface and the need for more supportive policies are noted as areas of concern. This also suggests that groundwater could be a viable solution to improve water quality for rural residents.

According to DWA (2013), South Africa's groundwater supplies could be significantly increased. Over 80% of South Africa's surface water resources—roughly 12,000 millioncubic meters per year (m3/a)—have already been allotted with uses between 2000 and 4000 million m3/a of this groundwater. Consequently, the total amount of renewable groundwater in South Africa is 10,343 million m3/a (or 7500 million m3/a during times of drought). Groundwater is the most important source of dependable and safe drinking water supply in rural and many urban areas of South Africa, for agriculture, for supporting mines and different other industries (Murei et al., 2022). Groundwater can be replenished through artificial recharge through redirecting extra surface water underground, where it will be stored in an aquifer for later extraction and use. The two most popular recharge techniques involve injecting water into boreholes (also known as injection wells) and moving water to spreading basins where it infiltrates into the ground. One of the primary natural processes that can lead to the formation of sinkholes on dolomite is the dissolution of the rock by water. Over time, water can infiltrate fractures and cavities within the dolomite, leading to the gradual dissolution of the rock and the creation of underground voids. When the overlying rock becomes too weak to support the weight above, it can collapse, resulting in the formation of a sinkhole at the surface (Harrison & Todes, 2017). To mitigate the consequences of collapsing sinkholes on dolomite, it is crucial to implement comprehensive geological assessments and monitoring programs to identify areas prone to sinkhole formation as most areas in Gauteng are prone to dolomite (Mabin, 2013). A landscape stability study will have to be done in Hammanskraal to ensure that does not run a risk of the formation of sinkholes.

The stability of landscapes is a complex and multifaceted topic that encompasses both natural and human-induced factors. Human interventions can exacerbate the formation of sinkholes on dolomite. For example, excessive groundwater extraction can lower the water table, leading to increased dissolution of the dolomite and the potential for sinkhole formation that can alter the natural drainage patterns, leading to increased infiltration of water into the dolomite and accelerating the dissolution process (Harrison & Todes, 2017; Mabin, 2013). Changes in land use can alter the natural drainage patterns, leading to increased infiltration of water into the dolomite and accelerating the dissolution process (Musakwa et al., 2020). Additionally, sustainable groundwater management practices and land use planning can help minimize the risk of sinkhole formation in dolomite landscapes.

Most game lodges are operating boreholes under the water rights, which is not the case for Hammanskraal residents, highlighting a need for studies on safety and measures which includes awareness to limit the amount of water that can be removed. Otherwise, if groundwater is excessively pumped it could lead to depletion, poor operation and maintenance of the wells, and increased damage of built-up. The hand dug wells indicated the disparity of water access and the emerging unsustainable patterns that are detrimental to the environment. What the residents of Hammankraal are doing is not something new and according to Alim et al. (2019), residents from rural areas tend to turn to ground water extraction as its relatively cheaper and allows them to meet their water demands particularly in cases where surface water is polluted. There are however several downsides associated with groundwater, Joseph et al. (2018) indicated that in Bangladesh 13% of their population were drinking water which was contaminated by arsenic and 98% of the population consumed water with *E. coli* which has a detrimental effect of stunting children's growth.

The excavation of hand wells is not only an adverse consequence but also poses a safety risk, as it has the potential to expose children to surface water inflow, depending on the depth of the well (Okotto-Okotto et al., 2015). Shallow wells are a common source of residential water self-supply in many sub-Saharan African cities, and their use in numerous growing urban centers has been reported (Olago, 2019). Although hand-dug wells are relatively inexpensive to build and maintain under the right conditions, they are often at risk of contamination due to many factors (Kelly et al., 2020). Sustainable use of groundwater in the context of inequalities in access to water, competing uses and future risks require improved water management options to ensure water security within residents (Okotto-Okotto et al., 2015). While they are cost-effective, they come with risks of contamination and safety hazards, particularly in the case of shallow wells. Effective water management is essential to address these challenges and ensure water security for residents.

Investments in water and sanitation have been shown to have a positive economic impact because they reduce health risks and medical expenses while also lowering costs (Biermann et al., 2022). This is accurate for all kinds of investments, from significant water supply infrastructure to domestic water treatment (Fonseca et al., 2020). Due to the importance of water neither the

governance systems of industrialized nor developing nations should be unable to guarantee that everyone has access to clean water (Yu et al., 2021). Experience has also shown that efforts to increase access to clean water, whether in rural or urban areas, primarily benefit the poor and can be a useful component of plans to fight poverty (Di Vaio et al., 2021). Accordingly, water infrastructure and technology must be scaled up and the focus on the poor must be underpinned by well-focused management systems. Game lodge owners engage in comprehensive cost-benefit analyses, considering both short-term gains and long-term sustainability. Collaboration between government sectors and the adoption of integrated policies could help strike a balance, ensuring that water and sanitation investments align with broader national development goals while addressing immediate challenges. Ultimately, a holistic and strategic approach to resource allocation is necessary to navigate the complexities of competing priorities.

Together, reflexive governance and the UNDP framework contribute to inclusive decision-making processes where stakeholder participation, accountability, and transparency are integral components that ensure that water allocation decisions are informed, equitable, and aligned with broader sustainability goals. It prompts an assessment of whether allocation strategies align with the principles of sustainable water management, accounting for environmental, social, and economic dimensions. Efficiency is another critical aspect of the UNDP framework, advocating for the optimal use of water resources. In the context of the theme on water allocation and distribution, this theoretical framework prompts an exploration of the effectiveness of existing allocation mechanisms and their alignment with broader water efficiency goals. It encourages an assessment of whether current distribution strategies promote the judicious use of water resources and whether there are opportunities for improvement in terms of efficiency. With sustainability, a core principle of the UNDP framework, underscores the need to consider the long-term implications of water allocation and distribution practices. When applied to the theme on water allocation and distribution, this principle encourages an examination of how allocation decisions impact the resilience of ecosystems and the overall sustainability of water resources. It prompts an assessment of whether allocation practices are in harmony with the principles of sustainable water management and whether they consider the potential effects of climate change and other long-term stressors.

5.4 Theme 3: Stakeholder engagement and collaboration

Stakeholder engagement and collaboration goes beyond a mere interaction; it embodies a strategic and inclusive approach to involve all relevant parties in the decision-making processes related to water governance. This theme extends beyond the concept of mere cooperation, it signifies a shared commitment to addressing water challenges collectively, transcending traditional boundaries and fostering synergy among different actors. The study findings indicated that there were potential areas for improvement, and the overall impact of stakeholder engagement on the efficacy of water governance strategies. The theme on stakeholder engagement and collaboration served as a crucial link in the exploration, connecting water quality and the allocation and distribution of water as collective towards practical action in water management. The insights gained from the findings will not only contribute to academic understanding but also provide practical guidance for those engaged in shaping water policies, fostering partnerships, towards sustainable water governance. By recognizing the importance of diverse perspectives and cooperative endeavors are actionable recommendations that resonate with the principles of adaptive and reflexive water governance as well as the principle of the UNDP framework can be promoted.

Stakeholder engagement and collaboration are important aspects of water governance, as they facilitate effective decision-making processes and the resolution of complex water-related issues (Wehn et al., 2020). The involvement of multiple stakeholders, including government agencies, private entities, civil society organizations, and local communities, is essential for ensuring inclusive and participatory water governance (Akhmouch & Clavreul, 2016). Stakeholder engagement is seen to enhance stakeholder empowerment, improve water governance, and make decision-making processes more transparent and democratic (Wehn et al., 2020). It is also recognized as a critical principle for building a resilient society and sustainable development (Wehn et al., 2020). Overall, effective water governance is ongoing, and its success will be measured by the degree to which it safeguards this invaluable resource for current and future generations.

Successful water governance relies on the collaboration of diverse stakeholders, including governments, local communities, NGOs, businesses, and international organizations (Allan, 2018). It necessitates the integration of scientific knowledge, traditional wisdom, and innovative

technologies to develop context-specific strategies that accommodate the unique characteristics of each environment (Biswas, 2018). Power dynamics, conflicting interests, and overlapping authorities can hinder effective collaboration and decision-making (Suminar, 2023; Mustofa et al., 2021). It is important to address these issues and establish cooperative relationships between stakeholders, such as government agencies and water user associations, to ensure the success of water management systems (Suminar, 2023; Rahman & Bukhori, 2022). Successful water governance relies on the active participation and collaboration of a wide range of stakeholders, the integration of different types of knowledge, and the establishment of cooperative relationships to address power dynamics and challenges in water management.

One approach that has gained attention in the field of water governance is reflexive governance. Reflexive governance is a crucial concept in water governance that emphasizes the need for self-reflection, learning, and adaptation to address complex problems (Mansson et al., 2022). It involves the capability to deal with multiple frames, adjust actions to uncertain changes, respond to changing agendas and expectations, and unblock stagnations (Termeer et al., 2013). Reflexive governance is particularly relevant in the context of social learning and participatory river-basin management, where collaboration, organization, and learning are key (Feindt & Weiland, 2018). It is also useful in understanding the necessary changes and circumstances in water management, natural resource management, and climate change adaptation (Triyanti et al., 2020). Reflexive governance in water governance emphasizes self-reflection, adaptability, and the capacity to deal with complexity.

Based on the findings in the study promoting reflexive governance may be an ongoing process that would require commitment, openness, and a willingness to adapt. By incorporating these strategies, governance systems can become more resilient, responsive, and better equipped to address the complex challenges of the modern world. Reflexive governance is an essential component of water management. It requires practitioners and stakeholders to navigate and situate themselves within a complex system of information flow and through it in a reflexive and adaptive manner (McLoughlin et al., 2020). To strengthen water governance systems, a process of reflexive learning and change is necessary. This process combines learning and real-life action and can contribute to enhancing the legitimacy, effectiveness, efficiency, and inclusiveness of existing water governance systems (Seijger et al., 2020). Reflexive governance can also be applied to coproduction in water

governance, where a more reflexive approach is needed to understand the political implications and improve governance practices (Lepenies et al., 2018). Reflexive governance is crucial in water management for effectively navigating complex systems, strengthening water governance, and improving coproduction practices. It emphasizes learning, adaptability, and critical thinking in addressing the challenges of water governance. The importance of reflexive governance, a dynamic and adaptive approach that incorporates feedback and learning was highlighted as essential for enhancing water efficiency and sustainability in both game lodges and residential areas. This approach involves continuous assessment and adaptation of policies and practices to respond to evolving challenges and opportunities.

Reflexive governance, while beneficial, faces significant challenges. Resistance to change from institutional inertia and fear of disruption, a lack of comprehensive data, and limited capacity and expertise hinder effective implementation. Political cycles and short-term pressures undermine the long-term perspective needed for complex challenges. Fragmented governance and inadequate stakeholder engagement impede coordination and participation. The complexity and uncertainty of issues like climate change complicate interventions, and resource constraints limit necessary investments. Strong political will and leadership are essential but often lacking. This study highlights these challenges, emphasizing the need for a comprehensive approach to balance immediate action with long-term reflexive perspectives. Reflexive governance often requires strong political will and leadership to drive necessary changes. The absence of such commitment can hinder the adoption of reflexive approaches, particularly when decision-makers prioritize short-term gains. These listed challenges indicate that decision-makers face numerous competing priorities, and reflexive governance is just one aspect. Balancing the need for immediate action with the long-term reflexive perspective can be challenging.

By building trust and fostering collaboration, adaptive co-management can enhance ecosystem management and contribute to the resolution of multi-scale society-environment dilemmas (Pollard et al., 2023; Allan & Rieu-Clarke, 2010). The Water Governance Framework proposed by the United Nations Development Programme (UNDP) aims to improve water resources management and water services provision through effective governance (UNDP, 2019). The UNDP's proposed water governance framework provides a comprehensive approach to addressing the global water

crisis by prioritizing equity, efficiency, and sustainability in water management practices (Baumgartner & Pahl-Wostl, 2013). The UNDP recognizes the importance of integrated water resources management in addressing the challenges of water scarcity and ensuring the availability of clean water for all (Gupta et al., 2013). The proposed water governance framework by the UNDP emphasizes the need for effective governance structures, stakeholder participation, and the integration of social, economic, and environmental considerations in water management (Moore, 2013). It promotes the principles of equity, ensuring that all individuals and communities have access to safe and affordable water services, regardless of their socio-economic status (Gupta et al., 2013). Adaptive co-management and the UNDP's Water Governance Framework represent approaches to address complex water management challenges and improve access to clean water for all. They stress collaboration, sustainability, and equity as key principles in water resources management.

The Global Water Partnership has identified key principles for effective water governance, which align with the elements of good governance in general (Allan, 2016). These principles include *accountability*, *participation,* and *transparency* for the involved stakeholders (Allan & Rieu-Clarke, 2010). *Accountability* ensures that water governance actors are responsible for their actions and decisions. In the context of water governance, accountability is crucial for ensuring that water management entities are held responsible for their actions and decisions (Allan & Rieu-Clarke, 2010). This includes financial accountability, where water utility customers are expected to fulfil their payment obligations (Sualihu et al., 2017). Effective water governance is guided by principles such as accountability, participation, and transparency.

Participation is another key element of effective water governance, as it promotes inclusivity and ensures that the voices of all stakeholders are heard participation involves involving stakeholders in decision-making processes (Allan & Rieu-Clarke, 2010). Engaging stakeholders in decision-making processes can lead to more informed and sustainable water management decisions (Allan, 2016). It also fosters ownership and cooperation among stakeholders, which is essential for successful water governance.

Transparency plays a vital role in water governance by providing access to information and promoting accountability (Allan & Rieu-Clarke, 2010). It enables stakeholders to understand the rules, regulations, and decisions related to water management, fostering trust and confidence in the governance process (Allan, 2016). Transparent governance processes also facilitate public scrutiny and reduce the potential for corruption and mismanagement (Biswas, 2018). These elements are crucial for ensuring responsible decision-making, stakeholder engagement, and access to information in water governance processes.

The use of the Water Governance Framework proposed by the UNDP provided a practical tool to addresses various aspects related to Stakeholder Engagement and Collaboration towards effective water governance.

5.4.1. Stakeholder engagement and collaboration towards water governance in *Mandela Village and Kekana Gardens*

The Equity and inclusiveness, Efficiency, Sustainability, Integrated management, Multi-level governance, Adequate financing, Transparency and public participation, Communication and awareness, Legal and Institutional Arrangements were taken into consideration to explain Stakeholder Engagement and Collaboration towards water governance for residents and game lodges.

5.4.1.1 Legal and institutional arrangements

Institutional Arrangements involve defining the roles and responsibilities of different stakeholders, such as government agencies, water user associations, non-governmental organizations, and the private sector (Makaya et al., 2020). It also includes the establishment of legal and regulatory frameworks for water management (Lubell et al., 2014). Developing clear water policies and plans that consider aspects like water allocation, water quality, water availability, and disaster management is crucial in water governance. These policies should reflect the needs and aspirations of various stakeholders while ensuring sustainable water resource management (Machado et al., 2020) and developing and maintaining the necessary infrastructure for water storage, treatment, and

distribution (Light, 2023). This can also include promoting the use of efficient water-saving technologies.

The discourse on water service privatization in South Africa is complex, requiring a holistic approach to address the intricate issues associated with water governance, infrastructure development, and equitable access. Divergent perspectives and challenges need to be acknowledged for the formulation of effective and sustainable water management strategies. While Jiménez and Pérez-Foguet (2010) posit that water service privatization has improved access in rural areas in other African countries, Hommes et al. (2019) argue that anti-privatization initiatives dominate in South African municipalities, raising concerns about the clarity of objectives and responsibility. Bakker (2008) sheds light on the failure of water privatization initiatives globally, emphasizing challenges related to commodification and its impact on the human right to water.

Within the South African context, Edokpayi et al. (2018) highlight difficulties in ensuring sustainable safe drinking water, particularly in rural communities where water quality and availability vary seasonally. Sambo et al. (2021) underline inequalities in access to improved water services in rural municipalities, emphasizing the need to address disparities. Maphela & Cloete (2019) discuss the complexities and challenges associated with water governance and management, specifically regarding the implementation of the National Water Act, 1998, in Soweto. The collapse of small-scale water infrastructure in rural South Africa, as emphasized by Sambo et al. (2018), raises significant concerns. The intricate interplay of factors contributing to this failure underscores the challenges in ensuring reliable and sustainable water infrastructure in rural areas. Addressing these challenges necessitates reflexive governance approaches that consider diverse perspectives, prioritize community needs, and navigate the intricate dynamics of water management. The importance of incorporating ethical considerations (Bell & Willmott, 2019), reflexive governance (Feindt & Weiland, 2018), and responsible innovation (Scherer & Voegtlin, 2020) becomes apparent in crafting sustainable and equitable water management strategies for the nation. Promoting reflexive governance is an ongoing process that requires commitment, openness, and a willingness to adapt. By incorporating these strategies, governance systems can become more resilient, responsive, and better equipped to address the complex challenges of the modern world.

Municipalities in their due power can contract services to serve residents as it was the case with Magalies Water. Unintended side effects of previously established policies, as well as differences between short- and long-term outcomes, are frequently signs of individual organizations' attempts to solve community problems. Improved feedback from community leaders is necessary to inform residents on any developments. This should encourage residents who indicated that previous groups on water governance in the area had been dissolved due to lack of progress of water services. The legislative mandate of South Africa advocates public participation, that no individual should be marginalized. Public participation is essential towards sustainable development. This means that to resolve community issues public participation should be prioritized which also cultivates responsible attitude for residents. Overall, the municipality should work with residents to ensure that they select the preferred arrangement for water services for domestic purposes.

5.4.1.2 Equity and inclusiveness

The monetization of water in Mandela Village and Kekana Gardens, where residents purchase bottled water either from tanker suppliers or community members, strongly signals the perception of water as a commodity with economic value. Reports in publications have further supported this perspective by emphasizing water pricing and underscoring the scarcity of water (Hope et al., 2020; Gómez Gómez et al., 2018, Meijerink & Ruijs, 2003). When water is viewed as a regular commodity that can be traded with specific market participation, it highlights how integrated it is into economic transactions (Savenije, 2002). It can be concluded that the criterion of water as a scarce commodity requires water efficiency measures to ensure environmental sustainability and social equitability.

An integrated approach, in line with the IWRM framework, is essential to account for economic, social dynamics, and technological needs, ensuring that the needs of marginalized residents are addressed. The game lodges around Dinokeng Nature Reserve contribute significantly to the local economy by providing employment opportunities to residents, aligning with the findings of Queiros (2022) and Coetzee et al. (2013). This approach highlights the importance of balancing environmental sustainability with socio-economic benefits, promoting inclusive development. While some residents, especially those who were located higher from the highway in Mandela

Village indicated no benefit to supply, those residents who were on the lower end felt that the game lodges contributed positively to them in solving water issues in the area with the little they could do. The centralization of the tap which requires no payment, providing 5 litres per person to residents and sharing water with affected employees were all highlighted as positive gestures. Infrastructure needs to be improved in Hammanskraal as the current challenges they are facing are not to do with water scarcity.

5.4.1.3. Transparency and public participation

Transparency and public participation are crucial aspects in water governance. The knowledge and insights are valuable for creating effective water management strategies (Armitage et al., 2009; Yang et al., 2022). One of the main factors limiting sustainable development in Hammanskraal water governance is the weak capacity and awareness of both the local government and the residents themselves. There should be community meetings which are necessary to present a way forward instead of only showcasing political party events. Equity and inclusiveness are important to ensure that everyone has access to clean and safe water. Monitoring mechanisms to help in tracking progress and identifying potential issues on water quantity, quality, and usage patterns is essential to prevent potential water conflict

According to Tang et al. (2022), it is crucial to ensure the active participation and engagement of local communities, water users, indigenous groups, and other stakeholders in decision-making processes. The residents' knowledge and insights are valuable for creating effective water management strategies. Additionally, the lack of a specific culture and sense of cultural identity can hinder residents' participation in water governance (Ruan et al., 2022). This underscores the need for transparency, community engagement, equity, and monitoring in water governance. It also points out challenges related to capacity, awareness, and cultural identity that can affect residents' participation in water governance.

Community action in water resource management is believed to provide a valuable tool for increasing the effectiveness and sustainability of service delivery and fostering incremental social change. Community involvement is also believed to contribute to water 'good management' at the

local level. Participation by influential community members in providing improved water supplies can therefore help achieve synergies in the pursuit of sustainable development goals (UNMDP, 2005). To address some of the governance challenges in supporting residents, the local government should seek to include a range of interests in community meetings and policy change. Because water policy negotiations involve the public who use water and listen to their suggestions and solutions before promulgating policies, more inclusive engagement carries minimal risk to decision-making. The value of this study shows that a one-size-fits-all approach is not realistic given various authoritarian systems, that local leadership is paramount to implementing joint governance among local governments.

The government's governance model alone is not sufficient to address the ecological and environmental problems in rural areas (Yang et al., 2022). Addressing the environmental impact and risk management in rural residents associated with water governance requires a comprehensive approach that involves multiple stakeholders and considers factors such as environmental information disclosure, social networks, cognition, and residents' sense of responsibility (Yang et al., 2022; Zhu et al., 2021). By improving residents' satisfaction and participation in water governance, it is possible to enhance the effectiveness and sustainability of rural environmental management efforts (Ruan et al., 2022). This indicates the need for a comprehensive approach to address ecological and environmental challenges in rural areas, with an emphasis on the involvement of multiple stakeholders and the empowerment of rural residents in water governance.

5.4.1.4. Communication and awareness

According to Rodina and Harris (2016) in South Africa water service provisions e.g., taps, pipes, toilets, in-house water and sanitation connections, and water meters were largely associated with formalised housing or an established community in a particular location. The use of water meters is not to assist with water abstraction as indicated by different residents in Kekana Gardens. However, such misinformation on water meters has also been noted by Mirosa and Harris (2012) who indicated that there was a belief that water meters contributed to the outbreak of cholera in KwaZulu Natal province where 171 died and 80 000 became sick. Water meters are a good investment by the municipality not only for billing purposes but also to assist residents looking to

reduce consumption. Water usage started to decrease as soon as metering was put into place as part of water conservation efforts (Domene & Sauri, 2006). Water meters in South Africa are used for various purposes, including tracking water usage, billing, and promoting water conservation. However, misconceptions and beliefs about their impact have been observed in some cases thus a need for awareness.

Any transformative change within residents should be properly communicated to prevent confusion. Water management in Hammanksraal lacks communication and any form of awareness material. Mobile phone applications within the environmental sector may be fewer compared to broader categories, yet they are plentiful, varied, and continuously growing, driven by the surge in social media interest (Alfonso, et al., 2022). While applications are mostly used in the urban setting, farmers in the rural set up have also been acquainted with technology in relation to climatic advisory and floods' early warning systems (Henriksen et al., 2018; Rivett et al., 2012). Taking advantage of mobile applications could assist residents to report and lodge their complaints directly to the municipality and to report pipe leakages towards water conservation. Therefore, phone applications could also assist community members to report any corruption associated with water service delivery e.g., follow up with tank drivers to stop demanding payments from community members.

Awareness material in the form of brochures or pamphlets for easy handouts e.g., Guide To Water Meters And Use Of Water Efficiency Measures can be simplified and translated to native languages for residents comprehension. South African residents need to be aware that they also need to play a role in water conservation by installing rainwater harvesting systems and not relying entirely on municipality water supply. Water governance uses the IWRM by focusing on ways to influence behavior in water management systems (Bianchi et al., 2021).

Research has shown that residents' comfort with water governance is positively impacted by the publication of rural environmental information (Yang et al., 2022). It has been discovered that the social networks and cognitive abilities of rural residents affect their involvement in rural environmental governance (Tang et al., 2022). Studies, however, have not sufficiently examined rural households' environmental protection cognition, including elements like their knowledge of

their responsibilities (Tang et al., 2022). However, residents' sense of responsibility acts as a driving force for their participation and contributes to the resilience of rural environmental governance (Ruan et al., 2022). Therefore, social network activities can positively influence resident participation in rural environmental governance.

5.4.2 Stakeholder engagement and collaboration towards water governance in game lodges

To explain stakeholder engagement and collaboration towards water governance in game lodges the aspects on efficiency, sustainability, integrated management, adequate financing were discussed on implementation towards sustainable development.

5.4.2.1 Integrated management

Integrated management in game lodges, particularly in the context of water governance, involves the coordinated and sustainable approach to managing various aspects related to water resources within and around the lodge premises (Katusiime & Schütt, 2020). This includes both ecological and human-related considerations to ensure the responsible use and conservation of water while supporting the lodge's operations and the surrounding environment. Effective stakeholder collaboration is essential to ensure a holistic and balanced approach to integrated management (Jiménez et al., 2020). Game lodge owners were not aware of the Department of Tourism incentive program which indicates that lack of knowledge is a barrier to further awareness perhaps through Tourism agencies, mass emails to inform the large community of accommodation establishments. Collaborative approaches among government agencies are essential for effective water governance, including water sustainability (Huang et al., 2017). Administrative fragmentation can be addressed through inter-agency cooperation (Huang et al., 2017). Multi-party collaboration involving joint decision-making among key stakeholders is vital for water governance (Goodspeed et al., 2020; Magnuszewski et al., 2018). Integrated water management in game lodges requires a coordinated and sustainable approach, with a focus on stakeholder collaboration. Addressing knowledge gaps, fostering collaboration among government agencies, and promoting multi-party cooperation are identified as key elements of effective water governance in this context.

It was also clear from many owners that they were interested in generating profit than implementing the latest technology. The findings confirm that the South African government's current efforts to adopt and implement sustainable water efficiency measures in the hospitality sector are hampered by a lack of enforcement legislation and weak stakeholder alliances. This corroborates the findings of Smith and Leonard (2018), highlighting the need for stronger regulatory frameworks and more robust partnerships among stakeholders to achieve sustainability goals effectively. The role of businesses, such as game lodges, in community development is crucial. It highlights the significance of identifying stakeholders and implementing Corporate Social Responsibility (CSR) initiatives that benefit the local community. By engaging with local stakeholders and prioritizing CSR, these businesses can foster economic growth, improve social well-being, and contribute to sustainable development. These efforts can lead to more sustainable and mutually beneficial relationships between businesses and the communities they operate in while providing unique and memorable guest experiences.

5.4.2.2 Efficiency and sustainability in game lodges

Efficiency and sustainability are critical considerations for game lodges, which aim to provide memorable experiences for guests while minimizing their impact on the environment and local communities. Collaborating with various stakeholders is essential to achieve these goals effectively. Here's how game lodges can foster stakeholder collaboration in the context of efficiency and sustainability:

1. *Local Communities and Guests*

Involving local communities in the lodge's operations by hiring staff, sourcing supplies, and engaging in cultural exchange programs creates a sense of ownership in sustainability efforts (Kiss et al., 2022, Logan, 2015). Collaborating on community development projects such as education, infrastructure improvements and providing training to residents, enhances their livelihoods. Furthermore, educating guests about the lodge's sustainability initiatives and encourage their participation in conservation activities.

2. *Environmental and Tourism Organizations*

Partnering with environmental organizations and travel agencies that prioritize responsible travel, promoting the lodge as an eco-friendly destination and implementing best practices for water conservation can improve efficiency and sustainability for game lodges (Makopondo et al., 2020). Working closely with local tourism boards such as the TGCSA to promote responsible and sustainable tourism practices to ensure compliance with environmental regulations and permits (Musavengane, 2019). Sharing insights and feedback to shape tourism policies that support sustainability in the region can be highly effective. By actively participating in policy discussions and providing valuable input based on on-the-ground experiences, stakeholders can influence the creation and implementation of tourism policies that promote environmental stewardship, socio-economic benefits, and long-term sustainability. This collaborative approach ensures that policies are well-informed and aligned with the needs and realities of the local community and environment.

3. *Media and Influencers*

Collaborating with media outlets and environmental influencers to raise awareness about the importance of water conservation can effectively reach a wider audience. Collaborate on marketing campaigns that highlight the lodge's commitment to environmental conservation and community engagement (Tosun & Scherer, 2020; Enqvist & Ziervogel, 2019). By engaging with the suggested stakeholders, game lodges can create a holistic approach to efficiency and sustainability that benefits not only the lodge itself but also the surrounding communities and ecosystems. Transparent communication, shared goals, and collaborative efforts will be key to achieving long-term success in these endeavours.

5.4.2.3 Financing

Financing stakeholder collaboration in game lodges requires a well-thought-out approach that considers the various parties involved and the benefits that collaboration can bring to the lodge's operations, sustainability goals, and overall success. Here are some strategies to finance stakeholder collaboration in game lodges:

1. *Dedicated Budget Allocation*

Game lodges can set aside a specific budget for stakeholder collaboration activities. This budget can cover expenses related to community engagement, conservation projects, partnerships, and other collaborative efforts (Pollard et al., 2023). Setting aside a budget for stakeholder collaboration activities demonstrates a commitment to engaging with various stakeholders and supporting initiatives that contribute to the lodge's sustainability and positive impact on the local community and environment.

2. *Partnership Agreements and Eco-Tourism Revenue Allocation*

Establish formal partnership agreements with stakeholders, outlining the roles, responsibilities, and financial contributions of each party. This could involve sharing costs for specific projects or initiatives that align with mutual interests. Allocate a portion of the game lodge's revenue generated from eco-tourism activities to fund collaboration efforts. Highlighting the game lodge's commitment to sustainability can attract environmentally conscious travelers who are willing to support such initiatives.

3. *Grant Funding and Donations*

Seeking grants from government agencies, non-governmental organizations (NGOs), and foundations that support conservation, community development, and sustainable tourism. Accept donations from guests, visitors, and organizations that value the lodge's collaborative and sustainable approach. Explore impact investment opportunities where investors provide funds in exchange for both financial returns and positive environmental and social outcomes achieved through collaboration. Use crowdfunding platforms to raise funds for specific projects or initiatives. Engage the lodge's community of supporters in contributing to collaboration efforts.

4. *Tourism Incentives*

Research available tourism grants, incentives, or subsidies provided by local or national governments to support sustainable tourism practices. These can help offset collaboration-related costs. Most game lodges indicated that they were not aware of incentives offered by NDT. Consider stakeholder collaboration as a long-term investment in the lodge's sustainability and success. Over time, the positive outcomes of collaboration can lead to increased revenue and brand loyalty.

To effectively finance stakeholder collaboration, it is important to communicate the value and impact of these initiatives to potential collaborators, guests, and investors. Emphasizing the positive outcomes for the lodge, local communities, and the environment can motivate stakeholders to contribute financially and engage in meaningful partnerships. By aligning policies, regulations, and investments with the broader goals of environmental sustainability, social equity, and economic prosperity, societies can forge a path towards a water-secure future.

The theoretical framework of reflexive governance emerges as a compelling lens through which to understand and analyze the intricate dynamics of collaborative efforts in water governance. Reflexive governance, with its emphasis on adaptability, learning, and ongoing dialogue, aligns well with the complexities inherent in fostering effective stakeholder engagement and collaboration. At its core, reflexive governance emphasizes continuous learning and adaptation in response to changing circumstances. Applied to a theme on stakeholder engagement and collaboration, this theoretical framework encourages dynamic, evolving processes that require constant reflection and adjustment. It prompts an exploration of how stakeholders actively participate in decision-making processes, learning from experiences, and adapting their strategies to achieve more effective collaboration.

The participatory nature of reflexive governance resonates strongly with the collaborative dimensions of the theme of stakeholder engagement and collaboration. By considering stakeholders as active contributors to the decision-making process, this framework promotes a culture of inclusivity and shared responsibility. It invites an examination of how different actors, including government bodies, non-governmental organizations, civil society, and residents, are involved in collaborative efforts and how their input shapes the overall governance landscape. Reflexive governance places a premium on the importance of feedback loops and dialogue. This theoretical framework further encourages an examination of communication channels, the quality of information exchange, and the responsiveness of governance structures to stakeholder input. It prompts an assessment of whether there are mechanisms in place for stakeholders to provide feedback, share knowledge, and actively contribute to decision-making processes.

The Water Governance Framework articulated by the United Nations Development Programme (UNDP) also stands as a highly relevant and comprehensive theoretical framework for the exploration of stakeholder engagement and collaboration. Rooted in principles of inclusivity, accountability, and sustainability, the UNDP framework provides a structured approach to understanding and fostering effective collaboration among diverse stakeholders in the realm of water governance.When applied to stakeholder engagement, this principle encourages an examination of how different stakeholders, ranging from governmental bodies to non-governmental organizations, civil society, and local residents, are actively involved in decision-making processes. It prompts an assessment of the inclusiveness of governance structures, ensuring that a wide spectrum of voices is considered in the collaborative efforts based on accountability and sustainability. It prompts an assessment of whether collaboration efforts are resilient, adaptive, and capable of addressing evolving challenges in the long run.

The selection of reflexive governance and the UNDP Water Governance Framework provided a robust and applicable theoretical framework for theme on stakeholder engagement and collaboration. Both emphasised inclusivity, accountability, sustainability, and stakeholder participation to align with the multifaceted challenges of stakeholder engagement and collaboration in water governance. By applying these frameworks, valuable insights were gained into the mechanisms that contribute to effective collaboration and the development of inclusive and sustainable water governance strategies.

5.5 Theme 4: Environmental impact and risk management

Within this theme on environmental impact and risk management, the profound consequences of human activities on the environment and the strategies in place for mitigating risks are discussed. This theme delves into the realm of environmental impact and risk management, presenting a condensed summary that encapsulates key findings and insights gathered from the study area. Water-related activities, from extraction to consumption, carry inherent environmental risks that demand vigilant management to safeguard ecosystems and biodiversity. This section will further provide a comprehensive overview of actionable recommendations for policymakers, environmental agencies, and communities vested in preserving the ecological integrity of water systems.

Environmental impact and risk management are essential concepts in addressing and mitigating the potential negative effects of human activities on the environment. These concepts play a crucial role in sustainable development and ensuring the well-being of both the environment and society. Environmental management practices play a significant role in creating long-term value and managing risks associated with economic, environmental, and social developments (Obamen et al., 2021). On the other hand, environmental risk assessment is a crucial tool for achieving sustainable development by assisting to identify and reduce the impacts of various activities on the environment (Fuentes-Bargues et al., 2020). Different methods, such as the *probability-impact matrix* and *evidence theory*, are used to assess and manage environmental risks (Hatefi et al., 2019). However, it is crucial to remember that not all potential hazards can be included in environmental risk assessments. Thus, to preserve biodiversity and ecosystem services, it is essential to translate more general policies—like sustainable development goals—into targeted preservation objectives. (Devos et al., 2015). Environmental risk assessment is a vital component of responsible and sustainable development. It helps in managing risks, protecting the environment, and ensuring that economic and social developments are in harmony with ecological preservation.

5.5.1 Environmental Impact and Risk Management in *Mandela Village and Kekana Gardens* associated with water governance

Hand-dug wells are a common source of groundwater for drinking purposes in many regions. However, these wells can pose environmental risks and challenges in terms of water quality and contamination. Several studies have been conducted to assess the environmental impact and risk management associated with hand-dug wells. The extraction of certain groundwater sources, such as hand-dug wells, have the potential to exhaust the replenishable water table (Maheshwari et al., 2023). The other challenge could be the possibility of groundwater pollution which cannot be reinstated. Environmental regulations and innovation are interconnected however environmental regulation need to be considered to comply and prevent hazards into the environment (Zhu et al., 2021). Hand-dug wells are valuable sources of groundwater, but they come with environmental challenges related to resource depletion and pollution. Addressing these challenges requires a

combination of regulatory measures, technological innovation, and compliance to ensure the sustainable and safe use of groundwater from hand-dug wells.

In one study, Lutterodt et al. (2018) evaluated the microbiological groundwater quality status of boreholes and hand-dug wells in Ghana. In comparison to boreholes, the study indicated that shallow hand-dug wells had more hygienic problems that could lead to contamination. Both hand-dug wells and boreholes contained fecal indicator bacteria (*Escherichia coli)* and viruses (Adenovirus and Rotavirus). The investigation also identified the typical local sources of microbiological contamination, including garbage dumps, pit latrines, unlined sewers, and malfunctioning septic tanks. (Lutterodt et al., 2018). There is importance in ensuring the safety and quality of groundwater sources, particularly in regions where hand-dug wells are commonly used. To mitigate microbial contamination, measures should be taken to address the sources of pollution, improve well construction and maintenance practices, and implement water treatment and testing protocols. Additionally, there is a need for regular monitoring and assessment of groundwater quality to protect the health of communities relying on these sources.

Another study conducted in Namibia by McBenedict et al. (2019) investigated the seasonal health concerns from hand-dug well water contaminated with zoonotic infections. The research discovered a varied collection of zoonotic bacterial infections in hand-dug wells. The investigation showed that the hand-dug well water had a higher exposure to zoonotic infections during the dry season, making it undoubtedly unsafe for consumption by humans and cattle.

In terms of risk management, it is important to consider the location, construction, hygiene, and sanitary practices associated with hand-dug wells. Fadipe et al. (2021) evaluated the connection between groundwater and the microbiological quality as the water source. The study concluded that poor hand-dug well location, construction, hygiene, and sanitary practices were among the factors affecting the bacteriological water quality (Fadipe et al., 2021). The findings emphasized the need for proper location selection, construction, and ongoing maintenance practices to ensure the bacteriological water quality of hand-dug wells. Additionally, promoting good hygiene and sanitary practices in the vicinity of wells can contribute to the protection of groundwater sources from contamination. These insights can guide efforts to manage and reduce the environmental and health

risks associated with hand-dug wells, which are important sources of drinking water in many regions.

To mitigate the environmental impact and manage the risks associated with hand-dug wells, it is crucial to implement proper sewage systems, improve waste disposal practices, and ensure regular monitoring and evaluation of water quality. Additionally, investments in supply-side enhancement, demand-side management, adequate institutional arrangements, pollution control, and groundwater resource and quality protection are required. (Foster & Chilton, 2003). Environmental impact and risk management in rural residents associated with water governance is a complex issue that requires a multi-faceted approach (Tang et al., 2022). Proper risk management strategies, including location, construction, hygiene, and sanitary practices, are essential to ensure the safety of groundwater sources. Investments in groundwater resource and quality protection are crucial to mitigate the environmental impact and ensure the sustainability of water resources.

5.5.1.1 Health Impacts associated with poor water quality

Poor water quality has significant health impacts on individuals and communities. Health professionals and legislators need to pay more attention to the burden of illness linked to inadequate sanitation, hygiene, and water supply. (Bartram & Cairncross, 2010). Similarly, Hunter et al. (2010) emphasized the need for more effort to improve access to safe water supplies. One of the health impacts of poor water quality is poor oral health which can lead to negative impacts on overall health and quality of life (Santoso et al., 2021). Poor water quality can have significant health implications for residents in Hammanskraal, including impacts on oral health. Ensuring access to safe water is crucial not only for drinking but also for maintaining proper hygiene practices that contribute to overall health and well-being. The health impacts of poor water quality are not gender-neutral, they have differential impacts on health and well-being to everyone affected (Oluwasanya, 2023). Ensuring access to safe and sustainable water supplies, improving sanitation, and promoting proper hygiene practices are critical steps in reducing the health burden associated with poor water quality. Additionally, addressing gender disparities and promoting equity in access to clean water and sanitation facilities is crucial for achieving positive health outcomes for all affected individuals and communities.

The economic impact of poor water quality is also significant. The health impact of poor water quality affects economic growth and productivity, with an associated global economic loss of nearly 12 billion USD per year (Oluwasanya, 2023). The economic consequences of poor water quality, leading to a loss in productivity, may directly affect the residents of Hammanskraal. Economic growth and development in the community could be hampered if health issues related to water quality are not adequately addressed. Water pollution, which contributes to poor water quality, has a significant impact on human health. Over 80% of the sewage produced by human activity is discharged untreated into rivers and oceans, which pollutes the environment and spreads illness. (Lin et al., 2022). Diarrhea is the most common disease caused by water pollution, mainly transmitted by enteroviruses in the aquatic environment (Lin et al., 2022). Water quality improvement, along with sanitation and hygiene, positively impacts health and socioeconomic development (Oluwasanya, 2023). Underinvestment in basic water supply and treatment facilities, coupled with rapid economic growth and urbanization, has led to increased exposure to industrial chemicals, heavy metals, and algal toxins (Lin et al., 2022). Tailoring interventions to the specific water needs and challenges faced by residents in Hammanskraal is vital. Community engagement, education, and the implementation of sustainable water management practices can contribute to positive health outcomes. Improving access to safe and sustainable water supplies, promoting proper hygiene and sanitation practices, and addressing gender inequalities are crucial for mitigating the health impacts of poor water quality.

5.5.1.2 Risks associated with water provision and sanitary infrastructure

Water provision and sanitary infrastructure are essential for public health and well-being. However, there are several risks associated with these systems that can have significant impacts on human health. One of the main risks is microbial contamination of drinking water sources. A systematic review conducted by Bain et al. (2014) found that microbial contamination is widespread and affects all types of water sources, including piped supplies. The study estimated that 1.8 billion people globally use a source of drinking water that has faecal contamination, with 1.1 billion people drinking water that is of at least "moderate" risk. The study also found that water contamination is most prevalent in Africa and South-East Asia with drinking water often contaminated in rural areas compared to urban areas. In addition to health risks, there are also economic and social implications

associated with water and sanitation infrastructure. The challenges of urban water management and sanitary infrastructure systems are increasingly frequent in cities, particularly in countries like Brazil (Richter et al., 2020). The reduction of urban floods and related threats to public health depends on the availability of drinking water, wastewater treatment, and efficient drainage systems.

Furthermore, infrastructure for water and sanitation does not ensure a decline in linked diseases or an improvement in standard of living. According to Fielmua et al. (2019), interventions may be negatively impacted by substandard sanitary and hygiene practices that are driven by historical and socioeconomic circumstances. The study emphasizes the need for integrated attention to behaviour change mechanisms in the organization and management of water and sanitation interventions. The situation in Hammanskraal may have unique characteristics, but it likely shares some commonalities with the broader challenges mentioned in the provided information. Specific findings related to water provision and sanitary infrastructure in Hammanskraal would require local studies or assessments.

Sanitary surveys have been proposed as an alternative approach for identifying high-risk water supplies. These surveys are observational checklists used to evaluate possible risks at water sources. When it comes to execution, they are less complicated and costly than microbiological testing. However, prior studies on the relationship between hazards determined by sanitary surveys and measured water quality have yielded conflicting findings., particularly for groundwater sources (Misati et al., 2017). Using interviews in this study allowed the residents to openly express their frustrations on the risks associated with water provision and sanitary infrastructure. It is important to note that addressing water and sanitation challenges requires a context-specific approach. Local authorities, community leaders, and relevant stakeholders in Hammanskraal should collaborate to conduct assessments, implement interventions, and prioritize community engagement to ensure sustainable improvements in water and sanitation infrastructure.

5.5.1.3 Risks associated with illegal water connections

Illegal water connections pose various risks to both the environment and human health. One of the significant risks associated with illegal water connections is the contamination of surface water sources. For example, the Save River, Zimbabwe's largest river, continues to be contaminated by

illicit gold panning operations, flowing into Mozambique and the Indian Ocean. (Muringaniza et al., 2022). Similarly, abandoned barite mines in Nigeria have been found to contaminate groundwater with heavy metals, posing a hazard to human health (Ayatse et al., 2022). Illegal water connections also have social and economic implications. They contribute to revenue losses for water utility companies, which can hinder their ability to provide adequate water services to the population (Kuma & Ewusi, 2010). Moreover, illegal water connections can perpetuate inequalities in access to water, as those who engage in illegal connections may gain an unfair advantage over others who rely on legal and regulated water sources.

In addition to water contamination, illegal water connections can also lead to the depletion of water resources. Unauthorized connections and leaks contribute to significant water losses, which can have adverse effects on water availability and utility revenue (Muringaniza et al., 2022). In Tarkwa municipality, Ghana, illegal connections, pipe leaks, and bursts accounted for 34-65% of water losses (Kuma & Ewusi, 2010). Furthermore, illegal water connections can have detrimental effects on the infrastructure and safety of water supply systems (Muringaniza et al., 2022). Unauthorized connections can overload the system, leading to pressure fluctuations and potential damage to pipes and infrastructure. This not only compromises the efficiency and reliability of water supply but also poses safety risks to the public (Girasek, 2019). Efforts to combat illegal connections and water losses should include measures to identify and address leaks, enhance security and monitoring of the water supply infrastructure, and enforce penalties for illegal connections. Promoting community awareness and responsible water use can also play a significant role in reducing these issues. Additionally, investing in infrastructure maintenance and modernization can help mitigate water losses and improve the overall efficiency and reliability of the water supply system.

To address the risks associated with illegal water connections, effective enforcement measures and awareness campaigns are crucial. The use of warning signs and educational initiatives, as demonstrated in a study on park visitors' risk-taking behavior, can help reduce the likelihood of illegal water entry and associated risks (Girasek, 2019). Additionally, implementing stricter regulations, improving institutional capacity, and addressing underlying socio-economic factors such as poverty and corruption are essential for mitigating the risks posed by illegal water connections (Muringaniza et al., 2022). Efforts should be made to enforce regulations, raise

awareness, and address the underlying factors that contribute to illegal water connections to ensure the sustainable and safe management of water resources.

5.5.1.4 Use of alternative water sources to mitigate risks on water shortages

Water scarcity is a significant global issue that affects many regions around the world (Qu et al., 2017). To address this problem, it is important to explore alternative water sources that can help mitigate water shortages and ensure sustainable water management. One effective strategy to mitigate water scarcity is rainwater harvesting. Rainwater harvesting involves collecting and storing rainwater for later use (Semasingha et al., 2022). This practice has been recognized as a key solution for water management (Qi et al., 2019). By capturing rainwater, it can be used for various purposes such as irrigation, toilet flushing, and laundry, reducing the reliance on traditional water sources. Incorporating reflexive governance principles in the implementation and management of JoJo tanks in Hammanskraal and game lodges can enhance the effectiveness of water solutions, promote community engagement, and contribute to sustainable water management practices.

Another strategy to mitigate water scarcity is the use of reservoirs in storing water which can help alleviate water shortages (Semasingha et al., 2022). They provide a buffer during times of low rainfall or drought, ensuring a stable water supply. Studies have shown that areas experiencing water scarcity are more likely to support alternative water sources (Semasingha et al., 2022). However, the experience of water scarcity alone may not be a clear predictor of support for water recycling factors such as community attitudes and concerns about water scarcity also play a role in determining support for alternative water sources (Degefu et al., 2018). By diversifying water sources and implementing sustainable water management practices, the risks of water shortages can be mitigated.

Reducing water shortages can be accomplished by redistributing water resources and achieving equilibrium in the supply and demand of water. (Li et al., 2022). Models and frameworks have been developed to optimize water resources allocation and mitigate drought (Li et al., 2022; Shiau, 2022). Conjunctive management of surface water and groundwater can also help reduce water shortage risks (Zhang, 2015). However, it is important to consider the availability and footprint of

blue water (surface and groundwater) when assessing the effectiveness of reservoirs in mitigating water scarcity (Li et al., 2018). The use of alternative water sources is crucial in mitigating the risks associated with water shortages. Inadequate supplies can be supplemented by other alternative sources such as public piped systems, water tankers, and refill water. (Genter et al., 2023). Effective water resource management should involve a combination of these strategies to ensure water availability, especially during periods of scarcity. Additionally, sustainable water management practices, conservation efforts, and responsible water use by consumers play vital roles in addressing water shortages.

According to the municipality official there has been no plans to prioritise water efficiency measures for residents. This is concerning given the effects of climate change. Other countries e.g., Brazil have experienced an evolution in policies whereby the legislation has been adopted as a new strategy to influence the installation of rainwater harvesting systems in buildings to increase the availability of potable water (Teston et al., 2018). Despite rain variation, this system has proven to provide savings on availability of potable water. Rainwater harvesting has been classified as the safest source of clean water unless polluted by the catching surface or air (Alim et al., 2019). As such other studies in South Africa (e.g., Nalwanga et al, 2019; Malema et al., 2018) have confirmed that rainwater does require treatment given surface contamination usually by birds, using technology such as SODIS may improve water quality. While there are perceptions on water quality associated with the use of RWH many households across South Africa are supplementing their water supplies for domestic purposes through this system (Chidamba & Korsten, 2015). However, non-use of alternative water sources can be attributed to a lack of trust in water quality and perceived poor taste (Genter et al., 2023). To improve water availability financial investments or donor requests will be necessary for proper RWH designs which minimises contamination. Implementing rainwater harvesting for communities such as Hammankaal will require collaboration between residents, local authorities, and relevant stakeholders towards funding and care of infrasture by residents. Having such systems in place not only addresses immediate water needs but also contributes to long-term water resilience and environmental sustainability.

The implementation of rainwater harvesting systems can have positive impacts on water conservation and the environment. It has gained increasing attention as a sustainable and cost-

effective solution, particularly in regions where there is a need to reduce environmental impact and adapt to changing precipitation patterns (Hofman-Caris et al., 2019). For example, for households, the use of a rainwater collection system reduced potable water use, decreased operating costs, and prevented storm runoff that could harm the environment (Beqaj et al., 2022). Rainwater harvesting is a practice that has gained attention in various regions, including Brazil, as a sustainable way to address water scarcity and manage water resources. Brazil, being a country with diverse climatic conditions and water availability challenges, has seen the adoption of rainwater harvesting techniques in both urban and rural settings.

In the Netherlands, rainwater harvesting has been studied in the context of drinking water production. Research has focused on understanding the quality of rainwater and assessing its potential to meet local drinking water demand. However, it has been found that the amount of rainwater that can be harvested in certain areas, such as densely populated city districts, may only cover a portion of the demand. This has led to the conclusion that rainwater harvesting for drinking water production in the Netherlands may not be economically feasible (Hofman-Caris et al., 2019). In Semarang Regency, Indonesia, the analysis of meteorological water availability and water demand showed that rainwater harvesting could fulfill the domestic water demand. This highlights the potential of rainwater harvesting as an effective means of conserving water resources (Herdiansyah et al., 2022). This underscores the importance of not only conducting local feasibility studies to assess the suitability of rainwater harvesting for drinking water production in the region but also scaling up the adoption of such systems. Factors such as local climate, rainfall patterns, population density, water demand, and available infrastructure all play a significant role in determining whether rainwater harvesting is a practical and economically viable solution.

Design and configuration play a crucial role in the effectiveness of rainwater harvesting systems. Accurate design, simulation, and maintenance schemes are necessary to ensure optimal performance. Additionally, government support and regulation are encouraged to promote the adoption of decentralized water supply systems like rainwater harvesting (GhaffarianHoseini et al., 2015). This study indicates the importance of creating policy solutions out of social problems therefore rainwater harvesting is an important strategy for water resource conservation that can be formalised for every household in Hammanskraal.

5.5.2 Environmental impact and risk management in game lodges associated with water governance

Environmental impact and risk management in game lodges associated with water governance is a complex issue that requires careful consideration of various factors. Game lodges, which are often located in remote areas, rely on water as a critical resource for their sustainability. However, changing weather patterns and persistent drought conditions in many parts of Southern Africa have highlighted the need for effective water management in these lodges (Mearns & Grobler, 2016). One approach to addressing water governance challenges in game lodges is to prioritize environmental impact and risk management to ensure the long-term sustainability of their operations, protect the environment, and provide a safe and enjoyable experience for their guests (Magnuszewski et al., 2018). These efforts not only benefit the lodge's reputation but also contribute to the overall conservation of the ecosystems in which they operate. The lack of use of dual toilets and low flow showerheads needs to be adopted by most of game lodges in Dinokeng Nature Reserve to significantly reduce water consumption, contributing to overall water conservation efforts in game lodges. This efficient use of water is essential in regions where water may be a limited resource. Also displaying information in guest rooms or common areas should encourage responsible water use during their stay. This can enhance the lodge's reputation as an eco-friendly destination.

Other considerations that can be adopted by game lodges include:

Constructed wetlands have been identified as a potential solution for water conservation and wastewater treatment in game lodges and resorts in Kenya (Makopondo et al., 2020). Preliminary findings suggest that game lodges in remote areas are prime candidates for constructed wetland establishment, which can promote sustainable hospitality operations and environmental conservation (Makopondo et al., 2020). Further studies are needed to test the efficacy and efficiency of constructed wetland technology in Kenyan wilderness areas. Effective water governance in game lodges also requires coordination and collaboration among multiple stakeholders (Magnuszewski et al., 2018). The structure of water management games reflects different mechanisms for coordinating governance and policy activities (Lubell et al., 2014). Furthermore, incorporating experiential learning through role-playing into planning processes can contribute significantly to improving

stakeholder collaboration (Ferrero et al., 2018). These tools provide a platform for stakeholders to engage, learn, and make informed decisions, ultimately contributing to better water governance and conservation efforts in game lodges and similar environments. Game lodges in Dinokeng Game Reserve used artificial dams to store water that can be used for various purposes, including drinking water supply, hydroelectric power generation, irrigation, and flood control. Whereas the use of constructed wetlands is designed to treat and manage wastewater, stormwater, or agricultural runoff, these systems can significantly improve water quality by removing pollutants, reducing nutrient loads, and providing habitat for wildlife. Constructed wetlands offer a sustainable and cost-effective solution for water treatment, contributing to the overall health of the ecosystem and supporting the goals of integrated water resource management (Makopondo et al., 2020). They use natural processes and vegetation to filter and purify water. While artificial dams may alter water quality within reservoirs, the constructed wetlands improve water quality by naturally filtering contaminants. Combining both these systems can be quite helpful in water management.

Biodiversity and habitat protection is crucial for game lodges to implement responsible land management practices to protect and conserve the natural habitat around the lodge (Magnuszewski et al., 2018). It is crucial to teach employees and visitors the value of protecting wildlife and natural vegetation, as well as how to observe animals without upsetting or stressing them unduly. Participants can learn more about the socio-political, cultural, ethical, legal, and technical facets of water management by modeling genuine decision-making scenarios with several stakeholders (Ferrero et al., 2018). This kind of learning can promote social learning in difficult tasks and raise awareness of the context of uncertainty in decision-making processes (Ferrero et al., 2018). The management's dedication to water management techniques and their promotion of staff involvement are important elements that impact the future course of game lodges about environmental practices (Kirogo et al., 2021). For game lodges in Dinokeng Nature Reserve there was no mention of staff education, yet everyone involved needs to be of understanding that water may be a limited resource. Water conservation is one of the most common green practices adopted by game lodges driven by cost savings, environmental concerns, and the simplicity of implementation and operation (Magnuszewski et al., 2018). According to Hall et al (2016), game lodges may also be more inclined to adopt water conservation practices if their area has been affected by natural disasters or extreme weather conditions e.g., droughts (Hall et al., 2016). These events can serve as powerful

triggers for lodges to prioritize and implement water-saving measures, recognizing the critical role of water management in their sustainability and resilience efforts.

5.5.2.1 Policies on the use of alternative water sources and water efficiency measures towards water management in game lodges

The use of alternative water sources and water efficiency measures has become increasingly important due to water scarcity and the need for sustainable water supply. Alternative water can supplement inadequate supplies and provide a reliable water source e.g., recycled water, desalinated water, greywater, and self-supply sources (Genter et al., 2023). Understanding community attitudes, considering the feasibility and benefits of alternative water sources are important factors in effective water management strategies (Liu et al., 2017). According to Liu et al. (2017), public acceptance and perceptions of alternative water sources vary between locations and water use purposes.

Preferences for water sources differ, and significant differences have been found in the percentage of respondents willing to use alternative water sources (Hurlimann & Dolnicar, 2018). Community attitudes towards alternative water sources, particularly for potable use, are important considerations in water management (Dolnicar & Hurlimann, 2009). Understanding these attitudes can inform water policy and decision-making (Dolnicar & Hurlimann, 2009). Water managers need to weigh the requirements of many stakeholders, costs and benefits, risks, public health, and environmental preservation while assessing alternative water delivery strategies (Cole et al., 2022). The use of alternative water sources in water management is crucial for addressing water scarcity and ensuring sustainable water supply in game lodges.

Another approach on with a significant role in water governance includes market-based environmental regulation policies (Katusiime & Schütt, 2020). These policies aim to provide economic incentives for businesses e.g., game lodges, to adopt environmentally friendly practices towards water management (Groenfeldt & Schmidt, 2013). One type of market-based policy is environmental taxation, which involves imposing taxes on activities that harm the environment, such as water pollution (Mustofa et al., 2021). This approach is based on the concept of the "double dividend," which suggests that environmental taxes can not only improve the environment but also

generate economic benefits (Goulder, 2002). However, the strong double dividend claim has been subject to debate, with mixed theoretical and empirical evidence (Goulder, 2002). Balancing economic efficiency with social and environmental considerations is crucial for the successful implementation of market-based environmental regulation policies in water governance.

Another market-based approach is the *use of subsidies* to encourage businesses to adopt environmentally friendly practices. Research has shown that market-oriented incentives can have a notable improvement on water efficiency measures (Gong & Dai, 2022). The findings of the study highlight a significant gap in awareness among game lodge owners regarding available incentives. To address this issue and encourage greater participation, several strategies focused on improved awareness and communication can be implemented such as utilizing various communication channels such as social media, newsletters, websites, and industry publications to reach game lodge owners and operators. Most game lodge owners were positive and interested on the use of incentives programs which is ultimately supporting sustainable practices within the industry.

In contrast, commanding regulatory policies, which rely on strict regulations and penalties, may not be as effective in promoting green innovation (Gong & Dai, 2022). This agreed with the findings in this study with some game lodge owners being against regulations. However, it is important to note that the effectiveness of market-oriented incentives may vary depending on the specific context and industry (Gong & Dai, 2022). It is crucial to tailor incentives and policies to the unique circumstances and needs of the game lodge industry and to consider the concerns and perspectives of lodge owners and other stakeholders.

The effectiveness of market-based policies in water governance is influenced by various factors, including water saving behaviours which can include encouraging guests and staff to adopt water-saving behaviours, such as shorter showers and reporting leaks promptly. As well as monitoring water usage regularly and identify areas for improvement in consumption patterns. Therefore, finding the right balance between regulation and innovation is crucial for sustainable development (Zhu et al., 2021). Research has shown that economic incentive policy tools have a positive correlation with economic development and public health (Xu et al., 2022). However, there is no meaningful connection between economic development and command-and-control policy

instruments on public health (Xu et al., 2022). Furthermore, the focus on authorizing water use in water governance has led to a pro-diversion bias and neglect of environmental flow needs (Curran, 2019). Effective water governance should consider a holistic approach that balances the interests of various stakeholders, economic development, public health, and environmental sustainability. This involves a mix of policy tools and strategies to create a framework that fosters responsible water use and management.

In addition to market-based policies, other types of environmental regulation instruments, such as voluntary policies, can also be used to complement market-based approaches. The Chinese government, for example, has recognized the need to transition from a government-oriented environmental regime to a market-oriented regime by implementing a mix of instruments, including market-based policies and voluntary policies (She et al., 2020). This multi-fold approach considers the heterogeneity of firms and industries and aims to improve the efficiency of water regulations (She et al., 2020). Overall, the effectiveness of any strategy on water governance may vary depending on the specific context, industry, and complementary policies in place. While most of the game lodges are self-sufficient with water management systems in place and not connected to municipalities, most did not use the latest technology on taps, showers, and toilets. Regularly reviewing and updating of water management strategies based on the outcomes of monitoring, feedback from stakeholders, and changing environmental conditions could assist game lodges towards continuous improvement. Implementing water conservation measures is crucial for emergency preparedness in case of water scarcity situations, such as droughts. These measures will help ensure that game lodge operations are not disturbed, maintaining business continuity, and reducing the impact on the local environment. By proactively managing water resources, game lodges can sustain their activities even during periods of limited water availability.

The adoption and implementation of policies require the integration of attitudes, behaviors, and perspectives across governance (Gofen et al., 2021). The study underscored that people's perceptions of reality, not the real world, influence how they behave. An illustration of how people's perceptions of reality influence their actions rather than the actual reality can be observed in the context of water conservation. *Perception* 1: An individual who closely follows water

conservation news and understands the environmental impact of the drought may voluntarily reduce water usage, fix leaks, and adopt water-saving practices.

Perception 2: An individual, despite being aware of the drought, may perceive the situation as less severe if their individual actions would not significantly impact the overall water supply. As a result, they might not actively engage in water conservation efforts. *Perception* 3: Conversely, someone who denies the severity of the drought or believes it to be a temporary issue may continue with water-intensive activities without making any changes to their behavior.

In these scenarios, the actual reality is the scarcity of water resources, but individual behaviors are influenced by varying perceptions of the severity of the situation. Understanding and addressing these perceptions are crucial for effective communication and the successful implementation of water conservation policies. Policies that consider and address diverse perspectives are more likely to gain voluntary compliance from individuals within the community.

Additionally, the significance of stakeholder consultation as a precursor to the policy development process cannot be overstated. In the context of game lodges, the findings indicated that achieving compliance with water efficiency measures is more likely when approached as a voluntary initiative rather than through intrusive or mandatory measures. These findings align with the conclusions of Sharpe et al. (2015), whose study revealed that promoting the adoption of voluntary water efficiency measures yielded more variable results compared to the enforcement of mandatory restrictions. While pricing and different demand management strategies were successful in cutting water use, the extent of the cuts differed depending on the type of strategy used. These findings suggest that a more voluntary approach to compliance on the adoption of water efficiency measures may be less effective and socially acceptable. Mandatory measures can ensure higher compliance rates and promote fairness. However, it is important to note that a combination of voluntary and incentivized approaches may be necessary to achieve optimal compliance rates. Based on the game lodges uninterest in more stringent policies in water governance, the current researcher suggests that game lodges still need to maintain policies that aim to alter the behavior of target populations e.g., guests and workers in a less intrusive manner by incorporating water efficiency measures.

In the context of environmental impact and risk management reflexive governamce fosters a deeper understanding of the mechanisms that contribute to effective environmental impact assessment and risk management in the realm of water governance. Reflexive governance encourages an examination of communication channels, the quality of information exchange, and the responsiveness of governance structures to stakeholder input. It prompts an assessment of whether there are mechanisms in place for stakeholders to provide feedback, share knowledge, and actively contribute to the adaptive management of environmental risks.

By considering various stakeholders as active contributors to environmental impact and risk management, this framework promotes a culture of inclusivity and shared responsibility. It encourages an examination of how different actors, including government bodies, environmental agencies, industries, and local communities, are involved in collaborative efforts, and how their input shapes the overall governance landscape given the changing environmental landscape. Reflexive governance places a premium on the importance of feedback loops and ongoing dialogue to understand and navigate the critical complexities of water governance. Reflexive governance, characterized by adaptability, learning, and ongoing evaluation, aligns well with the dynamic and evolving challenges associated with environmental impact and risk management.

On the other hand, the UNDP Water Governance Framework provided a structured approach to understanding and addressing the intricate challenges associated with managing environmental impacts and risks in the context of water governance. Rooted in principles of sustainability, inclusivity, and accountability, the UNDP framework provided valuable insights into the mechanisms that contribute to effective environmental governance, fostering a more resilient and sustainable approach to managing the environmental impacts and risks associated with water resources.It encouraged an assessment of whether the environmental impact assessment and risk management strategies align with broader sustainability goals, accounting for ecological, social, and economic dimensions. It prompts an examination of whether the decision-making processes are inclusive, fostering a sense of shared responsibility and ensuring that the perspectives of all stakeholders are considered. By actively involving stakeholders in water management and environmental impact decision-making processes, this approach guarantees that different viewpoints are considered, fostering a more inclusive and informed governance model.

5.6. Conclusion

The discussion provided understanding of the subject matter and allowed the researcher to contribute meaningfully to the existing body of knowledge. While certain limitations were identified, the study's strengths and contributions are significant. On water sources and infrastructure there was indication that some lodge owners were unable to invest in necessary technologies and water efficiency measures due to financial constraints. This highlights a critical barrier to the adoption of sustainable practices due to the upfront costs associated with water efficiency measures. Nevertheless, there was a universal interest among lodge owners in implementing such measures, driven by the recognition of water scarcity as a pressing concern. The study indicated that game lodges have extensive water needs, leading to high consumption levels compared to residents. Game lodges with robust water governance practices experience fewer operational disruptions during water scarcity events compared to those with less developed strategies. While game lodge owners acknowledged the benefits of water efficiency for both business and environmental sustainability, the absence of strict regulations and penalties contributed to excessive water usage in some cases. This underscores the necessity for robust policy frameworks and enforcement mechanisms to promote responsible water use. Game lodges were also found to use water to support growth of their agricultural produce which is an additional water use within the tourism industry.

From the residents' perspective, the study underscored the severe impacts of water scarcity and stress, particularly in marginalized communities such as those in Hammanskraal's Mandela Village and Kekana Gardens. These areas suffered from inadequate infrastructure and service provision, resulting in significant disparities in access to clean and safe drinking water. Residents had to resort to reuse, reduction, and recycling practices to manage the limited water supply, reflecting a critical need for equitable resource distribution and improved service delivery. Residents' desperate measure of resorting to hand-dug wells for water could have negative consequences if infrastructure, water allocation, and distribution are not prioritized.

The study highlighted the crucial role of government policies and regulations in shaping effective water governance. The lack of enforcement and a weak coalition of stakeholders to

encourage compliance were identified as major impediments to the adoption of water efficiency measures. Inadequate governance not only affects water management in game lodges but also exacerbates issues such as water pollution, inefficient use, and social inequalities. Effective governance requires not just policy formulation but also robust implementation and monitoring systems to ensure sustainable water management practices.

Effective water governance also hinges on involving communities, NGOs, and stakeholders in the decision-making process. This inclusivity ensures transparency and addresses the diverse needs and perspectives of different water users. The study emphasized the benefits and challenges of such participatory approaches, noting that involving local communities can enhance the effectiveness and sustainability of water management strategies. The study's findings are set against the backdrop of global water scarcity and stress driven by factors such as population growth, climate change, and increased water demand. These global trends underscore the urgency of developing adaptive and integrated water governance approaches to mitigate potential conflicts and competition among various users. In the context of Hammanskraal and game lodges in Dinokeng Game Reserve, understanding these broader dynamics provides valuable insights into crafting local solutions that are sustainable and equitable.

The principles of reflexive governance for coordinated planning towards sustainable infrastructure should be considered in achieving higher standards of water efficiency and sustainabilty. Continuous assessment must be embraced, enabling water governance frameworks to evolve in response to changing circumstances and emerging challenges. The journey toward effective water governance is ongoing, and its success will be measured by the degree to which it safeguards this invaluable resource for current and future generations. There was a significant difference in water management practices between game lodges and local residential areas, reflecting competing priorities and resource allocation challenges. Recommendations from this study will be in the next chapter serving as a guide for policymakers, game lodge owners, and other stakeholders to enhance current practices and develop more robust strategies for sustainable water use in these ecologically sensitive areas.

Chapter 6 Conclusions and Recommendations

6.1 Introduction

The purpose of this study was to investigate the extent of the implementation of water governance and water efficiency strategies in 3-5 star graded game lodges and associated residential beneficiation: The case of reflexive water governance at the Dinokeng Game Reserve in Gauteng, South Africa. In Hammanskraal, the current water challenges that residents experience are based on poor water infrastructure and a poor-quality water supply from the Tshwane Municipality. The study found that Hammaskraal residents and associated game lodges understood the need to employ more efficient techniques to achieve sustainable water resources management and poor water quality has negative long-term effects on socio-ecological systems. Accurate and up-to-date data play a crucial role in evidence-based decision-making enabling policymakers to track progress, identify trends, and assess the impact of interventions. The study underscores the importance of community involvement and participation in water governance. The study conclusions are based on the objectives of the study and implementation of study recommendations can contribute to more sustainable and equitable water resource management, ensuring that water remains accessible, clean, and reliable for both the tourism industry and local communities.

6.2 Study conclusion 1

In addressing study objective 1 that was: **to determine the extent of reflexive water governance and the effectiveness and enforcement of national laws, regulations and policies in addressing water efficiency to enable good water governance for selected game lodges**, the study provided insights into the level of self-regulation and adaptability in water governance among game lodges, as well as the effectiveness of government-led initiatives and regulations in promoting water efficiency and good water governance within the industry. The extent of reflexive water governance and effectiveness of national laws, regulations, and policies was investigated and reflected the industry's capacity for self-regulation and adaptability. The effectiveness of national laws and regulations in promoting water efficiency and governance practices was assessed, shedding light on the collaborative efforts required between governmental bodies and the hospitality sector.

The research suggested an examination of the effectiveness of national laws in promoting water efficiency and this suggests that water governance in the hospitality sector should not be static but should evolve based on ongoing reflection and assessment. This supports the usefulness of reflexive water governance, an approach that involves self-awareness, self-assessment, and adaptability in water management practices. This included evaluating how well existing laws align with sustainable water management practices and whether they contribute positively to the hospitality sector's water efficiency. There were suggestions for strengthening the implementation of national laws related to the adoption of water efficiency measures in the hospitality sector. The study's specific focus on game lodges in the Dinokeng Game Reserve suggests a localized and contextualized approach to understanding water management challenges and solutions within the hospitality sector. This implies that stakeholders within the sector should take proactive measures to regulate their own water usage and promote sustainable practices without relying solely on external regulations. The study advocates for collaborative partnerships between governmental bodies and hospitality stakeholders. This emphasizes the need for a collective effort involving both regulatory authorities and businesses to address water management challenges effectively.

To ensure successful reflexive water governance, the study suggests the need to enhance the capacity of the industry, possibly through education, training, and awareness programs. In addition, the research calls for strengthening the implementation of national laws and regulations related to water management in the hospitality sector. This could improve enforcement mechanisms and ensure that legal frameworks align with sustainability goals. To ensure sustainable water management practices in the hospitality sector aligns with broader environmental and conservation objectives, especially in ecologically sensitive areas such as game reserves. In summary, within this objective of the study a holistic and collaborative approach to water governance in the hospitality sector, emphasizing self-regulation, partnerships, and the effective implementation of national laws for sustainable water management practices.

This brief review supports the assertion that study objective 1 was suitably addressed.

6.3 Study conclusion 2

In addressing study objective 2 that was: **to examine the extent of adoption and implementation of water efficiency measures for 3 - 5 star game lodges and residents in the study area**, the study provided insights into the commitment of game lodges and residents to sustainable water management and conservation practices. This also helped in understanding the practical challenges and successes in implementing these measures in the study area. The study delved into practical challenges faced by game lodges and residents when implementing water efficiency measures. This included obstacles such as municipal incompetence, financial constraints, technological limitations, or other barriers that hinder the effective adoption of water conservation practices.

In addition to identifying challenges, the objective also aimed to highlight successful strategies and measures that game lodges and residents have implemented as valuable examples of effective water management practices that can serve as models for others in the study area or beyond. These provided a window into the on-the-ground realities of water conservation efforts in the study area. This involved a detailed examination of the day-to-day implementation of water efficiency measures, shedding light on how theoretical principles translate into practical actions. By focusing on game lodges and surrounding residents, the study aimed to provide a contextual understanding of water conservation efforts in the specific geographical area. This localized approach allows for a nuanced understanding of the unique challenges and opportunities within the study area.

Game lodges and surrounding residents are committed to sustainable water management. The insights gathered from this objective can inform the development or improvement of sustainable water management policies. Understanding the commitment levels, challenges, and successes can contribute to the formulation of targeted and effective policies that address the specific needs of the study area. The findings from this objective contribute to the broader knowledge base on water conservation practices, especially within the hospitality sector and residential communities. This information can be valuable for researchers, policymakers, and practitioners interested in promoting sustainable water management. Overall, the second study objective played a crucial role in providing a detailed and practical understanding of the adoption and implementation of water efficiency measures within the study area, offering insights into the commitment of stakeholders,

challenges faced, and successful strategies employed in the pursuit of sustainable water management.

This brief review supports the assertion that study objective 2 was suitably addressed.

6.4 Study conclusion 3

In addressing study objective 3 that was: **To identify the water governance strategies that are effective in 3 – 5 star graded game lodges**, the study assessed various water management strategies including water-saving initiatives, water recycling programs, staff training on water conservation, and technology adoption. By identifying effective water governance strategies, the study sought to provide insights into best practices that can be adopted by other game lodges or similar establishments to enhance their water management efforts. It also helped to highlight the key factors contributing to the success of these strategies in the context of game lodges towards effective water governance strategies. For example, implementing greywater recycling systems to treat and reuse water from showers and sinks. By identifying effective water governance strategies, the study focussed on strategies that have proven successful and can serve as examples for other establishments looking to enhance their water management efforts thereby transferring practical and actionable recommendations to the wider industry. In summary, the third objective successfully identified and analyzed various effective water governance strategies implemented by 3 – 5 star graded game lodges.

This brief review supports the assertion that study objective 3 was suitably addressed.

6.5 Study conclusion 4

In addressing study objective 4 that was: **to examine collaboration efforts by different stakeholders (i.e., government, non-governmental sectors, civil society, and residents) to enable reflexive water governance and strategies for game lodge and surrounding residents in the study are**a, the study shed light on the role of collaborative initiatives in promoting sustainable water practices and ensuring that both game lodges and residents benefit from improved water governance. The study assessed the extent to which such collaborations are effective in addressing

water-related challenges in the study area and the examination of collaboration efforts by different stakeholders. This implies an exploration of joint efforts and partnerships among different stakeholders to enhance water governance. The study assessed insights into the interconnectedness of stakeholders and highlighted the importance of unified efforts in achieving improved water governance.

The study considered the outcomes, impact, and overall success of joint efforts in achieving sustainable water practices including partnerships between governmental bodies, NGOs, civil society organizations, and residents and examined how the actions of one stakeholder group could influence or complement the efforts of others in achieving improved water management. This emphasizes the need for coordinated and collective action to address water-related challenges effectively. Collaboration efforts included shared resources, knowledge transfer, and the implementation of joint projects that promote responsible water use. These provide insights into effective collaboration and offer practical guidance for stakeholders involved. In summary, the fourth objective of the study provided comprehensive understanding of collaborative governance, stakeholder collaboration, and water management strategies can be achieved, contributing to the advancement of reflexive water governance and collaborative strategies for game lodges and surrounding residents in the study area.

This brief review supports the assertion that study objective 4 was suitably addressed.

6.6 Study conclusion 5

In addressing study objective 5 that was: **to explore if there are competing priorities between game lodges and residents**, the study sought to understand whether there are conflicting interests or goals when it comes to water governance and resource management. By exploring potential competing priorities, the study provided insights into any challenges that may arise due to differences in resource allocation or environmental impacts between game lodges and residents. For example, game lodges need substantial water for various operational purposes, whereas residents experience water shortages for their domestic needs. By recognizing the differing water needs and challenges of businesses and local communities, policymakers can create more equitable and

sustainable solutions that ensure adequate water supply for both economic activities and residential needs.

The study revealed the complexities in resource allocation and environmental impacts, underscoring the importance of a balanced and equitable approach to water governance.

This brief review supports the assertion that study objective 5 was suitably addressed.

6.7 Future studies

Future studies in the domain of water governance and efficiency in game lodges, particularly in the context of the Dinokeng Game Reserve in Gauteng, South Africa, could explore several avenues to deepen our understanding and contribute to sustainable practices. Here are some potential areas for future research:

- Conduct a follow up study on the assessment and analysis of public health concerns in Hammanskraal considering the status of water quality.
- Conduct a thorough hydrogeological assessment of the area to understand the geological and hydrological conditions in Hammankraal for ground water use.
- Explore tourists' perceptions and behaviors regarding water conservation in game lodges. Investigate how communication strategies, educational initiatives, and overall awareness influence visitors' water use practices during their stay.
- Conduct systematic long-term studies on behavioral interventions to reduce water use and waste production in lodging facilities, highlighting the importance of addressing water use behaviors of staff in game lodges.
- Explore the dynamics and effectiveness of multi-stakeholder collaboration in reflexive water governance. Investigate how collaboration between game lodges, government agencies, local communities, and NGOs contributes to successful water management.

These future studies can contribute to the ongoing discourse on sustainable water governance in game lodges, providing valuable insights for practitioners, policymakers, and researchers striving for environmentally responsible tourism practices.

6.8 Recommendations

The suitable recommendations including other successful studies for effective water governance strategies that could influence water efficiency use for the 3–5-star game lodges and residents in the study area were discussed below:

6.8.1 Recommendations for residents in Hammanksraal

- Community leaders need to be proactive, engage with community and report findings to the municipality.
- Community engagement will have to be fostered towards more sustainable and effective water management practices.
- Residents have a responsibility to maintain and not vandalise the necessary infrastructure for water storage, treatment, and distribution.
- Residents should make investments in promoting the use of efficient water-saving technologies.
- Developing planning and scheduling frameworks for tanker water supply systems can help optimize operations and ensure timely delivery.
- Social network activities and use of mobile applications can positively influence resident participation in rural water governance.
- Collaboration and negotiation between game lodges and residents can help find solutions that work for both groups. For example, game lodges can assist to invest in alternative water sources, without the resources being squandered by community members.

6.8.2 Recommendations for the City of Tshwane municipality

The list of actions that the Tshwane Municipality should consider:

1. *Infrastructure Investment*:

- Address and upgrade aging infrastructure, including water treatment plants, pipelines, and distribution networks.

- Invest in modern and efficient technologies for water treatment to ensure compliance with quality standards.
- There is a need for the municipality to urgently review water services in the area to avoid risks that may lead to the municipality pipeline damages and possible water borne diseases particularly considering groundwater extraction e.g., hand dug wells.
- Water provisions in the area need to be increased considering population growth and future water demands from various sectors such as agriculture, industry, domestic use, and environmental needs.

2. *Monitoring and Testing*:

- Implement a robust water quality monitoring system, conducting regular testing at various points in the distribution network. It is crucial to implement measures to improve water quality in both tap water and tanker water. This includes implementing proper hygiene and sanitation practices, ensuring adequate water treatment and disinfection, and regular monitoring of water.
- Enhance transparency by providing accessible and up-to-date water quality information to the public.
- Auditors could also monitor progress by connecting to the phone application. Additionally, the municipality should proactively address water conservation and water service delivery concerns rather than waiting for residents to report issues. This proactive approach would enhance water governance and improve overall effectiveness.

3. *Community Engagement*:

- Establish community awareness programs on water conservation, proper usage, and the importance of reporting water quality issues.
- Encourage citizen involvement in monitoring and reporting water quality concerns.

4. *Reflexive Governance Framework*:

- Implement a reflexive governance framework that promotes inclusive decision-making processes, stakeholder participation, accountability, and transparency.
- Establish mechanisms for regular consultations with the community to gather feedback on water quality and provision.

5. *Collaboration with Experts and Organizations*:

- Collaborate with water management experts, environmental organizations, and research institutions to leverage expertise and resources.
- Seek partnerships with NGOs and community-based organizations to enhance local initiatives and capacity building.

6. *Addressing Rural Community Challenges*:

- Prioritize rural community water needs by investing in decentralized water supply systems and appropriate technologies.
- Conduct thorough assessments of rural water sources, addressing challenges like contamination, access, and reliability.

7. *Preventative Maintenance*:

- Implement a preventive maintenance program for water infrastructure to reduce breakdowns and ensure continuous water supply.
- Develop emergency response plans to handle water supply interruptions promptly.

- Addressing corruption, mismanagement, and bureaucratic inefficiencies can also hinder effective water allocation and distribution e.g., the water tankers which can comparatively be more expensive due to marginalized pricing and not all residents can afford their services.

8. *Climate Resilience*:

- Incorporate climate-resilient strategies in water management to mitigate the impact of climate change on water availability and quality.
- Explore sustainable water harvesting and conservation practices.

9. *Regulatory Compliance*:

- Ensure strict adherence to water quality regulations and standards, including routine testing and compliance reporting.
- Implement measures to address non-compliance issues promptly.

10. *Capacity Building*:

- Invest in training and capacity building for water management personnel to enhance skills in water quality monitoring, infrastructure management, and crisis response.

- Promote education and awareness campaigns to inform the public about responsible water usage.

11. *Addressing Inequality*:

- Develop strategies to address water inequality by ensuring that all communities, regardless of their location or socio-economic status, have equal access to clean and safe water.

-A joint steering committee for skilled personnel and institutional capacity with the Department of Water and Sanitation to discuss implementation plans and joint assistance. Water resources are often subject to political interests and lobbying, which may prioritize short-term gains over long-term sustainability. These plans should typically outline goals, objectives, and actions aimed at ensuring efficient and equitable water utilization while addressing environmental, economic, and social considerations.

6.8.3 Recommendations for the Department of Water and Sanitation

- The current study indicated that significant investments were required to maintain and develop water supply infrastructure. Plans for infrastructure rehabilitation, enhanced water quality, and water efficiency measures that take environmental factors into account need to be prioritized. This will help residents improve their livelihoods and achieve a better quality of life.
- Outsourcing funds to address the challenges posed by climate change and changing water demand, more funding will be required for initiatives that improve adaptation at various levels e.g., household and game lodges.
- Additionally, there is a need for improved coordination and communication among water actors, integration between government institutions and non-formal provisions, and increased civic engagement for water infrastructure improvement.
- A policy should be formalized for the adoption of water efficiency measures by all hotels and game lodges to minimize water use and to protect the environment.

6.8.4 Recommendations for Game Lodges

- It is important to prioritize water resource protection and strike a balance between tourism development and water conservation to ensure the long-term sustainability of the industry by adopting the use of water efficiency measures to minimize water used.
- The use of alternative water sources in water management is crucial for addressing water scarcity and ensuring sustainable water supply in game lodges.
- Regularly reviewing and updating of water management strategies based on the outcomes of monitoring, feedback from stakeholders, and changing environmental conditions could assist game lodges towards continuous improvements.
- Based on the game lodges uninterest in more stringent policies in water governance, the current researcher suggests that game lodges to maintain policies that aim to alter the behavior of target populations e.g., guests and workers in a less intrusive manner by incorporating water efficiency measures.
- The involvement of the Dinokeng Projects and the cooperation of local NGOs, governmental agencies, and philanthropic organizations can significantly contribute to the well-being of the Hammanskraal community and the success of the water access initiatives.

6.8.5 Recommendations for the Department of Tourism

- Foster collaborative efforts among diverse stakeholders, including government agencies, local communities, NGOs, and technology companies.
- Establish platforms for open dialogue and joint decision-making to integrate various perspectives.
- Strengthen regulatory frameworks related to water conservation in the tourism industry.
- Ensure active guidance and compliance enforcement by the Department of Water and Sanitation (DWS).
- Allocate resources and funding to integrate social advocacy initiatives within the tourism sector.

- Partner with NGOs and community organizations to address social and environmental issues.
- Invest in training programs to educate tourism sector staff on water management practices.
- Raise awareness of potential impacts of water scarcity. Develop and regularly update drought preparedness plans, including risk assessments and communication strategies. Highlight how participating in incentive programs can benefit from their operations, both economically and environmentally.
- Prioritize water management alongside energy considerations, acknowledging their interdependence. Allocate resources for both energy and water-efficient technologies.
- Collaborate with technology companies, research institutions and international collaborations to share best practices and innovative water-saving technologies and smart infrastructure.
- Implement public awareness campaigns to educate tourists, local communities, and industry stakeholders on the importance of water conservation and encourage responsible water use practices. Utilize various communication channels such as newsletters, websites, social media, and industry publications to reach game lodge owners and operators.
- Participate in industry conferences, trade shows, and events where game lodge owners gather. These platforms offer opportunities to directly engage with the target audience and share information about available incentives.
- Establish feedback mechanisms to understand the specific needs and concerns of game lodge owners.
- Showcase case studies and success stories of game lodges that have successfully participated in incentive programs. Real-world examples can inspire others and demonstrate the positive outcomes of taking advantage of available incentives.
- Appoint liaison officers who can work directly with local government offices to bridge the communication gap. These officers can serve as points of contact for lodge owners seeking information on incentives.

6.8.6 Recommendations for the different stakeholders in water management

Partnering with local NGOs, governmental agencies, and philanthropic organizations can provide financial and technical support for water access projects. These organizations may have access to funding, expertise, and resources that can be channeled into community-based initiatives. The following initiatives can be considered.

1. *Considering the use of decentralised wastewater treatment plants*

Currently two centralised WTP's are meant to service Hammankraal. These are typically large-scale facilities designed to handle the wastewater from a broad area or community. They can be highly efficient in treating wastewater and are equipped with advanced technology for effective treatment. Centralised WTP's africasrequire skilled personnel for operation and maintenance, which can ensure consistent and reliable treatment. Centralized plants are closely monitored and regulated by local authorities to ensure compliance with environmental standards.

The decentralized WTP on the other hand treat wastewater at or near the source, such as individual homes, commercial properties, or small communities. They require less extensive infrastructure, making them suitable for areas with limited resources or where centralization is not feasible. Decentralized systems are more flexible and adaptable to various site-specific conditions. Some decentralized systems, like on-site septic systems, allow for water reuse, which can be advantageous in water-scarce regions. Smaller-scale treatment often results in lower energy consumption and operational costs particularly given South Africa's electricity loadshedding. Smaller communities or remote areas may benefit from decentralized systems, while larger urban areas may require centralized facilities. Decentralized systems can have lower initial capital costs but may require more frequent maintenance and operation by local personnel. Both approaches have their merits and can be effective when designed and operated correctly (see study, Risch et al., 2021).

2. *The use of the adaptable wash basin kit for existing toilets towards water conservation*

It may be essential to engage with game lodge owners and provide them with information about the benefits of water efficiency measures, both in terms of cost savings and environmental stewardship. Government incentives or regulations may also encourage businesses to adopt water conservation

policies. Additionally, showcasing successful case studies of similar lodges that have implemented such measures and reaped the rewards can be persuasive. Ultimately, raising awareness and providing incentives can help change the mindset of lodge owners and encourage them to prioritize water efficiency. For an example, the use of adaptable wash basin kit for existing toilets towards water conservation (see Fig. 33).

Figure 33: A hand wash toilet can be a practical choice to reduce water use. ***Source:*** WiCi (2023)

The concept of combining a handwash and toilet into one fixture is known as a "hand wash toilet" or a "sink toilet." This design integrates a sink into the top of the toilet tank, allowing an individual to wash hands using the same water that refills the toilet tank after flushing.

6.9 Theoretical Reflections

Theoretical reflections encompass critical analysis and contemplation of theoretical frameworks and concepts. In the context of the study the key theoretical perspectives to shape understanding of complex socio-environmental issues in the study area included governance, sustainability, and development.

6.9.1 Theoretical reflections on reflexive governance

Reflexive governance represents a theoretical approach that emphasizes self-awareness, adaptability, and collaboration in decision-making processes. Rooted in the concept of reflexivity, it acknowledges the complexity of social-ecological systems and the need for governance structures to continuously reflect on and adjust their strategies. This theoretical approach was particularly relevant in sectors where water efficiency is paramount, such as the hospitality industry. The application of reflexive water governance and the effectiveness of national laws in promoting water efficiency, focusing on a case study of residents and game lodges in Dinokeng Game Reserve emphasized the importance of involving stakeholders, including local communities and industry operators, in decision-making processes. In the hospitality sector, where water usage is intensive, reflexive approaches encouraged adaptive strategies based on ongoing learning to enhance water efficiency.

Theoretical reflections on reflexive governance highlighted its departure from traditional top-down models, emphasizing decentralized, participatory, and iterative approaches. Using this approach assisted in recognizing the dynamic nature of socio-environmental challenges, encouraging stakeholders to question assumptions, engage in self-critique, and adapt strategies based on ongoing learning. This collaborative approach can lead to more holistic and effective environmental protection measures in the global South, where diverse contexts and complex challenges prevail, reflexive governance offers a promising framework for addressing issues such as water scarcity, environmental degradation, and socio-economic inequalities. Reflexive governance empowers marginalized communities by giving them a voice in decision-making processes by reducing socio-economic inequalities by ensuring equitable access to resources. This can be crucial in addressing environmental degradation as it allows for continuous monitoring, evaluation, and adjustment of conservation strategies in water governance.

The emphasis of reflexive governance on local knowledge, community engagement, and adaptability aligns well with the nuanced realities of the global south, fostering more inclusive and context-specific governance models. The case study of game lodges in Dinokeng Game Reserve offered a unique opportunity to explore the practical application of reflexive water governance in

the hospitality sector. By assessing the effectiveness of national laws in promoting water efficiency and considering the dynamic nature of the socio-environmental system, this study aims to contribute valuable insights to both water governance theory and sustainable practices within the hospitality industry. Furthermore, reflexive governance can play a vital role in addressing industrial risks such as within the hospitality sector by promoting more responsive and responsible industrial practices that consider the well-being of local communities.

Promoting reflexive governance involves fostering a culture of self-awareness, adaptability, and responsiveness within governance systems. The several suggestions to enhance reflexive governance include the following:

1. Transparency and Information Sharing:

Establish transparent communication channels to share information about governance decisions, policies, and their implications. Accessible and understandable information empowers citizens to engage in informed discussions and hold decision-makers accountable. Establishing mechanisms for ongoing public consultations and feedback loops. Soliciting input from the public provides valuable insights and ensures that governance systems are responsive to the evolving needs and expectations of the community.

2. Capacity Building:

Invest in the training and development of government officials and stakeholders to enhance their understanding of the issues at hand, as well as their ability to navigate complex and evolving challenges. Conduct public education and awareness campaigns to inform citizens about governance processes, their rights, and how they can actively participate. An informed citizenry is essential for fostering reflexive governance.

3. Continuous Monitoring and Evaluation:

Implement robust monitoring and evaluation mechanisms to assess the impact of policies and decisions over time. Regular assessments allow for adjustments based on lessons learned, contributing to a more adaptive governance framework.

4. Use of Technology:

Leverage technology for data collection, analysis, and communication. Technological tools can enhance transparency, facilitate real-time feedback, and improve the overall efficiency of governance processes.

Training and capacity-building initiatives should be provided to water professionals and stakeholders to enhance their understanding of water governance principles and their practical application. Water tanks such as Jojo Tanks (polyethylene plastic) can be used.

6.9.2 Theoretical reflections on the Water Governance Framework by the UNDP

The UNDP Water Governance Framework, as a theoretical construct, provided a comprehensive and integrative approach to water management in the global south. aligning with the Sustainable Development Goals (SDGs). This framework is crucial, especially in developing countries, where the impact of infrequent water supply can undermine people's health, dignity, and economic conditions. The framework underscores the importance of stakeholder participation, recognizing that effective governance requires collaboration among governments, civil society, and various sectors. The emphasis on social, economic, and environmental considerations aligns with sustainable development goals in the global south, where issues of water access, sanitation, and resource management are often interconnected with broader development challenges. The UNDP's commitment to promoting good governance and the rule of law has been a forerunning commitment of international development agencies, emphasizing the importance of governance in human development The framework's adaptability to different contexts is crucial in the global South, where diverse socio-economic conditions and cultural landscapes demand flexible and context-specific solutions. Theoretical reflections on the UNDP framework underscore the need for inclusive and participatory governance structures that empower local communities, consider indigenous knowledge, and navigate the complexities of transboundary water management. The framework's integration of sustainability principles and its emphasis on balancing competing interests make it a valuable theoretical guide for addressing water-related challenges in the global south.

Overall, both reflexive governance and the water governance framework proposed by the UNDP are crucial concepts for addressing sustainability challenges, particularly in the global South as presented in the current study. Reflexive governance's emphasis on adaptability and collaboration complements the UNDP framework's comprehensive and inclusive approach inline with the SDG to ensure sustainable water management. Theoretical reflections on these concepts provided insights

into how governance structures can evolve to address the intricate and context-specific water-related issues prevalent in the diverse landscapes of the global south especially for developing countries. Examining the water situation in the study area highlights the evident necessity to move beyond depending solely on the government to identify and implement the measures essential for guaranteeing a secure and sustainable supply of drinking water.

6.10 Conclusion

Implementing these recommendations requires a concerted effort from all stakeholders involved, with a focus on the well-being of the Hammanskraal community and the sustainable development of game lodges in the region. By following these suggestions, it is possible to address the immediate water access needs of the community while also fostering long-term prosperity and environmental sustainability. By combining the resources, expertise, and commitment of various stakeholders, it is possible to address water access challenges in a comprehensive and sustainable manner.

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Annexures

Annexure A: Participant Information Sheet and Informed Consent Form

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number: 2022/CAES_HREC/025
Research permission reference number: Research Permission/S.Mnguni

January 10, 2022

Title: The efficiency of water governance strategies in 3-5 star graded game lodges and residential areas around Dinokeng Game Reserve, South Africa.

Dear Prospective Participant.

My name is Simphiwe Mnguni and I will be undertaking a research study under the supervision of Professor L Leonard in the Department of Agriculture and Environmental Sciences. My research is towards a PhD Degree in Environmental Sciences at the University of South Africa. We are inviting you to participate in a study entitled, “The efficiency of water governance strategies in 3-5 star graded game lodges and residential areas around Dinokeng Game Reserve, South Africa”.

WHAT IS THE PURPOSE OF THE STUDY?

- The aim of this study is to investigate the extent of the implementation of water governance strategies in 3-5 star graded game lodges and residential areas around Dinokeng Game Reserve, in Gauteng, South Africa.
- To determine the effectiveness of national laws, regulations, and policies to address water efficiency and the effectiveness of government enforcement to enable good water governance.
- To examine the extent of adoption and implementation of water efficiency measures for the three-to-five-star game lodges and surrounding residents in the study area.
- To identify the water governance strategies that are effective in three-to-five-star graded game lodges and surrounding residents in the study area.
- To examine governance and collaboration efforts by different stakeholders (government, non-governmental sectors) involved in the appropriation of policies on water governance for game lodge and surrounding residents in the study area.
- To make recommendations on how to improve water governance and efficiency measures in game lodges and water security for surrounding communities.

WHY AM I BEING INVITED TO PARTICIPATE?

You have been invited to participant in this study because your perceptions and knowledge can assist the researcher to investigate water governance strategies that should be in place to sustainably regulate and manage water resources for adaptation to high water demands considering the effects of climate change in 3-5 star graded game lodges and residential areas around Dinokeng Game Reserve, South Africa. The changes brought about by climate change uncover the need to build resilience and to identify fragmentation that could contribute to water conflict caused by poor water management (Dube at al., 2020). According to Mbenenge and Thomas (2019) water efficiency measures are necessary to ensure that water resources are managed in a sustainable manner for not only the hospitality industry e.g., game lodges in maintaining market competitive advantages but also to bring balance to the livelihood of neighboring residents.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

This study involves a semi-structured interview and will take an approximately 30-6 minutes to complete. The questions encompass questions pertaining to participan perspectives on the extent of the implementation of water governance strategies in 3-5 sta graded game lodges and residential areas around Dinokeng Game Reserve, in Gauteng South Africa.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Yes. Participation is voluntary and there is no penalty or loss of benefit for non-participation. You are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. It will not be possible to withdraw once you have submitted the questionnaire anonymously.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

Should the participants perspectives on water governance be identified it will assist the researcher to understand which water governance structures are within the community for their role and responsibility in ensuring sustainability. This includes investigating if there is existence of stakeholder alliances to collaborate efforts towards water governance structures to influence water efficiency use by ensuring that the water supply does not exceed demand. There is a great need for governance to prevent underdevelopment of water resource management strategies, according to Yates and Harris (2018) collaborative efforts on water sharing agreements and community members has proven effective in other areas through policies that involve social learning, flexible implementation, and

community engaged decisions. It is important that collaborative partnerships (stakeholder alliances) between game lodges and community members are forged to generate sustainable outcomes through enforcement and implementation of the adopted public policies and legislation on development of water resource management.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

Interviews will be done by the researcher. The researcher will arrange interviews will potential interviewees either face-to-face or virtually – depending on preference of the informant. Due to the current pandemic, informants may be more comfortable with virtual interviews which allows the researcher to record and save the details of the interview. If there are face-to face interviews, COVID-19 protocols will be adhered to mitigate risks by the adherence to social distancing, utilization of masks and sanitizers.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

Your name will not be recordered anywhere and no one, apart from the researcher will know about your involvement in this research. Interviews will be recorded but this will be kept safely and only will be accessed by the researcher and for transcription purposes. Informants remain anonymous and only codes or a pseudonym will be assigned to interviews will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Copies of the interview answers will be stored by the researcher for a period of five years in a locked cupboard maintained by the researcher. No names will be attached to the interviews but only a code will be assigned. For future research or academic purposes,

electronic information will be stored on a password protected computer. Information will be destroyed after five years. Any hard copies will be shredded and electronic copies will be permanently deleted from the hard drive of the computer.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

No payments will be made to participants.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Health Research Ethics Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Simphiwe Mnguni on 079 801 3754. Should you have concerns about the way in which the research has been conducted, you may contact Professor L Leonard on 011 471 2311, or llewel@unisa.ac.za. Thank you for taking time to read this information sheet and for participating in this study.

Signature of participant

Date

CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits, and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

Participant Name & Surname…… (please print)

Participant Signature……..Date……

Researcher's Name & Surname……(please print)

Researcher's signature……..Date……

Annexure B: UNISA Ethics Approval and City of Tshwane Permission Letter

UNISA-CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 21/09/2023

Dear Ms Mnguni

NHREC Registration # : REC-170616-051
REC Reference # : 2022/CAES_HREC/025
Name : Ms SNE Mnguni
Student #: 44376995

Decision: Ethics Approval Confirmation after First Review from 10/02/2022 to 31/01/2027

Researcher(s): Ms SNE Mnguni
simphiwemnguni.sm@gmail.com; 079-801-3754

Supervisor (s): Prof L Leonard
llewel@unisa.ac.za; 011-471-2311

Working title of research:

Examining water governance and water efficiency strategies in 3-5 star graded game lodges and associated residential beneficiation: The case of reflexive water governance at the Dinokeng Game Reserve in Gauteng, South Africa

Qualification: PhD Environmental Science

Thank you for the submission of your yearly progress report to the Unisa-CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is confirmed to continue for the originally approved period, subject to submission of yearly progress reports. **Failure to submit the progress report will lead to withdrawal of the ethics clearance until the report has been submitted.**

Due date for next progress report: 31 August 2024

The progress report form can be downloaded from the college ethics webpage: https://www.unisa.ac.za/sites/corporate/default/Colleges/Agriculture-&-Environmental-Sciences/Research/Research-Ethics

*The **low risk application** was originally **reviewed** by the UNISA-CAES Health Research Ethics Committee on 10 February 2022 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 Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
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 field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2022/CAES_HREC/025** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150

Prof MA Antwi

Chair of UNISA-CAES Health REC

E-mail: antwima@unisa.ac.za

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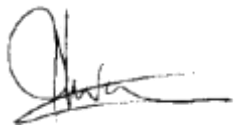

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CITY OF
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City Strategy and Organizational Performance

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My ref: Research Permission/S.Mnguni
Contact person: Pearl Maponya
Section/Unit: Knowledge Management

Tel: 012 358 4559
Email: PearlMap3@tshwane.gov.za
Date 31 March 2022

Ms Simphiwe Mnguni
Hillside View 6
4 Klarinet Street
Lynwood

Dear Ms Mnguni,

RE: THE EFFICIENCY OF WATER GOVERNANCE STRATEGIES IN 3-5 STAR GRADED GAME LODGES AND RESIDENTIAL AREAS AROUND DINOKENG GAME RESERVE, SOUTH AFRICA

Permission is hereby granted to Ms Simphiwe N.E. Mnguni, a PhD in Environmental Management candidate at the University of South Africa (UNISA), to conduct research in the City of Tshwane Metropolitan Municipality.

It is noted that the study aims to investigate the extent of the implementation of water governance strategies in 3-5 star graded game lodges and residential areas around Dinokeng Game Reserve, in Gauteng, South Africa. In addition, the study will also include the effectiveness of laws and regulations for water governance and enforcement thereof. The City of Tshwane further notes that all ethical aspects of the research will be covered within the pro\visions of the UNISA Research Ethics Policy. You will be required to sign a confidentiality agreement form with the City of Tshwane prior to conducting research.

Relevant information required for the purpose of the research project will be made available as per applicable laws and regulations. The City of Tshwane is not liable to cover the costs of the research. Upon completion of the research study, it would be appreciated that the findings in the form of a report and or presentation be shared with the City of Tshwane.

Yours faithfully,

PEARL MAPONYA (Ms.)
DIRECTOR: KNOWLEDGE MANAGEMENT

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Annexure C: Semi Structured Interview Questions for Mandela Village and Kekana Gardens Residents

1. How would you describe the water supply in your community? Please explain.
2. Why do you think water access is a problem in this community? Please explain.
3. How would you describe water governance by the municipality for water supply in your area? Please explain.
4. Are you aware of any community-based groups/ collaborative approaches to water management/ issues and water governance in your area? Please explain.
5. What sustainable initiatives have you adopted in your household towards water conservation? Please explain.
6. Are you aware of any collective community engagement on how to manage the water supply issues faced in the community collectively? who organized the event?
7. Are you aware of the community members actively engaged with the municipality to ensure sustainable use and supply?
8. Are you practicing any water reusing/reducing/ conservations initiatives given water supply issues in your area?
9. Do you believe local business such as game lodges need to show commitment to improving local water environment? Please explain.
10. Do you believe water conservation methods are a responsibility of households/municipality or both? Please explain.
11. Do you perceive public participation essential in water governance? Please explain.
12. In your knowledge does residing close to Dinokeng Nature Reserve of benefit to you and your community on water access?
13. Do you perceive that game lodges around Dinokeng Nature Reserve have better water quality and supply? If yes, why?
14. What changes need to be made to ensure equitable access to water considering future water scarcity in rural areas such as Kekana Gardens, Hammanskraal? Can you briefly describe some of those changes.

15. Do you think involving children in water conservation efforts is important? Please explain.
16. What type of event do you think supplies the best information on water management to local communities?

Annexure D: Semi Structured Interview Questions for Municipality Workers

1. What are the 5 main challenges on water governance in Hammanskraal?
2. What policies must be implemented to ensure effective water governance? Please explain.
3. Do you think there are any changes that need to be made to ensure equitable access to water considering future water scarcity in rural areas such as Mandela Village, Hammanskraal? Can you briefly describe some of those changes.
4. What changes need to be made to ensure equitable access to water considering future water scarcity in rural areas such as Kekana Gardens, Hammanskraal? Can you briefly describe some of those changes.
5. What policy and practice mechanisms need to be put in place to successfully implement water demand management and conservation?
6. Do you believe collaboration with various stakeholders including local businesses e.g., game lodges is necessary to improve water governance capacity?
7. How has the municipality effectively dealt with the water related challenges in Hammanskraal over the past 5 years?
8. To what degree do you think water efficiency measures should be adopted in your municipality?
9. In your knowledge has there been any water conflicts associated with growing residential populations with accommodation establishments e.g., game lodge along Dinokeng Nature Reserve? If so**,** please elaborate.

Annexure E: Semi Structured Interview Questions for Counsellors/ Community Leaders

1. Does collaboration with community members increase community confidence in water management? Please explain.
2. Does collaboration with various stakeholders increase community confidence in water management? Please explain.
3. How is the community and stakeholder (public–private partnerships) participatory efforts on water governance for Kekana Gardens? Please explain.
4. How is the community and stakeholder (public–private partnerships) participatory efforts on water governance for Mandela Village? Please explain.

5. To what extent do you think local businesses should show commitment to improving the local water environment? Please explain.
6. Are there any water efficiency strategies adopted by communities (in Kekana) in the event of shocks such as droughts as perceived solutions? Please explain.
7. Are there any water efficiency strategies adopted by communities (in Mandela Village) in the event of shocks such as droughts as perceived solutions? Please explain.
8. What water efficiency measures could be adopted by residents to reduce water use in Mandela Village and Kekana Gardens , Hammanskraal? Please explain.
9. In your knowledge has there been any water conflicts associated with growing residential populations with accommodation establishments e.g., game lodge along Dinokeng Nature Reserve?
10. What policies must be implemented to ensure effective water governance? Please explain.

Annexure F: Semi Structured Interview Questions for Private Water Institutions e.g. TGCSA

1. What is the status of policies, laws and plans to support Integrated Water Resources Management (IWRM) in the hospitality industry? Please explain.
2. What is your opinion on the lack of government legislation in the enforcement of implementation of green initiatives in South African hospitality industry to implement sustainable changes? Please explain.
3. How best can your institution ensure preparedness to address potential water management challenges in the hospitality industry? Please explain.
4. What would be the best management practices to implementing sustainable water management in the hospitality industry e.g., game lodges? Please explain.
5. Are there any plans to consider natural resources e.g., implementation of water management as a criterion on star grading? Please explain.
6. What is your understanding of water efficiency measures? Please explain.
7. What water efficiency measures could be adopted by residents to reduce water use in the area?
8. How can the uptake and adoption of water efficiency measures be improved in both the rural and urban hospitality industry environments? Please explain.
9. What suggestions would you recommend for accommodation establishments in rural areas e.g., game lodges to ensure effective water management?

Annexure G: Semi Structured Interview Questions for The Department of Water and Sanitation

1. What are the 5 main water governance challenges facing the department generally?
2. Are the current legal frameworks and laws adequate to address water governance challenges? Please explain.
3. How is the department working to address water governance challenges especially given the involvement of different stakeholders? Please explain.
4. What is the status of policies, laws and plans to support Integrated Water Resources Management (IWRM) at the national level and other levels? Please explain.
5. Do you believe that the law on sustainable water management is flexible enough to permit reform in response to technological change and socio-economic need? Please explain.
6. What objectives should be addressed by legal frameworks and laws to achieve optimal regulations to promote a sustainable management of water resources? Please explain.
7. What is the status of financing for water resources development and management at national and other levels? Please explain.

Annexure H: Semi Structured Interview Questions for The Department of Tourism

1. What is the status of policies, laws and plans to support Integrated Water Resources Management (IWRM) within the hospitality industry especially those in rural areas? Please explain.
2. What is your opinion on the lack of government legislation in the enforcement of implementation of green initiatives in South African hospitality industry to implement sustainable changes? Please explain.
3. Please describe any innovative/unique water related initiatives being undertaken by your institution for preparedness to address potential water management challenges affecting the hospitality sector?
4. Are there any plans to support IWRM implementation in collaboration with stakeholders involved in the management of the hospitality industry e.g., TGCSA?
5. What strategies have been identified as most effective for improved water efficiency in the hospitality industry that could assist the hospitality establishments based in rural settings?
6. Do you feel rural establishments e.g., game lodge require more inputs than urban establishments to manage and govern water resources?
7. What innovative water related initiatives or the institution's preparedness to address potential water management challenges affecting the hospitality sector?
8. How can the uptake and adoption of water efficiency measures be improved in the rural hospitality industry environments?
9. Is there anything further you may want to add that we have not spoken about?

Annexure I: Semi Structured Interview Questions For Game Lodges

1. What water challenges do you face in the area, if any? Please explain.
2. Are there any water situations/ challenges of the neighboring communities that affect your establishment?
3. In your knowledge has there been any water conflicts associated with growing residential populations with accommodation establishments e.g., game lodge along Dinokeng Nature Reserve?
4. Do you believe South African law on sustainable water management is flexible enough to permit reform in response to technological change and socio-economic need? Please explain.
5. To what extent do you think local businesses should show commitment to improving the local water environment? Please explain.
6. Do you believe that sustainable water practices give business a competitive advantage? Please explain.
7. What workable strategy can you recommend for effective water governance to the neighboring communities e.g., Mandela Village and Kekana Gardens ?
8. What water efficiency measures could be adopted by residents and game lodges to reduce water use in rural setting? Please explain.