International Journal of Development and Sustainability
ISSN: 2186-8662 – www.isdsnet.com/ijds
Volume 13 Number 9 (2024): Pages 730-753
ISDS Article ID: IJDS24012201

Water conservation and water demand management business planning in South Africa

Tinashe Mukonavanhu *, Danielle Nel-Sanders

College of Business and Economics, School of Public management, Governance, and Public Policy, University of Johannesburg, Gauteng, South Africa

Abstract

This research focuses on Water Conservation and Water Demand Management (WC/WDM) business planning in South Africa (SA). It provides an overview of the problems experienced in water resource management, emphasizing how crucial it is to have well-structured Water Conservation and Water Demand Management business planning to guarantee the conservation of water. This paper provides a discussion based on the current evidence and knowledge of research in WC/WDM business planning. The study uses a qualitative research approach and combines a systematic analysis of literature using search strategies and a classification framework encompassing a broad outline regarding the major research concerns and results based on the years 1956 to 2023 combined with interview findings from five professionals in the Vhembe District Municipality. The major findings of this systematic mapping study encompass a compilation involving the main literature, a systematic map for equating, categorising, as well as assessing present expertise within the subject of WC/WDM business planning SA, a broad analysis of the main research themes and results, as well as suggestions for upcoming research.

Keywords: Sustainable; Water conservation; Water demand management; Business planning; South Africa

JEL Classification: Q01, Q25, Q3

Cite this article as: Mukonavanhu, T. and Nel-Sanders, D. (2024), "Water conservation and water demand management business planning in South Africa", *International Journal of Development and Sustainability*, Vol. 13 No. 9, pp. 730-753.

* Corresponding author. *E-mail address:* tynuhsher@gmail.com

1. Introduction

In addressing sustainable water management, strategies like WC/WDM, groundwater utilization, desalination, water re-use, rainwater harvesting, and acid mine wastewater treatment are crucial. Despite these efforts, over 3 million people in South Africa (SA) lack sufficient water for decent living, while 14.1 million lack adequate sanitation. Furthermore, 64% of households do not receive enough water, and a substantial portion (56%) of wastewater treatment facilities are in disrepair (Department of Water and Sanitation SA, 2023a). These challenges underscore the urgent need for effective policies and infrastructure improvements to ensure equitable access to water and sanitation across the country.

SA is experiencing a significant water shortage due to inadequate conservation practices and an anticipated supply-demand imbalance by 2030. This issue is worsened by droughts, excessive water use, and limited runoff (Grewar, 2019). Additionally, Water Conservation (WC) challenges stem from a disjointed understanding of water systems, which impacts economic growth and water quality management amid increasing scarcity and urbanization pressures (Knight, 2019).

SA is grappling with a water crisis driven by population growth, climate change, urbanization, and economic development, which necessitates innovative freshwater resource management (Ngcobo, 2021). The country faces rising water demand amid unpredictable supply. Rural and peri-urban areas have been less responsive to WC campaigns, underscoring the need for a social ethic of conservation (Onyenankeya et al., 2018). The water scarcity following Cape Town's 2018 Day Zero crisis has led to increased use of water-saving equipment, influencing household WC behaviours (Thiam et al., 2021).

SA struggles with water infrastructure issues such as under-pricing, poor return on investment, high levels of non-revenue water, and a significant capital investment gap, which affect sustainability and economic growth (Ruiters and Echendu, 2022). The country also experiences water scarcity and drought, resulting in periodic water restrictions, making public awareness and understanding vital for encouraging sensible water use (Pretorius et al., 2022). Additionally, severe water scarcity arises from low rainfall, high consumption rates, and poor conservation practices (Grewar, 2019).

WC in SA is hampered by inadequate technical guidance, financial limitations, policy gaps, and limited knowledge, jeopardizing sustainable practices and risking environmental and agricultural sustainability, which could lead to food insecurity (Agholor and Nkosi, 2020). Inadequate municipal WC exists and is due to poor planning and a lack of awareness of its benefits. Municipalities often lack the capacity and fail to secure funding for sustainable water management (Wegelin and Jacobs, 2013). Historically, access to water in SA has been skewed in favour of those with land and economic power, leaving many, especially black and rural populations, struggling to secure this basic right (Gabru, 2005).

The politics of water supply in SA encompass technical difficulties, budget allocation disputes, rights-based service provision, and global debates on human rights, economics, and environmental issues (Muller, 2007). The 1956 SAn water policy, rooted in colonialism, has created challenges in modern water management due to historical ideologies and community resistance, affecting conservation efforts (Maphela, 2016). Historically,

access to water in SA has favoured those with land and economic power, leaving many, particularly black and rural populations, struggling to secure this fundamental right (Gabru, 2005).

In spite of the increasing amount of systematic knowledge in various areas of WC/WDM in SA, a vacuum exists with regards to the availability of research that comprehensively examines the current state of WC/WDM business planning research. Therefore, this paper addresses this gap by aiming to organize and categorize the existing knowledge in relevant research domains. The research questions of the study are:

- What are the key challenges facing Water Conservation and Water Demand Management (WC/WDM) business planning in South Africa?
- How do social and behavioral factors influence the effectiveness of WC/WDM initiatives in South Africa?
- What strategies can be implemented to improve WC/WDM business planning and address the identified challenges?

This study addresses the critical need for well-structured WC/WDM business planning in SA to ensure sustainable water resources. SA faces severe water scarcity issues exacerbated by inadequate conservation, droughts, overuse, and limited runoff, with a projected supply-demand imbalance by 2030. Research problems include fragmented understanding of water systems, impacts of economic growth, water quality management amid scarcity and urbanization, and historical and systemic challenges. Objectives include analysing conceptual and theoretical variables influencing WC/WDM business planning, examining policy and structural contexts, understanding involved processes, identifying challenges, and proposing solutions. The study aims to integrate business planning into water services management, contributing to broader WC/WDM goals.

The introduction emphasizes the importance of well-structured WC/WDM business planning in SA, addressing water management challenges and answering Research Question 1: “What are the conceptual and theoretical variables that influence WC/WDM business planning?” It underscores the need for sustainable strategies and transitions to the “Theories that inform Water Demand Planning (WDP)” section, establishing a theoretical framework for effective planning. This foundation enhances understanding of WC/WDM approaches and aids in developing strategies to promote sustainable water practices in SA.

2. Literature review

The literature review in this study analyses existing research on WC/WDM business planning in SA, addressing the conceptual and theoretical variables and the challenges in WC/WDM planning. It discusses key theoretical frameworks and identifies variables shaping WC/WDM practices. The review highlights implementation challenges and critically evaluates current solutions and literature gaps. This analysis enhances understanding of WC/WDM factors and identifies areas for new research and strategies.

2.1. Theories that inform water demand planning

This section examines theoretical frameworks like Dynamic social impact theory (DSIT) and Theory of Planned Behaviour (TPB). These frameworks elucidate the conceptual foundations of water demand management

strategies, showing how socio-cultural and behavioural factors influence WC. Linking these theories to policy and structural aspects provides a comprehensive understanding of WC/WDM business planning. This analysis establishes a foundation for effective, culturally resonant, and structurally sound water demand management strategies, addressing the study's core objectives.

2.1.1. Dynamic social impact theory

The DSIT is crucial for understanding how cultural variations influence human cognition and behaviour in spatially distributed groups. DSIT examines interactions in isolated populations, leading to cultural markers: clustering, correlation, consolidation, and continuing diversity (Harton and Bullock, 2007). In this study, DSIT informs the methodology by analysing community responses to WC initiatives in SA. It aids in interpreting results by highlighting local disparities, new connections, reduced differences, and persistent diversity in water management practices. This theory connects to the research objectives, informing strategies for effective WC/WDM business planning and addressing WC challenges.

2.1.2. Theory of planned behaviour

Planned behaviour theory exists as a framework utilised in forecasting as well as accounting for human behaviour in given situations. It assumes that people's intentions are indicative of their desires and motivations to engage in a particular behaviour. These intentions are influenced by the level of effort individuals are willing to exert and the extent to which they are committed to carrying out the behaviour. Generally, individuals with higher intentions are more likely to perform the behaviour. However, it is important to note that individuals can only act upon their behavioural intentions if they do so voluntarily (Ajzen, 1991).

The TPB is essential to this study, providing a foundational framework for understanding human behaviour in WC and demand management business planning in SA. Emphasizing intentions, desires, and motivations, the theory guides research into how these factors influence actions for sustainable water practices. In methodology, it informs variable selection for behaviour analysis, and in analysis, it interprets how attitudes, subjective norms, and perceived control shape planning strategies. This theory guides the study's methodology, analysis, and interpretation, highlighting the importance of influencing intentions for effective WC practices (Ajzen, 1991).

Delving into the theories that inform WDP provides a framework for understanding cultural influences on human behaviour in WC initiatives. By analysing how different communities in SA interact and respond to WC efforts, the study gains insights into local disparities and behavioural patterns. This theoretical foundation informs the methodology and interpretation of results, guiding strategies for effective WC/WDM business planning. Transitioning from the theoretical framework, the subsequent section provides a literature review of existing research related to WC/WDM business planning in SA. By reviewing relevant publications and examining legislative frameworks, the literature review aims to provide a thorough discussion on the current state of research in WC/WDM business planning. This analysis of historical policies and their impact on present-day water management practices contributes to understanding the challenges and opportunities for sustainable water practices in the region, aligning with the study's objectives of promoting effective WC strategies.

2.2. Legislative frameworks that influence WC/WDM business planning

The establishment of water policy in SA, particularly through the Water Act of 1956, offers historical insights into water management practices, rooted in apartheid laws that enforced racial segregation and resource disparities (Brauns and Stanton, 2016). This policy's examination informs current WC and demand management strategies (South Africa, 1956), shaping the study's methodology and result analysis. Understanding past policies elucidates current water management challenges and opportunities for sustainable practices in the region.

2.2.1. Water Act (No. 54 of 1956)

The Water Act of 1956 (South Africa, 1956) marked a transformative shift in SA'n water legislation, replacing riparian-rights laws with the *Dominus Fluminis* principle, which granted the government authority over all water resources as a custodian for all citizens. However, during apartheid, this principle only applied to the white minority, excluding non-whites. This legislation is pivotal to the study, as it influenced contemporary water management practices and the development of current WC and demand management strategies, aligning with the study's objectives (South Africa, 1956).

2.2.2. Constitution of the Republic of SA (No. 108 of 1996)

The Constitution of the Republic of South Africa (No. 108 of 1996) is crucial to the study as it provides a legal framework for ensuring equal access to resources, including water, for all citizens (South Africa, 1996). The research explores how constitutional principles influence WC and demand management strategies. By analysing these legal provisions, the study interprets how constitutional rights shape water management policies. This legal perspective enhances understanding of the constitutional underpinnings and their implications for sustainable water practices in SA.

2.3. Policy instruments, strategic frameworks, guidelines, and plans that affect WC/WDM business planning

2.3.1. National development plan

The National Development Plan (NDP) is essential to the study as it aims to ensure equitable access to safe piped water for all SA'ns (National Planning Commission (NPC), 2012). The research aligns with the NDP's goal of reducing urban water demand by 15% by 2030, emphasizing economic growth and employment through effective water management. The NDP guides the study's methodology for analysing and implementing water management practices. During analysis, the NDP's objectives inform result interpretation, highlighting sustainable water resource management's role in achieving SA's broader developmental goals.

2.3.2. Integrated development planning (IDP)

Integrated Development Planning (IDP) involves stakeholder participation to create comprehensive plans covering economic, spatial, social, institutional, environmental, and fiscal aspects for equitable resource

allocation (Harrison, 2001). This concept is pivotal to the study, promoting inclusive planning (Harrison, 2001) aligning with objectives to improve WC and demand management strategies in SA. IDP principles guide result interpretation, emphasizing holistic and sustainable water resource management approaches. Integrating IDP principles offers insights into how comprehensive planning supports effective water management and sustainable development in the region.

2.4. Institutional, structural, and functional contexts of WC/WDM business planning

There are several institutions in SA that provide guidance for business planning in WC/WDM. At the national government level, the Department of Water and Sanitation (DWS) is responsible for governing Water Resources Management (WRM). However, water usage and management are closely connected to other departments as well.

2.4.1. Department of Water and Sanitation (DWS)

The Department of Water and Sanitation (DWS) is vital to the study, as the DWS is responsible for sustainable water management in SA. DWS's role shapes the research objectives, focusing on sustainable practices and effective strategies. Their mandate guides the selection of analytical frameworks for WC and demand management in the study. DWS's responsibilities influence result interpretation, emphasizing regulatory measures and conservation efforts of the study. This study enhances understanding of the regulatory framework and initiatives needed for water sustainability in the region.

2.5. WC/WDM business planning in SA

The implementation of WC/WDM business planning in SA is vital, aligning with the Water Services Act of 1997, which emphasizes equitable access to water services (Van Zyl et al., 2008). WC/WDM business planning is crucial for sustainability and reducing water demand, reflecting research objectives of improving water management practices. WC/WDM frameworks guide the analysis of strategies and inform the interpretation of results, underscoring the importance of structured planning. By integrating WC/WDM business planning, the study advances effective WC strategies and enhances water management practices.

Wegelin and Jacobs (2013:417) propose the implementation of a Water Demand Management (WDM) strategy that is flexible and requires less initial financial investment but expands over time. This approach is preferable to creating extensive plans from the beginning that demand a significant amount of capital and are not effectively put into action. Figure 1 illustrates the recommended methodology for developing the strategy and business plan for WDM.

The suggested approach proposes using a common business strategy model to establish the vision and mission of the organization, as depicted in Figure 1. Defining mission and vision statements has implications for planning and other activities related to organizational performance (Phanuel and Darbi, 2012). Developing vision and mission statements necessitates a comprehensive understanding of the organization's current situation. If there is enough clarity regarding the organization's current state and well-defined targets and goals, a strategy and business plan can be created to steer the organization towards achieving its objectives.

Figure 1. Strategy and business plan methodology; Source: Wegelin and Jacobs (2013)

2.5.1. Vision

The organization's vision represents its goal or purpose. It is an ambitious aspiration or desire that cannot be measured or fully described and remains constant. All municipalities in SA share the same vision. The vision for SA'n municipalities is outlined in the Water Services Act of 1997 and states: "To deliver water services to all current or potential consumers within its jurisdiction in a manner that is efficient, affordable, fair, cost-effective, and sustainable" (Wegelin and Jacobs, 2013).

2.5.2. Mission

The mission of an organization consists of the primary responsibilities that must be carried out in order for the organization to accomplish its vision. The mission is measurable and outlines the specific tasks that the organization needs to undertake in order to achieve its vision, along with the estimated timeframe for accomplishing it.

2.5.3. Strengths, weaknesses, opportunities, and threats (SWOT) analysis

It is crucial to examine key factors that contribute to the success of WC/WDM business planning, such as non-revenue water, water losses, and water usage (Wegelin and Jacobs 2013:417). A SWOT analysis can be conducted on a comprehensive scale or can be focused on specific facets of an organization's operations (Civil Engineering: Magazine of the South African Institution of Civil Engineering, 2002).

Table 1. SWOT analysis to develop strategy (Wegelin and Jacobs (2013)

SWOT Analysis	External opportunities refer to favourable circumstances or conditions that are beyond an individual's control but can be leveraged for their benefit. These external factors present potential advantages that can be capitalized on.	External - Threats from unfavourable circumstances that are beyond one's control, but the impact of which can be reduced.
Internal-Strengths Positive elements that one has control over and can take advantage of	Strengths and Opportunities (SO)- Approaches that leverage strengths to optimize opportunities	Strengths and Threats (ST)- Approaches that leverage strengths to mitigate threats
Internal-Weaknesses Negative aspects that one has control over (to a great extent) and can make plans to improve	Weaknesses and Opportunities (WO)- Approaches that exploit opportunities while mitigating weaknesses	Weaknesses and Threats (WT)- Approaches that mitigate weaknesses and circumvent threats

The strategy encompasses the key accomplishments required to actualize the vision and mission of the organization. Managers at all levels consistently face the pressure to perform, even in the most unfavourable economic circumstances (Burger, 2010).

2.5.4. Business plan

The business plan provides a comprehensive overview of the organization's vision, mission, and strategy. It is imperative for the business plan to include a detailed breakdown of the financial needs, sources of funding, allocation of funds, cost analysis, responsibilities of key stakeholders, potential risks and hazards, and compliance with legal obligations (Wegelin and Jacobs, 2013:417).

2.5.5. Implementation

Municipalities are required to secure funding, engage with private sector partners and contractors, efficiently manage financial resources, and successfully meet predetermined objectives within specified timeframes (Majam and Uwizeyimana, 2018).

2.5.6. Monitoring and reviewing

To achieve the vision and mission objectives, it is crucial to consistently assess, monitor, and evaluate progress. Audit results for SA'n municipalities have declined over the years, with worsening outcomes between 2018 and 2020. In the 2020-21 financial period, only 16% of municipalities achieved a clean audit, highlighting challenges in producing accurate financial statements (Mabelane et al., 2022). The future of management will emphasize the surveillance and conservation of water resources (Nomquphu et al., 2007). The DWA has been assigned the responsibility of making decisions at the national level (Ntombela et al., 2016).

2.6. WC/WDM strategy and business plan model

Incorporating WC/WDM strategy and business plan modelling is crucial, providing a structured framework for effective WDP (Wegelin and Jacobs, 2013). Essential components include background information, quantitative assessments, and execution potential evaluations, aligning with research objectives of enhancing WC and demand management. In the methodology, these models guide analytical frameworks for assessing water management practices. During analysis, these components inform result interpretation, highlighting systematic planning's importance for sustainable water resource management in SA.

2.6.1. Background

The background section encompasses the research methodology, contact details of relevant officials for obtaining information, and the elucidation of any technical terminology and additional pertinent information (Wegelin and Jacobs 2013:418).

2.6.2. Base information

The ability to make well-informed decisions is hindered when fundamental data is lacking. In competitive markets, the presence of up-to-date information is essential for achieving success in most organizations (Lubbe, 2004).

2.6.3. Quantitative scorecard

The quantitative scorecard presents the information obtained from the SWOT analysis and guides the subsequent planning process (Wegelin and Jacobs 2013:418). After completing the SWOT analysis, the next step is to create a strategy by minimizing errors and dangers and maximizing strengths and opportunities (see Table 1).

2.6.4. Integrated water resource planning

The National Water Act of 1998 requires the adoption of an integrated watershed-based approach to water service management. Each Water Service Authority (WSA) must have complete knowledge of the levels of supply and demand in its catchment area, as well as the extent to which additional resources are required and when these additional resources need to be provided. A study involving eight cities in southern Africa found that cities that adopted WDM reduced water loss by at least 20% (Karar, 2017). Figure 2 depicts water supply and demand balance (Wegelin and Jacobs 2013:418).

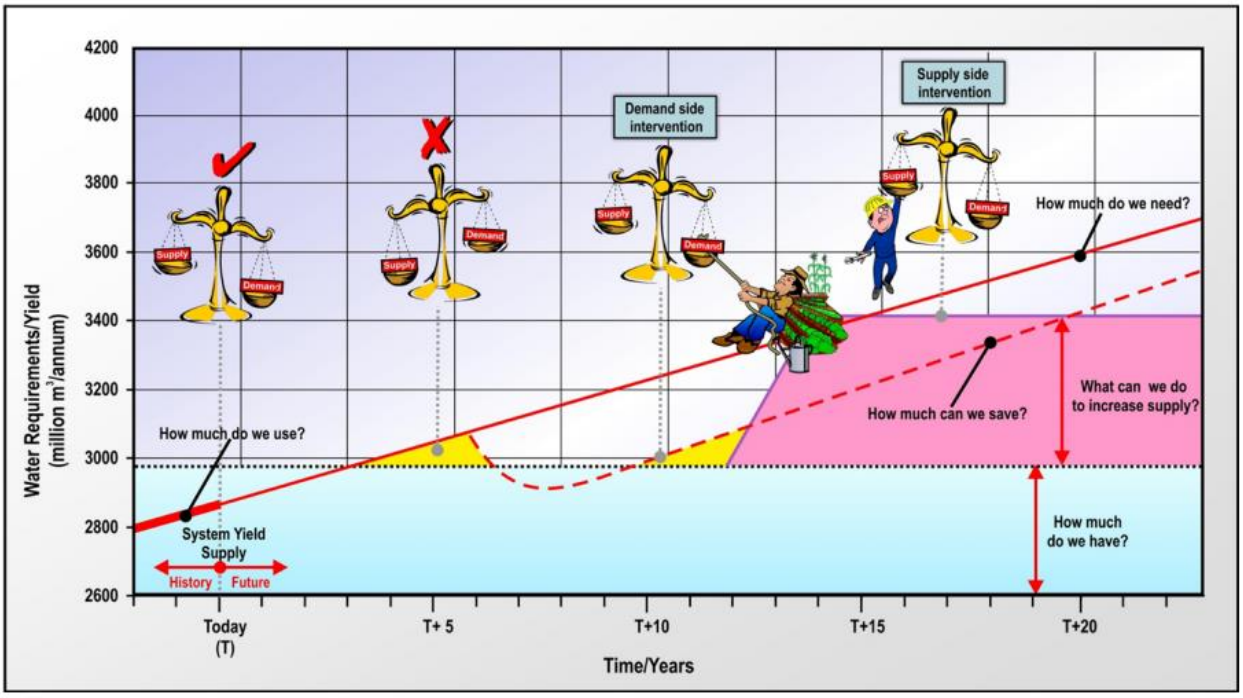


Figure 2. Supply and demand balance; Source: Wegelin and Jacobs (2013)

2.6.5. Water balance calculations

The application of the International Water Association's (IWA) water balance formula, adjusted to suit SA's specific conditions by including Free Basic Water (FBW) in its computations, is crucial for estimating potential reductions in water consumption (Seago et al., 2004). Table 2 illustrates the IWA's water balance, highlighting in green cells the potential water savings achievable through WC/WDM.

The specifications involved for the individual classifications in Table 2 are explained below:

- Billed and recovered: This incorporates both metered and unmetered water that is actively paid for.
- Allowable free basic: This involves the water supplied to consumers at no cost each month, amounting to 6 kilolitres (kl) per household.
- Potential billed and recoverable: This comprises water, whether metered or unmetered, for which customers do not incur charges.
- Unbilled unmetered: This classification encompasses authorized consumption that is not billed and remains unchanged even when billing procedures are optimized.
- Apparent losses: This classification of water comprises apparent losses calculated by estimating the volume of water lost due to illegal connections and unaccounted water resulting from aged or malfunctioning water meters.
- Unavoidable Annual Real Losses: This water category is computed using the standard Unavoidable Annual Real Losses equation.

Table 2. WC/WDM savings (Wegelin and Jacobs, 2013)

<table>
<tr><td rowspan="8">System input volume</td><td rowspan="5">Authorised consumption</td><td rowspan="5">Billed and unbilled authorised consumption</td><td>Billed and recovered</td><td></td></tr>
<tr><td>Allowable free basic</td><td></td></tr>
<tr><td>Potential billed and recoverable</td><td>Financial saving</td></tr>
<tr><td>Unbilled unmetered</td><td></td></tr>
<tr><td>Savings from reduction in unbilled use</td><td>Physical saving</td></tr>
<tr><td rowspan="3">Losses</td><td>Apparent losses</td><td>Apparent losses</td><td></td></tr>
<tr><td rowspan="2">Real losses</td><td>Unavoidable annual real losses</td><td></td></tr>
<tr><td>Savings from reduction in physical losses</td><td>Physical saving</td></tr>
</table>

2.6.6. Savings calculations

The overall water savings resulting from established strategies represent a combination of reduced water consumption by consumers and decreased physical water losses due to improved leakage detection (Hazelton, 2019).

2.6.7. Execution potential assessment

Estimating the potential volume of water that could be saved is a challenging task due to the diversity of water systems, making predictions complicated. Comparing the projected savings derived from the water balance calculation with potential savings achievable through different strategies offers a more accurate estimation of the possible savings attainable. For reliable potential savings, these two figures should not significantly differ (refer to Table 3). If the variance between these figures is approximately 10% to 20%, the estimated figure may be considered inaccurate and should not be relied upon (Wegelin and Jacobs 2013:419).

Table 3 offers insight into the potential savings achievable through the implementation of WC/WDM business planning strategies over an extended period (Wegelin and Jacobs 2013:419).

Table 3. Savings versus interventions (Wegelin and Jacobs (2013)

Potential savings from water balance calculations	Potential savings from WDP interventions
Billed and recovered	Metering and billing
Allowable free basic water	Pressure reduction
Potential billed and recoverable	Upgrading and eliminating inefficient devices
Unbilled unmetered	Maintenance of pipes
Savings from less unbilled use	Controlling leakages
Apparent losses	Regulation and enforcement
Unavoidable Annual Real Losses (UARL)	Categorisation and bulk metering
Savings from less physical losses	Public education

Table 4 elaborates on additional strategies intended to reinforce the solutions listed in Table 3, all aimed at alleviating the strain on water resources by curbing demand.

Table 4. Potential savings (Wegelin and Jacobs (2013)

Intervention	Potential saving
Regulation and control of water pressure in the distribution system	Pressure management leads to a decrease in minimum night-time flows by an estimated 15% to 30%
Proactive and reactive approaches to leak control	Efficient management of pipe bursts and swift repair processes can result in significant WC
Updating or modernizing existing systems, structures, or equipment	Between 2 to 15 kilolitres per property can be conserved each month, potentially reaching as high as 50 kilolitres in certain areas
Improved management through the implementation of sectorization, water balance calculations, and quicker response times	This can result in a decrease in water usage by 1% to 5%
Application of water-conserving equipment or technologies	Installation of low-flow shower heads, dual-flush toilets, and other water-saving fixtures has the

	potential to decrease water consumption by 10% to 20%
Environmentally conscious gardening practices aimed at WC and efficiency in plant care	Gardening accounts for 30% to 50% of household water consumption, and this can be reduced through the adoption of water-wise gardening practices

Formulating a WDP involves considering various aspects. To accurately estimate potential savings, a comprehensive understanding of the practical, organizational, social, regulatory, and budgetary challenges related to the system is crucial (Wegelin and Jacobs 2013:419). These challenges include:

- A departure of skilled experts from the water services industry (Wegelin and Jacobs 2013:419).
- Supply-oriented thinking and system operation.
- Insufficient system understanding (Wegelin and Jacobs 2013:419).
- Inadequate water information management.
- Limited funding.
- Lack of maintenance (Wegelin and Jacobs 2013:419).
- Resistance from most water users to pay for water services.
- Widespread belief among water users that water is free and should not incur charges (Wegelin and Jacobs 2013:419).

Building on the comprehensive analysis in the “Literature Review” section, the study establishes a strong knowledge foundation for the “Methodology” section, focusing on WC/WDM business planning in SA. Insights from the literature review, including legislative frameworks and historical policies, inform the research methodology's development. By synthesizing current research and identifying gaps in WC/WDM business planning, the study transitions into a structured methodology to address research objectives. This ensures a logical progression towards implementing a robust methodology and promoting sustainable water practices.

3. Methodology

This research adopts a qualitative methodology and utilizes a case study design. It incorporates a systematic review, collecting data from participants through open-ended interviews. The study employs a non-probability sampling technique, specifically purposive sampling, for the interviews. Purposive sampling, also known as judgmental or selective sampling, involves the researcher intentionally choosing units based on predefined criteria (Guest, 2014).

The interview data were collected through purposive sampling, which involves deliberately selecting a targeted population to examine their attributes, perspectives, and motivations. This method allows for targeted selection based on defined characteristics, aiding in theoretical, analytical, and logical generalizations (Andrade, 2021). The research utilized open-ended interviews with carefully designed questions to elicit detailed responses, promoting an exploratory methodology. In social sciences, thorough interviews provide individuals a platform to express their viewpoints, facilitating a deeper understanding of their perspectives and beliefs (Knott et al., 2022).

The interviews were carried out over a prolonged duration spanning from March 2021 to November 2021, allowing the researcher to accumulate ample data, particularly for follow-up inquiries or resolving any discrepancies in the participants' responses. Interviews were scheduled in advance with participants before the interview sessions took place. The researcher conducted a total of five interviews, each lasting between forty minutes to two hours.

The study methodology combines a systematic review with open-ended interviews to facilitate triangulation of data obtained from interviewees and conclusions derived from the systematic review. Systematic reviews present several benefits such as reducing biases, yielding more precise outcomes, and aiding evidence-based decision-making by amalgamating evidence using structured methodologies and rigorous evaluation of pertinent research (Sgarbossa et al., 2022).

This paper utilizes a systematic mapping approach, as per Murakami et al. (2021), to analyse and categorize WC/WDM business planning practices. Beginning with a strategic search strategy using key terms relevant to the study's focus, the research aims to gather up-to-date information on this topic. Academic databases were rigorously evaluated to identify pertinent studies, supplemented by stakeholder interviews to gather expert insights. The culmination of these efforts produced a curated compilation of primary studies, selected based on predefined criteria, addressing specific research questions. This process ensures a comprehensive assessment of WC/WDM business planning applications, integrating both academic findings and expert perspectives.

The overarching objective of these inquiries is to gain insights into how business planning can contribute to the broader goals of WC/WDM. This involves examining how business planning can be integrated into water services management to effectively fulfil essential functions and responsibilities.

The systematic review process, guided by MacFarlane et al. (2022), begins with defining research questions and establishing protocols. A comprehensive literature search identifies relevant studies, which are then screened for suitability. Analysing the gathered evidence follows, culminating in a synthesized review. For effective search strategy creation, as outlined by Alimkhodjaeva (2022), three key steps are implemented: selecting appropriate databases for current and high-quality research, formulating search terms and strings, and executing queries to retrieve pertinent content from extensive datasets on WC/WDM business planning.

Table 5. Search strings and terms used in the systematic mapping study (Authors own creation)

WC	Water Conservation, WC, environment, Water Services Act (No. 108 of 1997), National Water Act (No. 36 of 1998), Constitution of the Republic of SA (No. 108 of 1996), Water Act (No. 54 of 1956), pollution, degradation, Environmental Management Act (No. 107 of 1998), sustainable
Water Demand Management	Water demand, Demand management, Water demand management, water resource management, water management plans, Environmental Management, operational management, water information management, water services management, Water Services Act (No. 108 of 1997), National Water Act (No. 36 of 1998), Constitution of the Republic of SA (No. 108 of 1996), Water Act (No. 54 of 1956)
WC/WDM Business Planning	Water Conservation, WC, Business Plan, Water Demand Management, WDM, Water Demand Management Business Planning, WDM, National Development Plan, NDP, Integrated development planning, IDP, Medium Term Expenditure

	Framework, MTEF, National Water Resource Strategy, NWRS, White Paper on a National Water Policy of 1997

Four academic databases have been selected due to their repository of relevant and high-quality information concerning WC/WDM business planning. These databases include Google Scholar, ResearchGate, Academic Search Ultimate, and Taylor and Francis. They encompass an extensive array of publications on WC/WDM business planning and data analysis. Notably, Google Scholar and Academic Search Ultimate have been particularly valuable for providing an expansive overview of the targeted research areas, given their capability to conduct searches across multiple databases.

The recall of a search string, also known as sensitivity, measures the proportion of all the relevant papers that are retrieved or found by the search (Khanh Vi Tran et al., 2022). Search strings were created based on sensitivity analysis and the identification of terms pertinent to the title and keywords. Table 5 outlined the alternative terms established for this purpose.

After executing the search process for candidate studies and performing stakeholder interviews, 54 studies were identified for further consideration in the subsequent selection process. The study selection involved explicit inclusion and exclusion criteria, which were implemented by the researcher. These criteria were employed to mitigate potential biases and evaluate the relevance of the studies (refer to Table 6).

Table 6. Selection criteria of the systematic mapping study of WC/WDM business planning

Inclusion criteria	Exclusion criteria
Studies detailing the implementation of WC/WDM business planning in water services	The original study is not accessible in an electronic format
Documents that outline the findings and results of completed research	Documents that are written in languages other than English
Studies with similar objectives that aim to organize knowledge, including literature reviews and systematic mapping studies	Documents that do not make reference to the enhancement of water services management
	Studies that focus on quality assessment since the objective is to obtain a systematic overview of the entire research landscape rather than evaluating the efficiency of a specific approach or application

To streamline data extraction and enhance the organization of the extracted data, a robust classification scheme was developed, structured into three levels: research objectives, research questions, and trends/characteristics/directions of the research. Following the selection and filtering of previous studies based on the established criteria in the first and second levels, they were categorized into four main aspects of state-of-the-art of the research field in the third level, encompassing contributions and approaches, topics and findings, advantages, and challenges. The classification scheme for the systematic mapping study is illustrated in Figure 3.

Following the completion of the systematic mapping process and stakeholder interviews, the subsequent selection of candidate studies yielded a collection of 13 key articles: (Civil Engineering: Magazine of the South African Institution of Civil Engineering, 2002); Harton and Bullock, 2007; Phanuel and Darbi, 2012; Seago et al., 2004; Van Zyl, 2006; Van Zyl et al., 2008; Water Research Commission, 2015; Wegelin and Jacobs, 2013; Department of Water & Sanitation South Africa (2023a); Das, 2019; (Department of Water & Sanitation South Africa, 2023b); National Water Act of 1998; (South Africa, 1998)] with these 18 key articles being identified for having the highest value and significant contributions to the state of the art in the entire research field.

The methodology section delineates a systematic approach to data collection, analysis, and synthesis, crucial for investigating WC/WDM business planning in SA. Following a structured framework, the study aims to uncover significant insights and trends, enhancing comprehension of current practices. Transitioning from broad research trends, the subsequent section focuses on a case study of the Vhembe district municipality (VDM), illustrating real-world applications and perceptions. Integrating findings from systematic mapping into this localized study enhances understanding of decision-making and stakeholder views on WDP. This comprehensive approach bridges theory and practice, offering recommendations to advance sustainable water management in SA, aligning with the study's overarching goals (adapted from MacFarlane et al., 2022; Alimkhodjaeva, 2022).

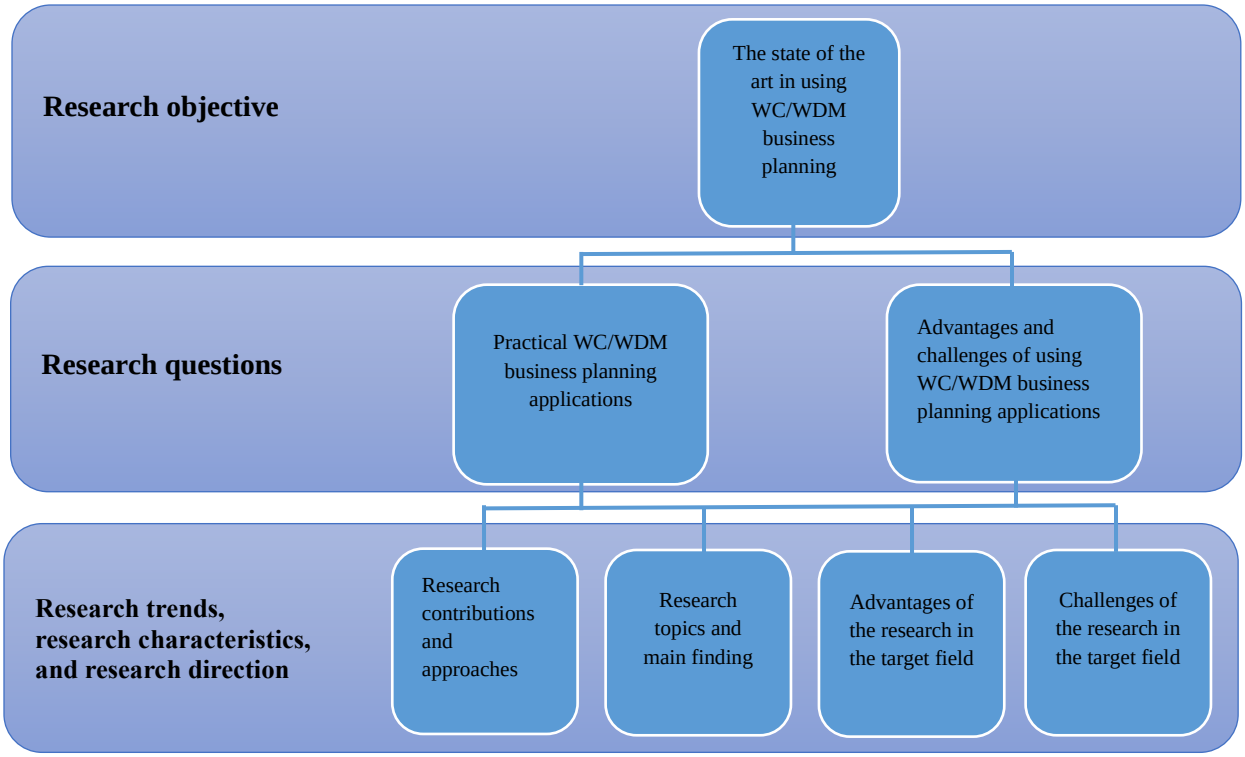


Figure 3. Classification scheme of the systematic mapping study; Source: Adapted from (Alimkhodjaeva, 2022)

3.1. A case study of the Vhembe district municipality in South Africa

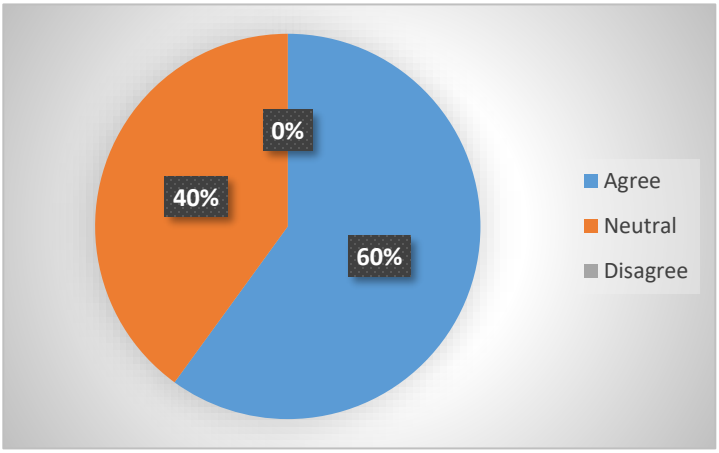
A research study was conducted within the VDM in SA spanning from 2019 to 2021 aimed to explore the perceptions and beliefs of interview participants regarding the decision-making practices of public servants in WDP.

The researcher received an ethical clearance letter from the University of Johannesburg and authorization from the VDM, where the study took place. This clearance ensured adherence to ethical procedures, safeguarding participants' rights to self-determination and anonymity (Korkiamäki and Kaukko, 2023). Participants were informed of the study's objectives and procedures through an introductory letter and consent was obtained before their participation (Lutomski et al., 2023). Anonymity and confidentiality were strictly maintained, ensuring no personal information could be traced back to participants. Participants' right to self-determination was respected, allowing them to freely choose their involvement without coercion. To ensure data validity, interviews were handwritten and data reliability was verified through triangulation of multiple sources (Santos et al., 2020). The researcher also clarified any ambiguous data through follow-up inquiries via telephone and electronic messaging. Additionally, the researcher consulted literature, industry professionals, supervisors, and peers to further validate the data and ensure a comprehensive understanding of the research problem.

The case study of the VDM in SA explores public servants' perceptions and decision-making in WDP, providing insights into the practical application of WC strategies. It highlights the challenges and opportunities of implementing sustainable water management at the municipal level and stresses aligning organizational goals with sustainability. The results section builds on these insights, presenting a comprehensive analysis from both the localized case study and broader systematic mapping. This approach ensures a holistic perspective on effective WC/WDM business planning, promoting sustainable water management practices in SA.

4. Results

The case study of the VDM via the distributed questionnaires revealed that a significant majority of participants held the belief that public servants prioritize organizational goals and policies over personal interests or biases when making decisions related to WDP (refer to Figure 4). Findings indicated that participants perceived these processes from two perspectives: procedural and stakeholder involvement. Those in agreement expressed the



belief that public officials are primarily motivated by procedural considerations rather than pursuing actions aligned with personal interests.

Figure 4. Public servants decision making regards WDP;
Source: (Mukonavanhu, 2022)

For those participants who opted to remain neutral, one individual mentioned having no specific comment on the question. Another participant, classified as neutral by the researcher due to a response that exhibited neither a clear inclination toward agreement nor disagreement, provided the following commentary on the matter:

> *"It depends in terms of the decision-making level of that particular official as well as the influence that they have. But in most cases administratively they would have to adhere to the procedures that have been set in place for them to adhere to."*

It is evident that while interview data suggests public officials in WDP rely on procedural methods and engage in consultative processes with communities, the literature highlights significant challenges in their decision-making processes. DSIT helps explain the disconnect by illustrating how cultural and social dynamics influence officials' interactions and the effectiveness of consultative processes. Meanwhile, TPB sheds light on the behavioural aspects, suggesting that the reliance on external experts and criticisms of the IDP processes reflect underlying attitudes, subjective norms, and perceived control issues that hinder genuine public inclusion in decision-making (Tshabalala and Lombard, 2009).

This section presents findings that address each research question in SA regarding WC/WDM business planning. The literature review provides a comprehensive overview of existing research on WC/WDM business planning in SA. It identifies major themes, including the impact of economic growth on water resources, the role of policy and governance, and the need for sustainable water management practices. The review highlights existing gaps in research, particularly in the integration of business planning with water services management (Department of Water and Sanitation South Africa, 2023a). The systematic review findings indicate that the majority of existing WC/WDM business planning studies (53%) demonstrate the formulation and application of WC/WDM business planning in WRM as indicated in Table 7, there is still.

Table 7. Number of article classifications based on the findings (Authors own creation)

Article classification	WC/WDM business planning
Contributions and approaches	3
Topics and findings	4
Advantages	3
Challenges	3

Overall, the results of the study offer a comprehensive understanding of the complexities and opportunities in sustainable water management practices in SA. By bridging theoretical insights with practical applications, the research provides a roadmap for future interventions aimed at promoting effective WC and demand management strategies in the region. The detailed findings underscore the importance of context-specific approaches, stakeholder collaboration, and policy alignment in advancing sustainable water management practices, ultimately contributing to the broader goal of ensuring water security and environmental sustainability in SA.

The Results section provides a detailed analysis of the existing knowledge base in WC/WDM business planning in SA, uncovering key insights and trends through a systematic mapping approach. This examination sets the stage for the discussion section, which interpret these findings, linking them back to the literature review and highlighting their significance.

5. Discussion

The study emphasizes understanding cultural variations influencing WC initiatives, advocating for strategies tailored to social dynamics. Integrating frameworks like DSIT, it highlights the impact of historical factors such as the Water Act of 1956 on current water management practices in South Africa in general. The literature review shows community-specific approaches enhance WC/WDM effectiveness. Primary research in the VDM indicates that engaging communities through the IDP process improves sustainable water management. Aligning conservation efforts with socio-cultural and legislative contexts fosters community buy-in and compliance, forming a robust foundation for effective WC/WDM strategies on a national scale in SA, tailored according to different local community needs on a national scale.

The study examines decision-making and stakeholder perceptions in WDP in the VDM. DSIT highlights how social and cultural dynamics influence public servants to prioritize organizational goals over personal interests, while TPB explains the attitudes, norms, and perceived control behind this commitment. The study identifies challenges in WC/WDM business planning, such as resource constraints, technological limitations, and the need for better stakeholder engagement. These challenges are analysed through TPB, revealing the behavioural factors complicating effective WC strategies and pinpointing areas for policy and practice improvements.

SA faces severe water scarcity issues exacerbated by poor conservation practices, droughts, high consumption rates, and limited runoff. The anticipated supply-demand imbalance by 2030 underscores the urgency of implementing effective WC/WDM strategies in SA's municipalities which will help to reduce the supply-demand gap on a national scale (Grewar, 2019). The study found that the country's water scarcity is a result of multiple interrelated factors, including inadequate technical guidance, financial limitations, policy gaps, and a lack of public awareness and engagement in conservation efforts (Agholor and Nkosi, 2020; Wegelin and Jacobs, 2013).

The study identifies critical infrastructure challenges such as under-pricing, poor return on investment, high levels of non-revenue water, and a significant capital investment gap, which hinder the sustainability of water resources and economic growth (Ruiters and Echendu, 2022). DSIT helps explain how historical and systemic issues, including apartheid-era policies, contribute to current disparities in water access and management by highlighting the role of social dynamics and cultural influences. TPB further elucidates these

challenges by addressing how attitudes, perceived control, and normative beliefs of stakeholders impact decision-making processes and behaviours related to water management (Gabru, 2005; Muller, 2007).

Public awareness and understanding are vital for encouraging sensible water use. The study found that rural and peri-urban areas have been less responsive to WC campaigns, highlighting the need for a social ethic of conservation (Onyenankeya et al., 2018). The Cape Town "Day Zero" crisis in 2018 has increased the use of water-saving equipment and influenced household WC behaviours (Thiam et al., 2021). The study emphasizes the importance of robust legislative frameworks to support WC/WDM. Historical policies, such as the Water Act of 1956, have shaped current water management practices but also perpetuated inequalities (Brauns and Stanton, 2016). Modern legislative efforts must address these disparities and promote equitable access to water resources.

The IDP process, led by the VDM through community meetings, is a practical manifestation of participatory decision-making. This approach aligns with DSIT, which underscores the importance of community interaction and cultural variations in shaping behaviour. Through the IDP process, communities should be given a platform to voice their concerns and preferences, fostering a sense of ownership and engagement in WC efforts. This participatory model contrasts with top-down decision-making driven solely by public officials, promoting a more inclusive and responsive approach to water demand management. By integrating the TPB, it becomes evident that the intentions and motivations of individuals within these communities are crucial in driving sustainable practices. The IDP process, therefore, not only empowers communities but also leverages their collective intentions and behaviours to achieve effective WC and demand management, addressing the challenges outlined in the study.

6. Conclusions

This section provides practical recommendations and insights aimed at addressing the identified obstacles in business planning for WC and demand management in SA, with the goal of fostering efficient and enduring water management practices. This study underscored the urgent need for well-structured WC/WDM business planning in SA. The research highlighted the fragmented understanding of water systems and the significant economic impacts resulting from historical and systemic challenges in water management. These factors have exacerbated the water scarcity issues facing the country. The analysis of the conceptual and theoretical variables influencing WC/WDM business planning revealed a complex interplay of policy, functional, and structural contexts that must be navigated to develop effective and sustainable water management strategies in SA and that can be replicated in other countries.

The application of DSIT was instrumental in understanding how different communities in SA interact and respond to WC initiatives. By examining local disparities in opinions and behaviours, DSIT provided a nuanced perspective on the social dynamics influencing WC/WDM efforts. Additionally, the TPB offered valuable insights into how individual intentions, desires, and motivations shape actions related to WC. Together, these theoretical frameworks guided the research methodology, analysis, and interpretation of results, highlighting the importance of addressing both community-level interactions and individual behaviours in promoting sustainable water practices.

Despite the comprehensive nature of this study, several limitations were acknowledged. The reliance on existing literature and secondary data sources may have introduced bias and limited the scope of analysis.

Furthermore, the complexity of social dynamics and the variability in local contexts pose challenges in generalizing the findings across different regions of SA. Future research should aim to conduct empirical studies that assess the effectiveness of proposed WC/WDM strategies in diverse settings. Such studies would provide more robust evidence on the applicability of these strategies and help identify context-specific challenges and opportunities for improvement.

Future research should also explore the integration of emerging technologies and innovative practices to enhance WC efforts. Technologies such as remote sensing, smart water management systems, and advanced data analytics could provide new avenues for improving water resource management. Additionally, engaging with local communities and stakeholders through participatory approaches will be crucial in developing more resilient and adaptive water management frameworks. By addressing these areas, future studies can contribute to the creation of comprehensive, context-sensitive strategies that effectively tackle SA's pressing water scarcity issues.

References

Agholor, A.I. and Nkosi, M. (2020), "Sustainable water conservation practices and challenges among smallholder farmers in Enyibe Ermelo Mpumalanga Province, South Africa", *Journal of Agricultural Extension*, Vol. 24 No. 2, pp. 112-123.

Ajzen, I. (1991), "The theory of planned behaviour", *Organizational Behaviour and Human Decision Processes*, Vol. 50, pp. 179-211.

Alimkhodjaeva, N. (2022), "A systematic mapping study of using artificial intelligence and data analysis in digital marketing: Revealing the state of the art", In: *The 6th International Conference on Future Networks & Distributed Systems (ICFNDS '22)*, December 15, 2022, Tashkent, TAS, Uzbekistan. ACM, New York, NY, USA.

Andrade, C. (2021). "The inconvenient truth about convenience and purposive samples", *Indian journal of psychological medicine*, Vol. 43 No. 1, pp, 86-88.

Brauns, M. and Stanton, A. (2016), "Governance of the public health sector during Apartheid: The case of South Africa", *Journal of Governance and Regulation*, Vol. 5 No. 1, pp. 23-30.

Burger, R. (2010). "Strategy: Getting it right", *Graphix*, Vol. 9, pp. 7-9.

Civil Engineering: Magazine of the South African Institution of Civil Engineering. (2002), "Scenarios for the future (1) SWOT analyses, trends and issues – the basis for scenario planning", *Civil Engineering: Magazine of the South African Institution of Civil*, Vol. 10 No. 3, pp. 25-26.

Das, D. (2019). "Exploring perspectives of the Information Technology industry in a South African city". *Sustainability,* Vol. 11 No. 22, pp. 6520.

Department of Water & Sanitation South Africa. (2023a), "National Water Resource Strategy". available at: https://www.dws.gov.za/Documents/Gazettes/Approved%20National%20Water%20Resource%20Strategy%20Third%20Edition%20(NWRS3)%202023.pdf (accessed 28 June 2024).

Department of Water & Sanitation South Africa. (2023b), "No Drop Watch Report 2023". available at: https://ws.dws.gov.za/IRIS/releases/NDWR.pdf (accessed 28 June 2024).

Gabru, N. (2005), "Some comments on water rights in South Africa". *Potchefstroom Electronic Law Journal/Potchefstroomse Elektroniese Regsblad*, Vol. 8 No. 1, pp. 1-33.

Grewar, T. (2019), "South Africa's options for mine-impacted water re-use: A review", *J. S. Afr. Inst. Min. Metall*, Vol. 119 No. 3, pp. 321-331.

Guest, G. (2014), "Sampling and selecting participants in field research", *Handbook of methods in cultural anthropology*, Vol. 2 No.1, pp. 215-250.

Harrison, P. (2001), "The genealogy of South Africa's Integrated Development Plan", *Third World Planning Review,* Vol. 23 No. 2, pp. 175-193.

Harton, H. and Bullock, M. (2007), "Dynamic social impact: A theory of the origins and evolution of culture"., *Social and Personality Psychology Compass,* Vol. 1 No. 1, pp. 521-540.

Hazelton, D. (2019), "Enhancing WC/WDM enablers", *Water and Sanitation Africa,* Vol. 14 No. 1, pp. 6-39.

Karar, E. (2017), *Freshwater Governance for the 21st Century*, 1st ed., Zurich, Springer International Publishing.

Khanh Vi Tran, H., Börstler, J., bin Ali, N. and Unterkalmsteiner, M. (2022), "How good are my search strings? Reflections on using an existing review as a quasi-gold standard", *e-Informatica Software Engineering Journal,* Vol. 16 No. 1, pp. 69-89.

Knight, J. (2019), "Water Resources in South Africa", available at: https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Water+Resources+in+South+Africa+Jasper+Knight&btnG= (accessed 01 July 2024).

Knott, E., Rao, A.H., Summers, K. and Teeger, C. (2022), "Interviews in the social sciences". *Nature Reviews Methods Primers,* Vol. 2 No. 1, pp. 73.

Korkiamäki, R. and Kaukko, M. (2023), "Faceless, voiceless child–Ethics of visual anonymity in research with children and young people", *Childhood*, Vol. 30 No. 1, pp. 55-70.

Lubbe, S. (2004), "Management information searching for decision making", *South African Journal of Information Management,* Vol. 6 No. 3, pp. 309.

Lutomski, J.E., Rainey, L., de Jong, M., Manders, P. and Broeders, M.J. (2023), "Expanding the boundaries of previously obtained informed consent in research: Views from participants in the Personalised Risk-based Mammascreening study", *Health Expectations*, Vol. 26 No. 3, pp. 1308-1317.

Mabelane, K., Mongwe, T. M., Mbuvha, R. and Marwala, T. (2022), "An Analysis of Local Government Financial Statement Audit Outcomes in a Developing Economy Using Machine Learning", *Sustainability,* Vol. 15 No. 1, pp. 12-12.

MacFarlane, A., Russell-Rose, T. and Shokraneh, F. (2022), "Search strategy formulation for systematic reviews: Issues, challenges and opportunities", *Intelligent Systems with Applications,* Vol. 15, pp. 1-10.

Majam, T. and Uwizeyimana, D. (2018), "Aligning economic development as a priority of the Integrated Development Plan to the annual budget in the City of Johannesburg Metropolitan Municipality", *African Journal of Public Affairs,* Vol. 10, pp. 138-166.

Maphela, B. (2016), "The evaluation of the heritage of the 1956 South African water policy", *Environmental economics*, Vol. 7, No. 4, pp. 113-119.

Motsoeneng, R. (2022), "Public Sanitation Challenges in SAn Local Government", *Administratio Publica,* Vol. 30 No. 4, pp. 1015-4833.

Mukonavanhu, T. (2022), "Water demand management and planning in the Vhembe district municipality". Doctoral dissertation. University of Johannesburg.

Muller, M. (2007), "Parish pump politics: the politics of water supply in South Africa", *Progress in Development Studies*, Vol. 7 No. 1, pp. 33-45.

Murakami, Y., Okasaki, N. and Miura, K. (2021). "A systematic mapping study of digital marketing and large manufacturing firms: a perspective from Japan", *Journal of Marketing and Communication,* Vol. 4 No. 2, pp. 11–20.

Mutamba, J. (2014), "Water service delivery challenges - what role for water demand management?", *Water Wheel,* Vol. 13, pp. 30-33.

National Planning Commission (NPC). (2012). "National Development Plan 2030: Our Future – Make It Work". available at: https://www.gov.za/sites/default/files/gcis_document/201409/ndp-2030-our-future-make-it-workr.pdf (accessed 27 June 2024).

Ngcobo, M. (2021), "The water crisis in Durban: an analysis of the role of households in water conservation", Doctoral dissertation, Durban University of Technology.

Nomquphu, W., Braune, E. and Mitchell, S. (2007), "The changing water resources monitoring environment in South Africa: SAEON review", *South African Journal of Science,* Vol. 103, pp. 306-310.

Ntombela, C., Funke, N., Meissner, R., Steyn, M. and Masangane, W. (2016). "A critical look at South 165 Africa's green drop programme". *Water SA,* Vol. 42, pp. 703-710.

Onyenankeya, K., Caldwell, M. and Okoh, A. I. (2018), "Sustainable water use and the nexus of behavioural intentions: The case of four South African communities", *Water and environment journal*, Vol. 32 No. 2, pp. 285-291.

Phanuel, W. and Darbi, K. (2012), "Of mission and vision statements and their potential impact on employee behaviour and attitudes: The case of a public but profit-orientedtertiary institution", *International Journal of Business and Social Science,* Vol. 3 No. 14, pp. 95-109.

Pretorius, A., Kruger, E. And Bezuidenhout, S. (2022), "Google trends and water conservation awareness: the internet's contribution in South Africa", *South African Geographical Journal*, Vol. 104 No. 1, pp. 53-69.

Ruiters, C. and Amadi-Echendu, J. (2022), "Economic costs and investment challenges of water infrastructure in South Africa", *Infrastructure Asset Management,* Vol. 9 No. 4, pp. 194–206.

Santos, K. D. S., Ribeiro, M. C., Queiroga, D.E.U.D., Silva, I.A.P.D. and Ferreira, S.M.S. (2020), "The use of multiple triangulations as a validation strategy in a qualitative study". *Ciencia & saude coletiva*, Vol. 25, pp. 655-664.

Sgarbossa, N., Ibáñez Cobaisse, M., González Cianciulli, G., Bracchiglione, J. and Franco, J.V.A. (2022), "Systematic reviews: Key concepts for health professionals". *Medwave,* Vol. 22 No. 9, pp. 1-12.

Seago, C., Bhagwan, J. and McKenzie, R. (2004), "Benchmarking leakage from water reticulation systems in South Africa", *Water SA,* Vol. 30 No.5, pp. 25-32.

South Africa (1956), "Water Act, No. 54 of 1956", available at: https://faolex.fao.org/docs/pdf/saf1272.pdf (accessed 27 June 2024).

South Africa (1998). "National Water Act, No. 36 of 1998". available at: https://www.gov.za/documents/national-water-act (accessed 27 June 2024).

Thiam, D.R., Dinar, A. and Ntuli, H. (2021), "Promotion of residential water conservation measures in South Africa: the role of water-saving equipment", *Environmental Economics and Policy Studies*, Vol 23, pp. 173-210.

Tshabalala, E. and Lombard, A. (2009). "Community participation in the integrated development plan: a case study of Govan Mbeki municipality", *Journal of Public Administration,* Vol *44* No. 2, pp. 396-409.

Van Zyl, A. (2006), "An Operational Management System (OMS) for Bloem Water", *Interdisciplinary Journal,* Vol. 5, pp. 85-98.

Van Zyl, A., Ilemobade, H. And Van Zyl, J. (2008), "An improved area-based guideline for domestic water demand estimation in South Africa". *Water SA,* Vol. 34, pp. 381-391.

Water Research Commission (2015), "Corporate Plan for the fiscal years 2015/16 - 2019/20". Available at: https://wrc.org.za/wp-content/uploads/mdocs/Final%20draft%20Corporate%20Plan%20January%202015_for%20submission.pdf (accessed 27 June 2024).

Wegelin, W. and Jacobs, H. (2013), "The development of a municipal water conservation and demand management strategy and business plan as required by the Water Services Act, South Africa", *Water SA,* Vol. 39 No. 6, pp. 415-422.