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Sustainable water supply in South African rural areas: a comprehensive and contemporary bibliometric analysis

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Introduction: Water is central to the survival of humans, animals, ecosystems, and biodiversity. However, its availability, in the right quantity and quality, has been challenging in most rural areas of developing economies, such as those of South Africa. Particularly in South Africa, this trend has been investigated with much focus on factors militating against sustainable water supply; health, economic, social, and cultural impact of water shortages on rural dwellers, and so on. Each of these studies has suggested one recommendation or the other, yet the water supply problem in the rural areas persists in the country. More concerning is the observation that existing research efforts on the issue have been uncoordinated, with several repeated studies, often in the same area. To better appreciate and contribute to the rural water supply situation in South Africa, this paper conducts a comprehensive bibliometric analysis of contemporary studies on the subject to streamline existing studies into research themes while exposing uncharted research areas for future effort.

Methods: As one of the earliest efforts in this regard, the study adopted the PRISMA protocol to gather literature for the study. A total of 44 published journal articles published between 2022 and 2024 were adopted in this study from the Scopus database. In the analysis of these documents, Biblioshiny and VOSviewer were used to map and analyze scholarly contributions on the topic.

Results: Resulting from the analysis, three research areas were found to be saturated with scant effort in the use of digital technologies in rural water management. Existing studies have investigated the health impact of inadequate water supply, the impact of climate change on water availability in the South African rural areas, and the issues confronting water policy implementation in the country.

Discussion: Much research has not been done on the application of information technologies in the management of water in the South African rural areas. Sequel, this study suggests that subsequent research efforts be directed to exploring the application of ICT, IoT, cloud seeding, rain, and fog harvesting in rural water management.

KEYWORDS

sustainability, sustainable water, water supply, rural areas, bibliometric analysis, thematic analysis, South Africa

1 Introduction

Water plays a vital role in the universe, as it is fundamental to sustainable living. And as furthered by Matimolane et al. (2023), it is central to the survival of the ecosystem. Water is crucial not just to individuals and communities, but also to businesses (Adom et al., 2023; Khabo-Mmekoa et al., 2022). Ensuring sustainable access to water has assumed importance at the global level, especially as evidenced in its priority as the 6th item on Sustainable Development Goals (SDGs). This implies that by 2030, universal access to safe water and sanitation must be guaranteed (Bazaanah and Mothapo, 2024). Also sharing in this concern is the United Nations that has re-emphasized that access to safe water is a fundamental human right (Hove et al., 2023) and a key component of the sustainable development agenda (Adom et al., 2023; Bazaanah and Mothapo, 2024). Despite this global concern and efforts, Malima et al. (2022) reported that over 884 million people worldwide still have limited access to safe drinking water and this has forced people, especially in the rural areas, toward the consumption of unsafe open source and contaminated water.

Even though this water shortage situation is true of most arid countries on the African continent, the situation is much worse in South Africa given the interference of factors such as rapid urbanization, modernization, migration, and climate change (Ingwani et al., 2024). Particularly in the rural areas of the country, the availability of safe drinking water remains inadequate (Adom et al., 2023; Adom et al., 2023; Bazaanah and Mothapo, 2024; Fanteso and Yessoufou, 2022; Kapwata et al., 2022). In summarizing the water situation in the country, Adom and Simatele (2024) posited that over 20% of South Africa's population, mostly in rural areas, still lack regular access to potable water. In consequence, rural dwellers have contracted many water-related diseases, arising from the consumption of unsafe water. As noted by Masiangoako et al. (2022), this situation has been greeted with repeated protest from the people, calling on government to live up to its constitutional responsibility of ensuring the right of South Africans to clean and safe water (Hove et al., 2023; Malima et al., 2022), yet the ugly situation persists.

In addressing societal problems such as this, there is the need for collaboration between the academics and government. Studies from higher institutions could inform government's policy actions toward improving the status quo. To create this collaboration, there is the need for a proper coordination of existing rural water-related studies toward improving government's response to the rural water challenge. However, a cursory look at existing studies on water supply in the South African rural areas showed an unorganized research pattern that has resulted into several repeated studies, often in the same location, leaving several water-related issues and municipalities, unresearched, thereby creating a significant research gap. For instance, Adom and Simatele (2024), Adom et al. (2023), Bazaanah and Mothapo (2024), Fanteso and Yessoufou (2022) and Kapwata et al. (2022) all examined water supply in remote municipalities without proper focus on rural communities. In addition, there were studies on the effect of water scarcity on female gender (Adom et al., 2023; Jayaweera et al., 2023; Mashabela et al., 2022), factors contributing to water supply shortages to rural areas (Adom and Simatele, 2024; Adom et al., 2023; Matimolane et al., 2023) and the health effect of relying on contaminated water in the South African rural areas

(Bazaanah and Mothapo, 2024; Mbana and Sinthumule, 2024; Khabo-Mmekoa et al., 2022).

Evidently from the studies cited above, excessive research efforts have been directed at exploring water supply to remote municipalities (with 5 studies); three studies on water scarcity and the female gender; factors leading to water supply shortages to South African rural areas (with 3 studies); and the health effects of contaminated water consumption (with 3 studies). None of these studies explored the possible interactions that could happen between rural water management and technology, despite the numerous points of technology application in solving social service delivery challenges. The inability of existing studies to offer effective recommendations for addressing the rural water challenge may be because of the absence of crucial research in the use of emerging technologies in rural water management. To better guide subsequent studies in this research area, this paper conducts a comprehensive bibliometric analysis of existing contemporary studies on the subject to streamline them into research themes while exposing uncharted research areas to researchers. More specifically, this study:

- i. identifies the prolific authors, affiliations, and countries contributing to research on sustainable rural water supply in South Africa,
- ii. analyses the thematic focus of existing contemporary literature,
- iii. suggests future research directions for scholars working on sustainable water supply in rural South Africa and,
- iv. provides policy recommendations for government on how to leverage on technology and stakeholders' collaboration toward addressing drinking water supply shortage in the South African rural areas.

Findings from this study could inform future research efforts on sustainable water supply in the South Africa rural areas. In addition, it could promote research collaboration among researchers with shared interest in the topic. More so, it could foster better collaboration between the academics and the government through informed research output that could impact government's policy actions and inactions.

This study is organized in line with the highlighted objectives. Structurally, this paper presents a background to water scarcity in the rural areas of South Africa, the research methodology, showing the process involved in article harvesting and analysis, the characteristics of the adopted papers, thematic analysis of contemporary studies, discussion, gap in knowledge, conclusion and recommendations.

2 Background on water scarcity in the South African rural areas

South Africa is characterized by periodic drought and limited rainfall (Nhamo et al., 2019) that has continued to cause acute water shortages (Adom et al., 2023) that necessitate strategic management of available water resources. More concerning in the country is the growing decline in water quality due to industrial waste, agricultural runoff, and inadequate wastewater treatment infrastructure (DWS, 2023; Mema, 2010; Cossio et al., 2020), particularly in rapidly urbanizing areas and rural settlements. To better sharpen this submission, Adom et al. (2023) presented the following statistics: South African urban centres currently accommodate over 64% of South Africans, with about 36% living in rural

and informal settlements and without a matching water supply (Murwirapachena, 2022).

The water crisis in rural South Africa also has a gender dimension to it as rural women bear the brunt of the water scarcity due to their traditional domestic roles (Adom et al., 2023; Jayaweera et al., 2023). Most households in rural areas source water from outside their homes (Bazaanah and Mothapo, 2024; Mashabela et al., 2022), thereby requiring women to spend significant time and energy on searching for water, limiting their opportunities for education, employment, and personal development. In communities like Mashite, for example, 94% of residents travel about a kilometer to access water (Mashabela et al., 2022). This situation has left women exposed and as confirmed by Jayaweera et al. (2023), 25.9% of young rural women in South Africa face violence related to water, sanitation, and hygiene (WASH) while searching for water, jeopardizing their health and safety.

Various factors contribute to the irregular supply of safe drinking water to South African rural areas. Corruption, inadequate skills, and decaying infrastructure are among the key factors (Adom and Simatele, 2024; Adom et al., 2023; Matimolane et al., 2023). In explaining these factors, Adom and Simatele (2024) specifically noted that weak water infrastructure results in over 37% of the country's water supply leakage during distribution, reducing the quantity of water available to households. Consequently, many South Africans are dissatisfied with both the quality and quantity of water supplied, citing issues such as poor billing systems, frequent disruptions, and substandard water quality (Adom et al., 2023).

As South Africa is an arid country, it is projected that by 2030, water shortages could become more severe unless current challenges to sustainable water supply are addressed. Although successive government administrations in the country have attempted to tackle rural water shortages, their efforts have been hampered by uncoordinated research recommendations and unreliable data from the Department of Water and Sanitation (DWS), which often overstates the number of households with regular water access (Adom and Simatele, 2024).

3 Research methodology

In this section, the various activities resulting in the achievement of the research objectives are presented. These include the research process that includes the search for literature, bibliometric data analysis and discussion. The basic tools adopted in this study are VOSviewer for creating co-citation networks and Biblioshiny for exploring the research cluster on the research field. Lastly, PRISMA was adopted to screen out literature with less relevance to the objectives of the paper.

3.1 Research process

In this study, a bibliometric research approach was adopted in pursuit of the objectives of the paper. As noted by Kalaoane et al. (2024), Albugami et al. (2024) and Mufungizi et al. (2023), bibliometric analysis is efficient for exploring literature quantitatively on a topic or concept. This paper used a combination of quantitative and qualitative techniques to explain the research pattern on rural water management in South Africa in a bid to gain deep insight into recent research

directions and gap on sustainable water supply in the South African rural areas. This approach was equally adopted by Agyei et al. (2024) in their study, a bibliometric analysis that explored the role of sustainable transportation in achieving development objectives at the local, national and global levels. In the selection of literature for this study, PRISMA, as presented Table 1 and as used by Agyei et al. (2024), Kalaoane et al. (2024) and Mufungizi et al., 2023 was adopted given its robustness in evaluating research papers for thematic analysis. PRISMA leverages on indicators such as theme, methodology and results to identify papers suitable for review.

To eliminate article duplication while ensuring that only well-reviewed articles were adopted in this study, Scopus, the largest and well-referred scientific database for keywords, abstract and citations was adopted (Albugami et al., 2024; Kalaoane et al., 2024). This database has assumed popularity among recent bibliometric papers. For instance, Agyei et al. (2024) while investigating emerging research gaps and directions on sustainable transportation adopted published manuscripts from Scopus. Their study concluded that research on sustainable transportation has rather focused on the extent to which transportation contributes to green gas emission rather than on the impact of climate-induced disasters on the vulnerable transport system in Africa. The study thus recommends the need to channel research effort toward this gap. In addition, Mufungizi et al. (2023) relied on the database to examine how the concept of shifting ecosystems has evolved amidst growing pressure from climate change and human activities. The study found that shifting ecosystem literature can be characterized by 8 broad categories of: evolutionary adaptation, regime shift/range shift and ecosystem restructuring, range shift and

TABLE 1 PRISMA study selection table.

Criteria type	Description	Rationale
Inclusion criteria		
Time coverage	2022–2024	To capture only recent and relevant studies
Document types	Reviewed journal articles	To accommodate only well-reviewed literature
Language	English language publications	To ensure accurate consistency in literature interpretation
Subject area	Sustainable water supply in the South African rural areas	To maintain focus on the research scope and the objectives of the study
Database coverage	Only articles indexed in Scopus	To ensure focus on quality journal articles
Exclusion criteria		
Document types	Editorials, book review, conference papers etc.	To eliminate literature that lacks substantial bibliometric data
Relevance	Studies not directly related to the research question	To maintain research focus and validity
Quality	Non-peer reviewed publications	To ensure that only literature with scientific rigor is adopted in this study

invasive species, range shift and species distribution, elevational and altitudinal shift, regime shift modeling, hydrological shift, and regime shift and invasive species. These studies attest to popularity and wide acceptance of Scopus database among recent bibliometric papers.

3.2 Data gathering

Searching for literature on databases has remained an important task Mufungizi et al. (2023) in a bibliometric analysis. In harvesting papers for this paper, a Boolean search string was developed using basic keywords in the study as common to bibliometric papers (Agyei et al., 2024; Kalaoane et al., 2024). The terms used in querying the database were “sustainable water supply,” “potable water supply” “regular water supply,” “South African rural areas,” and “rural areas in South Africa.” Severally, these search strings were refined to ensure that only relevant literature was generated. Basically, the on the Scopus database was done using the title, abstract and keywords parameters. The literature search was observed on 30th September 2024 at 20:56 pm. Given the large number of manuscripts on the subject and the need to include only recent studies to ensure that genuine research gap is established, a benchmark of published research articles between 2022 and 2024 assumed importance as depicted in the PRISMA Table. Had the coverage period been extended to cover longer years, ascertaining the current state of rural water supply in South Africa might be difficult. Furthermore, additional inclusion and exclusion criteria as shown in Table 1 and Figure 1 were adopted to ensure that only genuine literature was adopted in this paper. Several bibliometric

papers have eulogized the relevance of these criteria to eliminating irrelevant literature (Agyei et al., 2024; Rizelioglu, 2025; Mufungizi et al., 2023).

3.3 Data analysis

Prior to the analysis of the bibliometric data harvested from the Scopus database, the .csv file downloaded was screened to make sure that all data required on each paper is present. This data includes the author’s name, publication year and abstract. After this, this study utilized open-source web interface software, Biblioshiny, a component of R tool for bibliometric (Aria, 2017) to present the descriptive statistics of the adopted documents. In the construction of the authors’ and keyword co-occurrence network, the study adopted VOSviewer (version 1.6.20). This software has assumed prominent authors of recent bibliometric papers (He et al., 2025; Agyei et al., 2024; Albugami et al., 2024; Kalaoane et al., 2024; Mufungizi et al., 2023). Other analysis done in this study includes authors’ and documents’ annual scientific production; co-authorship networks; and a three-field plot indicating the connections among the prolific authors, their institutions and countries.

Lastly, this paper conducted a thematic analysis of the adopted papers to explore the prevailing arguments and issues on rural water management in South Africa. Thematic analysis is effective for engaging literature in a bid to better identify literature gaps (Mufungizi et al., 2023).

In Figure 1 above is the literature identification flow chart. At the identification level, 632 documents relating to the study objectives

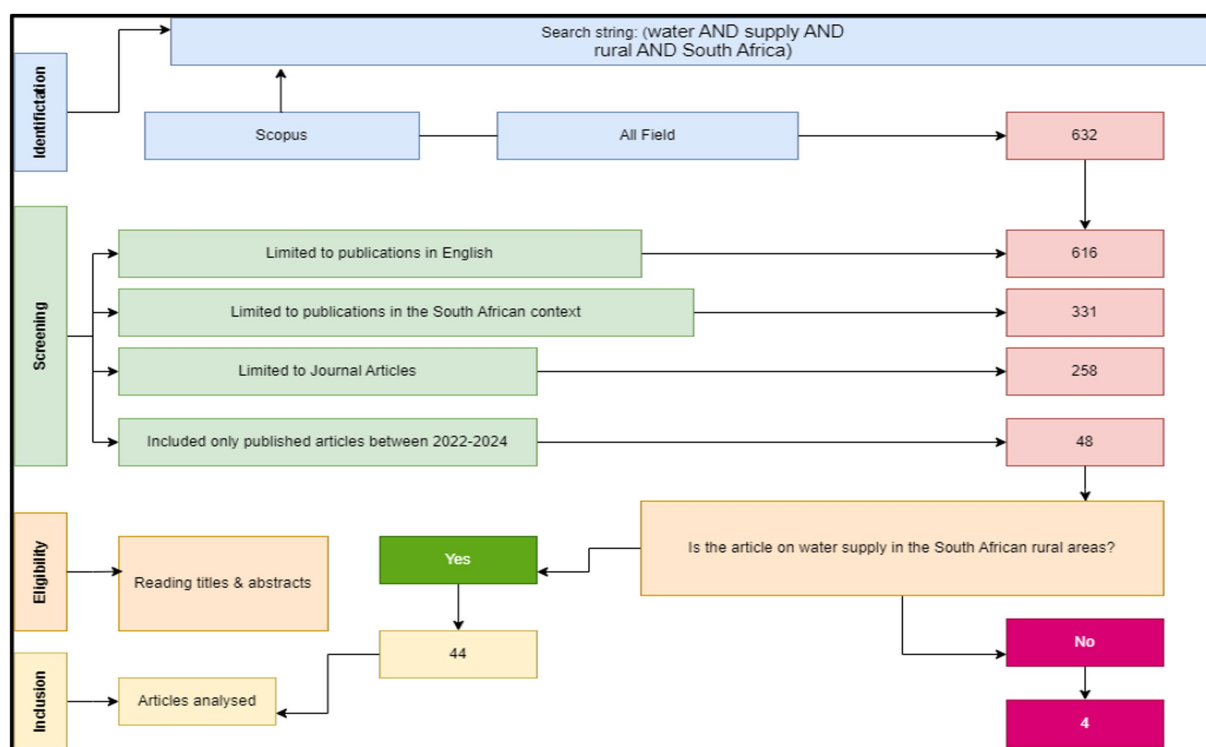


FIGURE 1
Data collection process.

were found on the Scopus database. Using the PRISMA criteria as depicted in [Table 1](#), the documents were scaled down using the inclusion criteria of: English language (616); focused in South Africa (331); journal articles (258), published between 2022 and 2024 (48), and on water supply in the South African rural areas (44).

4 Results

In the presentation of the result of the bibliometric analysis, this paper is sectioned into bibliometric descriptive statistics and a thematic analysis of sustainable water supply in the South African rural areas. In the first section, the basic features of the adopted journal articles such as, citation trends, authors, collaboration networks, authors' affiliations and countries were presented. In the second, keyword occurrences, co-citation networks, overlays, and thematic maps were presented.

[Table 2](#) above analyzed the features of the adopted literature in this study. Out of the 44 journal articles adopted, only 1 (2.3%) was authored by a single individual, while the remaining 43 papers (97.7%) were written by multiple authors. On average therefore, each article had about four authors (4.1) per document. This exposes the extent of collaboration among scholars on sustainable water supply in the South African rural areas.

4.1 Sustainable water supply in the South African rural areas

Having presented the descriptive features of the adopted literature, this section further explores the notable authors, articles, institutional affiliations and countries making significant contributions to research on sustainable water supply in the South African rural areas. [Figure 2](#) presents the annual document production, in addition to the citations gathered by each document per year.

[Figure 2](#) shows that in 2022, only 20 articles were published on water supply in the South African rural areas. In the following year, 2023, 16 documents were recorded, indicating a sharp reduction in rural water research. Furthermore, in 2024, a further 25% reduction

in document production on the subject was recorded. A proper explanation of this reduction trend is lacking; however, it could be speculated that the reduction could be due to loss of interest on the topic among researchers or that the problem of water management in the South African rural areas is solved. Despite the literature reduction on the topic, evidence abounds on the increasing document citations with the focused timeframe. For instance, in 2022, the 20 journal articles recorded 20 citations, however, while subsequent years recorded reduced article production, the level of citations continue to increase.

For instance, in 2023, a reduction of 20% in paper production was recorded, while the citation for these papers increased by 38.5%. A similar trend could be observed in 2024 when only 12 papers, a further 25% reduction from those published the previous year recorded 61 citations, a further increase of 14.8% in citations. This trend required careful analysis. First, early papers are expected to record more citations given their year coverage, however, the opposite is observed in this trend. This document and citation pattern contradicted the submission of [Agyei et al. \(2024\)](#) that fewer citations are usually recorded by recent articles. This trend presents a dilemma. This dilemma is in the interpretation of the reducing document production and the increasing citations. This dilemma further justifies the need for a bibliometric paper that will profile recent literature on rural water supply in South Africa.

In [Table 3](#), authors of adopted journal articles were ranked based on the number of citations they garnered. The table further complements [Figure 2](#) by revealing the prolific authors with impressive citations. Evidently from the table, the work of [Murei et al. \(2022\)](#) that examined the barriers to water and sanitation safety plans in rural areas of South Africa recorded 14 citations within a span of three years. The study found that poverty, inequality, unemployment, lack of access to purified water, and inadequate sanitation facilities have resulted in the spread of waterborne diseases and further impact WSSP. Also recording impressive citations were [Bazaanah and Mothapo \(2024\)](#), [Khabo-Mmekoa et al. \(2022\)](#), [Davids et al. \(2022\)](#) and [Lalumbe and Kanyerere \(2022\)](#) with 11, 11, 9, and 9 citations, respectfully. Other authors such as [Fanteso and Yessoufou \(2022\)](#), [Orieuvulu and Iwuji \(2022\)](#), [Kapwata et al. \(2023\)](#), [Slayi et al. \(2023\)](#) and [Njoku et al. \(2022\)](#) had 6, 5, 5, 5, and 4 citations, respectfully.

Equally presented in [Table 3](#) are the research focus of the papers with most citations. While the papers are all on access to water in rural areas of South Africa, each examined these in different context, but with a few sharing similar research focus. For instance, [Murei et al. \(2022\)](#) and [Bazaanah and Mothapo \(2024\)](#) explored the effect of sanitation on water safety and quality. Their studies both adopted a survey research design to gather data for the study, even though their studies were conducted in separate municipalities of Lepelle Nkumpi Local Municipality and Vhembe District, Limpopo Province. The studies both concluded that there is need for the promotion of sanitation education at the grassroots. This, they argued would promote healthy living among South Africans in the rural areas.

[Davids et al. \(2022\)](#), [Kapwata et al. \(2023\)](#), [Khabo-Mmekoa et al. \(2022\)](#) and [Lalumbe and Kanyerere \(2022\)](#) examined the nexus between water quality and health risks. Using several indicators such as Enteric Pathogens, Hydro-Geochemical Processes and concentrations of arsenic, the studies established the presence of contaminants in open-sourced water in their various areas of investigation. These contaminants pose serious health risks to

TABLE 2 Sample statistics.

Description	Results
Timespan	2022–2024
Documents	44
Annual growth rate %	–19.56
Document average age	1.14
Average citations per document	2.727
Author's keywords (DE)	167
Authors	181
Authors of single-authored documents	1
Authors of multi-authored documents	43
Single authored documents	1
Co-authors per document	4.64
International co-authorship %	31.82

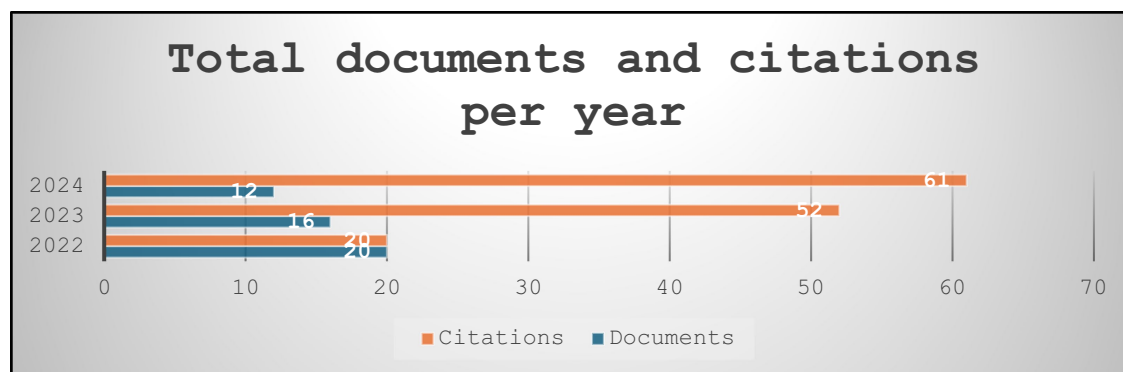


FIGURE 2
Annual document number and citations from 2022 to 2023.

people, and they all recommended that adequate measures are required to monitor and address the issue of water quality in the South African rural areas.

Other papers with high citations focused on separate aspects of sustainable water supply in the rural areas such as that of [Fanteso and Yessoufou \(2022\)](#) that examined water conservation knowledge among rural people in South Africa. This study documented the various approaches to water conservation given the rising level of water scarcity in drought-ridden areas of Eastern Cape province of the country. Using structure questionnaires to glean data from 93 respondents, the study succeeded in documenting 10 water conservation techniques in the province. Also, on drought, [Orievulu and Iwuji \(2022\)](#) examined the impact of drought on the health condition of people living with HIV/AIDS in rural Hlabisa sub-district of uMkhanyakude. Using qualitative data gathered from policy documents and interviews, they found that drought had a negative impact both on the individuals and communities in the study area.

From the table above, it is evident that most of the literature that garnered impressive citations were on the health effect of inadequate water supply to the South African rural areas. This underpins the serious implication of this issue to the wellbeing of the rural dwellers. Without due attention to addressing this menace, this paper argued that government expenses might rise astronomically over the years, as aside committing funds to promoting sustainable water supply to the rural areas, they may have to upgrade health facilities to better serve the growing health needs of the people. Evidence to this can be found in the conclusion of the studies done by [Kapwata et al. \(2023\)](#) and [Khabo-Mmekoa et al. \(2022\)](#) where they held that series of health diseases is prevalent in the South African rural areas and these have been attributed to the growing consumption of unsafe open water in the focused context.

Furthermore, adequate connection among access to water in abundance, water conservation strategies, consumption of unsafe water, proper sanitation and health conditions of rural areas have been established in the ten well-cited articles in [Table 3](#). For instance, [Murei et al. \(2022\)](#) posited that due to the inadequacy of water in the rural areas, rurals have resulted to traditional water conservation and treatment strategies to convert open source contaminated water for use. These strategies have often failed to guarantee safe drinking water and thus put the health of the people to risk. In consequence, these are jeopardizing the realization of SDG 6 by 2030.

Aside recording high citations, authors of well-cited literature as depicted in [Figure 3](#) have demonstrated consistency in sustainable rural water supply research in the South African. For example, Momba and Khabo-Mmekoa both affiliated to Tshwane University of Technology in South Africa have contributed the most to literature on the subject. In total, they co-authored 4 papers ([Khabo-Mmekoa et al., 2022](#); [Mothiba et al., 2024](#); [Murei et al., 2022](#); [Sekgobela et al., 2023](#)), while Momba co-authored another one with others, such as that with [Mudau et al. \(2023\)](#). Other authors that turned out multiple papers were Lalumbe in collaboration with others. These papers examined groundwater source but in different context. While one focused on the characterization of hydro-geochemical processes influencing groundwater quality for improved management and sustainability of resources while improving rural livelihoods ([Lalumbe and Kanyerere, 2022](#)), the other explored the feasibility assessment of the application and design of a sustainable groundwater remediation technique as an approach to curtailing groundwater contamination and potential health risks to people in the Soutpansberg region ([Lalumbe et al., 2022](#)). These papers demonstrated the relevance of Lalumbe in sustainable water research in the South Africa rural areas. Others with multiple papers were Kapwata ([Kapwata et al., 2022](#); [Kapwata et al., 2023](#)) and Adom ([Adom and Simatele, 2024](#); [Adom et al., 2023](#)).

This paper observed a growing collaboration pattern among scholars with dedicated interest in rural water management in South Africa. This collaboration network is explored and presented in [Figure 4](#). This collaboration is clustered into 6 research areas as differentiated with various colors. In the red cluster with 7 nodes were Momba, Khabo-Mmekoa, Mothiba, Mudau, Ngobeni-Nyambi, Murei, and Sekgobela. These scholars were united by their interest on the nexus among variables such as drinking water quality, sanitation, water contamination, and water conservation ([Khabo-Mmekoa et al., 2022](#); [Mothiba et al., 2024](#); [Mudau et al., 2023](#); [Murei et al., 2022](#); [Sekgobela et al., 2023](#)). Rather than investigate each of these variables independently, these scholars understand the interconnectedness and interrelatedness among the variables. This perspective better suggests a credible way through which government could engage the complex challenges confronting rural areas.

Another cluster (green) with three nodes has Kapwata, Kunene and Wright whose studies examined climate change, environmental health, and water pollution ([Kapwata et al., 2022](#); [Kapwata et al., 2023](#)). Going by the research focus in this cluster, evidence of abounds of the effect of

TABLE 3 Top 10 articles with the highest citations.

S/N	Paper	Focus	Total citations
1	Murei et al. (2022)	Barriers to water and sanitation safety plans in rural areas of South Africa	14
2	Bazaanah and Mothapo (2024)	Sustainability of drinking water and sanitation delivery systems in rural communities	11
3	Khabo-Mmekoa et al. (2022)	Enteric pathogens risk factors associated with household drinking water in Ugu District Kwa-Zulu Natal province	11
4	Davids et al. (2022)	Health outcomes and civic environmental management interventions	9
5	Lalumbe and Kanyerere (2022)	Characterization of hydro-geochemical processes influencing groundwater quality in rural areas	9
6	Fanteso and Yessoufou (2022)	Diversity and determinants of traditional water conservation technologies in the Eastern Cape province, South Africa	6
7	Orievulu and Iwuji (2022)	Institutional responses to drought in a high HIV prevalence setting in rural South Africa	5
8	Kapwata et al. (2023)	Personal exposure to elevated concentrations of arsenic in water and soil and blood arsenic levels amongst people living in rural areas in Limpopo	5
9	Slayi et al. (2023)	Constraints inhibiting farmers' adoption of cattle feedlots as a climate-smart practice in rural communities of the Eastern Cape	5
10	Njoku et al. (2022)	Investigating the attitude of domestic water use in urban and rural households in South Africa	4

climate change and water pollution on environmental health. In South Africa, just as it is common to most drought prone countries, the effect of climate change is felt more in the scarcity of water. When water becomes scarce, the ecosystem is negatively affected, thereby constituting points of concern to government and stakeholders. It is therefore necessary for concerted to be geared toward exploring the nexus among climate change, water pollution and environmental health.

Furthermore, the 3rd (blue), 4th (yellow) and 5th (purple) clusters have two authors each and they explored water management, public participation and groundwater quality, respectively (Adom and Simatele, 2024; Adom et al., 2023; Lalumbe and Kanyerere, 2022; Lalumbe et al., 2022; Masiangoako et al., 2022; Orievulu and Iwuji, 2022). These three clusters, just like those discussed before them navigated the role of multi-level stakeholder participation in ensuring proper water management in the South African rural areas. This underscored the importance of consultation and integration in addressing the challenges of water supply in the rural areas.

To further explore the factors responsible for research collaboration among authors of adopted journal articles in this paper, a three-field plot as depicted in Figure 5 was prepared. The figure explored the interrelationship between authors, their institutions and country. By so doing, institutions and countries with impressive research out on the subject of this paper is identified. In explaining this figure, reference will be made to the co-authorship network on Figure 4.

The first four authors in the left section of Figure 5 rhythms with those on the red cluster of Figure 4. These authors were Momba, Khabo-Mmekoa, Mothiba, and Mudau. One of the major factors promoting research collaboration among them was their institutional connection, Tshwane University of Technology and the University of Venda, in South Africa. In addition, Figure 5 showed that each of these authors relates to the two institutions. This may emanate from prevailing academic activities such as sabbatical or adjoint positions. Another factor propelling rural water research in these universities may be due to the prevailing water scarcity in the immediate environment of these institutions. This indicated that higher institutions and academics have a significant role to play in addressing social challenges confronting their immediate environments.

Also in Figure 5, scholars such as Kapwata, Kunene and Wright shared affiliation with the South African Medical Research Council and the University of Johannesburg. These scholars dominated the green cluster on Figure 4, and they are affiliated with the two institutions, simultaneously. Evidence of significant dual institutional affiliation is prominent among authors of adopted studies in this paper. This trend position South African academics as enjoying the liberty to get engaged with multiple institutions. Aside from exposing academics to diverse research contexts, this opportunity promotes interdisciplinary research toward addressing complex social issues, such as that of rural water inadequacies as being currently examined.

In linking the number of publications with institutions, Figure 6 was prepared. The figure identified Tshwane University of Technology as the leading institution on rural water supply in South Africa with 22 publications. As noted earlier, rural areas surrounding the institution are characterized by water supply inadequacies. This could be the motivating factors for this feat. Furthermore, the management of the university dedicated a significant portion of their research funds to water research. Another institution that recorded a high publication rate of eight papers is the University of Cape Town. As a coastal town, Cape Town is one of the cities in South Africa that is most impacted by climate change. This reality has prompted considerable research effort toward water research. This could explain the impressive paper production in the higher institution driving innovative solutions to water scarcity in the city.

Furthermore, three universities recorded seven publications each. These institutions comprising the University of Johannesburg, University of Kwazulu-Natal, and University of Venda. This relatively moderate article production rate indicated the limited interest that researchers in these institutions have in rural water supply research. This could result from the availability of alternative research areas with more funding than those bothering of water research. Furthermore, there are indications of improved water service delivery in Johannesburg and Kwazulu-Natal. Other institutions, as depicted in Figure 6, recorded between 6 and 5 papers, each.

Furthermore, in Figure 7, are the corresponding authors' countries with South Africa recording the highest, followed by

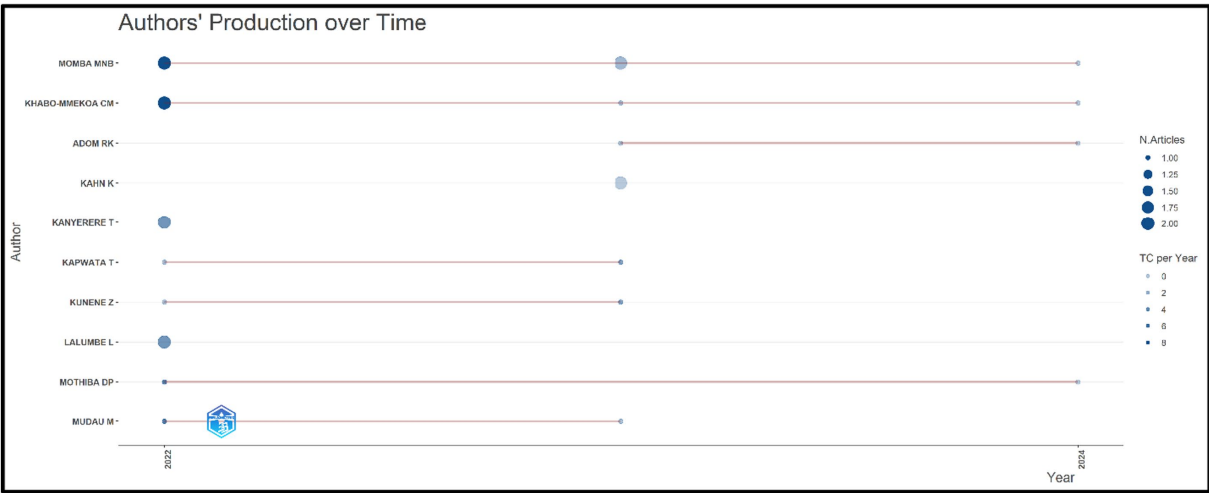


FIGURE 3
Top 10 most productive authors.

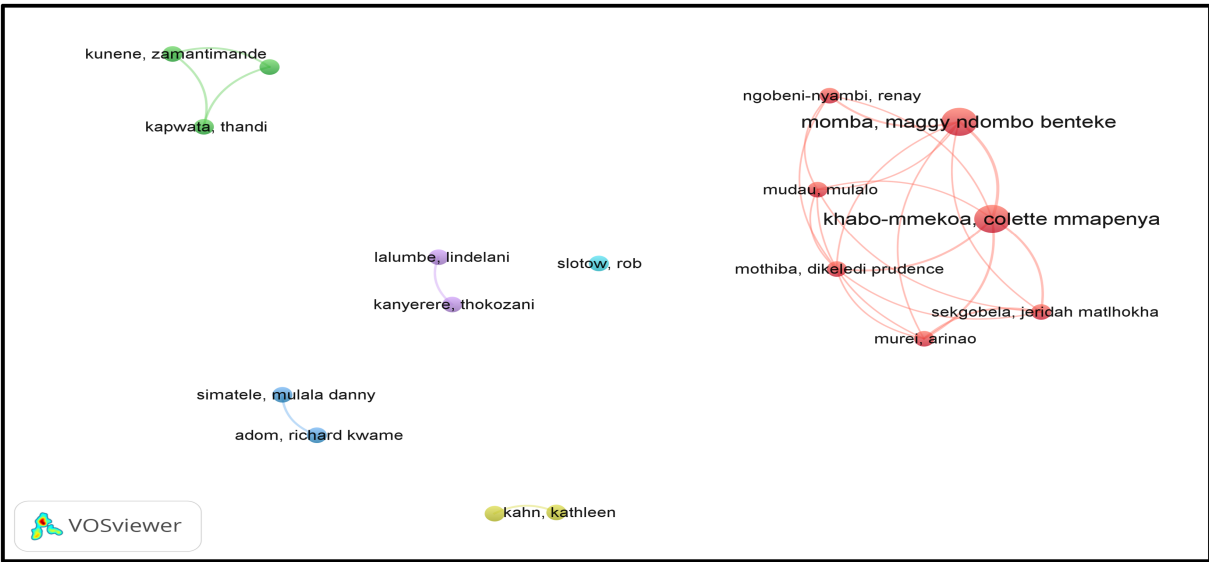


FIGURE 4
Co-authorship network.

Germany and the United States. While these three countries demonstrate high scholarly output, others such as Algeria, Ethiopia, Ghana, Netherland, Norway, Sweden and UK equally demonstrated an appreciable amount of scholarly output to research on sustainable water supply in the South African rural areas. Unlike the previous three figures, this particularly showcased the menace of inadequate rural water supply in South Africa as a global issue attracting interest from institutions outside South Africa.

Having presented the demographic details of the adopted journal articles in this paper, in these following sections, effort would be directed as exploring a qualitative analysis of the adopted literature. This comprises of an in-depth analysis of the current and emerging themes on sustainable water supply in the rural areas of South Africa.

4.2 Thematic analysis

The need to analyze the themes of papers on sustainable water supply in the rural areas of South Africa adopted in this paper cannot be over emphasized. Doing this would enable existing research in the field to be classified based on research focus. Furthermore, this would create the needed platform for appreciating the contributions of these literature to advancing knowledge on water supply in the South African rural areas. And lastly, this qualitative analysis would facilitate the exploration of emerging research gaps on the subject of focus in this paper.

To effectively group adopted literature into varied research themes, there is the need to identify the major keywords in the adopted paper. Figure 8 presents the word cloud containing the most

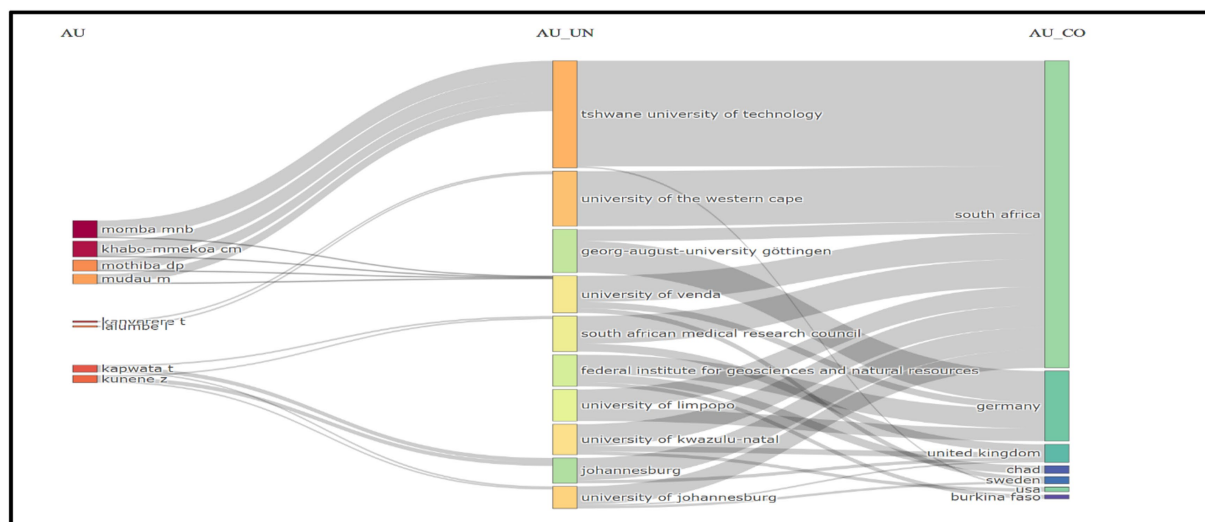


FIGURE 5
Authors, affiliation, and countries.

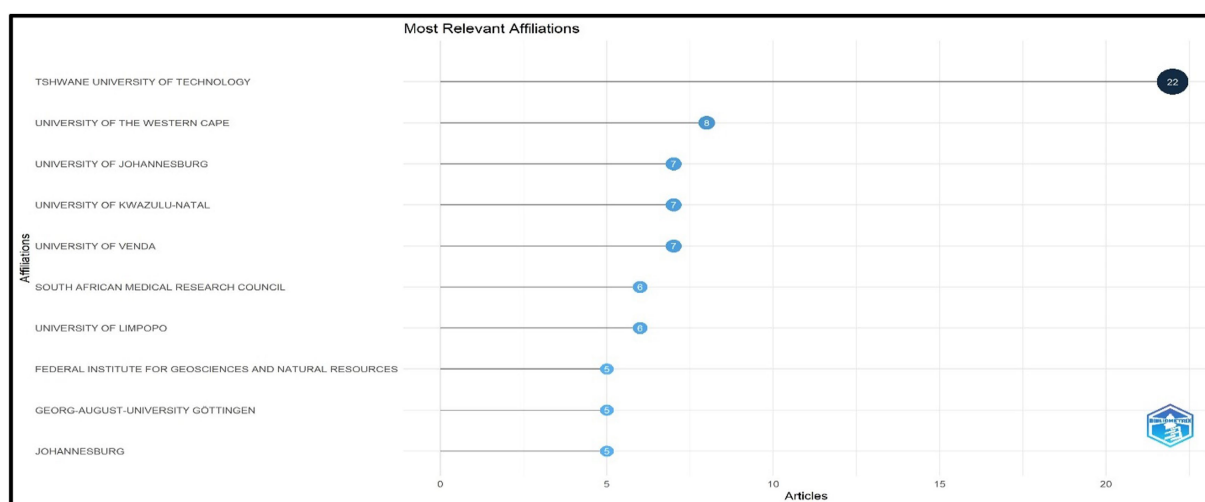


FIGURE 6
Top 10 universities with more publications.

common authors' keywords in the adopted studies. In filtering the numerous keywords down to 50, this paper using Bliiblioshiny, a component of the R package for bibliometric analysis adopted 4 reoccurrences as the benchmark for inclusion in Figure 8.

The qualifying keywords were nouns, sometimes accompanied by an adjective to better capture intended concepts. To avoid keyword duplication, those referring to similar context such as rural population and rural populace; water preservation and water conservation; climate risk and climate change were synchronized. In the figure, the size of each keyword corresponds to the number of times they appear in the dataset. The top 5 keywords in this study were South Africa, water management, rural areas, drinking water, and sanitation with each appearing 8, 4, 4, 4, and 4 times, respectively. This suggests that these keywords hold important spots in sustainable water supply research. The prevalence of South Africa in the word cloud is due to the environmental context of adopted studies.

These keywords further confirm that the literature adopted in this study matched the focus of the study. For instance, the major keywords were South Africa, drinking water, sanitation, waste management, rural population and rural areas. These keywords revolved around issues having bearing with water supply in the South African rural areas. With these keywords, identifying the research themes of the adopted papers is made less complex. To better establish the primary themes and the structure of knowledge in sustainable water supply in the South African rural areas, VOSviewer was adopted in preparing the keyword occurrence network. This network exposes the extent to which individual keywords appeared in the adopted publications and their relationships with the context of those studies. Furthermore, the network showcased the keywords in nodes with their size corresponding to the number of times each keyword appears. To present a concise network, only keywords with a minimum of four occurrences were adopted and this resulted in a total of 30 keywords as presented in Figures 9, 10.



rural water supply in South Africa. In the green cluster (cluster 2, with 14 items) are keywords such as sustainable development, sustainability, water management, rural population, water conservation, and climate change. These keywords focused on promoting sustainable potable water supply in the rural areas of South Africa.

Furthermore, Figure 10 presented the time-varying trend among the major keywords in the study ranging between 2022 (in dark purple) and 2024 (in yellow). Right from 2022, there was a shift in the use of keywords in studies on sustainable water supply in South Africa. Initially, the focus was on keywords such as risk assessment, control study, sanitation, water quality and water conservation. By 2023,

however, a sharp shift in paradigm to keywords such as sustainability, sustainable development, and cross-sectional studies were observed. In these emerging keywords, sustainable development and sustainability occupy central positions in studies bothering on social service delivery. The keyword clustering as presented in Figures 9,10 gives an idea of the thematic structure of documents adopted in this study.

To enhance the understanding of the research themes in the adopted papers, a thematic map in addition to a detailed analysis of the adopted papers was conducted. The authors' keywords were grouped into clusters based on their interrelatedness and frequency to generate literature maps as depicted in Figure 11. Just as noted previously on nodes, the size of clusters also represents the frequency of each keyword. To understand this thematic map, there is the need to explain the basic terms in the map. Density and centrality as the main terms in this map and they indicated the volume and relevance of each literature in the rural water supply research. While density measures the development of themes based on the association of internal keywords. Centrality, on the other hand focused on theme importance through external keyword associations. While density is located on the y-axis and measures the growth of the themes, centrality is placed on the x-axis, and it measures themes' significance. As noted by Agyei et al. (2024), thematic maps usually classify themes into Motor, Niche, Emerging/Declining, and Basic categories.

4.2.1 Motor themes

Themes in this category are found at the top right section of the map, and they possess high density and centrality. This means that the themes in this section are well researched and critical to the research field. Two clusters were formed within this theme. While the first consists of rural communities and climate change adaptation, the second comprises sustainable development and water management. Basically, themes in the Motor category explore the nexus between climate change and water management in rural areas toward facilitating sustainable development. As illustrated also in Figure 10, climate change adaptation and sustainable development are areas of research that directly influence rural water supply. In attestation to this are several studies such as those of Kapwata et al. (2022), Malima et al. (2022), Nelson et al. (2022),

Orieuvulu and Iwuji (2022) and Shah et al. (2024) exerted efforts toward exploring sustainable water management techniques in response to the rapid climate change in the rural South Africa. Precisely for instance, Kapwata et al. (2022) conducted a risk assessment of climate change and associated water, sanitation and hygiene. Nelson et al. (2022) examined the impact of climate change on smallholder maize farming system in Southern Africa. Their study showed that climate change not only affects the environment, but rather its effect is also felt by businesses, especially those in the agricultural sector.

This theme established that addressing rural water shortages can positively affect many components of the rural communities. For instance, as noted by Nelson et al. (2022), farming activities suffers when water is scarce and similarly, maintaining proper hygiene in such an environment assumed difficulty (Kapwata et al., 2022). This is a further confirmation of the interrelatedness among water scarcity, healthy living, maintaining proper sanitation and thriving farming activities. There is therefore the need for a complex framework that establish the link among these variables. Even though the quantity of research output in this theme is high, proper mechanism for coordinating their efficient realization has not been properly investigated.

4.2.2 Niche themes

This category of themes has high density but low centrality which indicates that there is a high volume of research in these areas but with limited research impact on the field of study. The keywords in this quadrant include environmental health, HIV/AIDS and vulnerability. Even though there is a direct link between water scarcity and the health conditions of the people but the terms in this quadrant are too specific to command much significance in the research area. For instance, Hove et al. (2023) examined the importance of collaborative and participatory effort in the provision of safe water to communities with health priorities. Similarly, Kapwata et al. (2023) also explored the relationship between personal exposure to elevated concentrations of arsenic in water and soil and blood arsenic levels amongst people living in rural areas in Limpopo, South Africa. Other studies in this regard were Kerdoun et al. (2022), Khabo-Mmekoa et al. (2022), Mngadi et al. (2023) and Mudau et al. (2023).

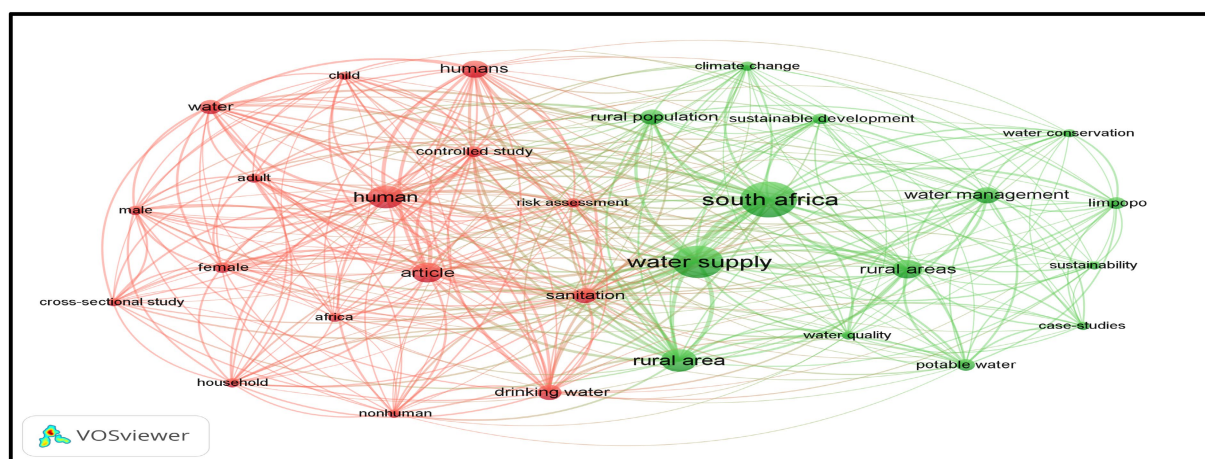


FIGURE 9
Keyword occurrence network visualization.



In every research, there are usually emerging concepts forming new trajectories in the research area. Similarly, other existing terms get replaced by new ones. This category of keywords in this study are grouped into the emerging/declining research themes. These themes are located at the lower left quadrant of the thematic map, and they depict low density and centrality. The themes here are usually emerging or declining topics in the field. Found in this category is ecosystem services. These services denote the various benefits that

humans derive from the ecosystem. As an emerging area, [Ingwani et al. \(2024\)](#) investigated the effect of peri-urban expansion caused by increasing population, migration and modernisation on the ecosystem. This study argued that the growth of such peri-urban centres put strain on the ecoservices, such as water, electricity, sewage system etc. In attesting to the emerging status of ecosystem research in the field of sustainable water supply in the rural areas of South Africa, only one study out of the 44 adopted in this bibliometric analysis focused on the subject.

The argument here is that the current water scarcity experienced by rural areas in South Africa are not only occasioned by the changing climate condition or the ineffectiveness of government agencies. Rather, the scarcity could emerge from the growing population of dwellers of peri-urban settlements in South Africa. As effort is geared toward addressing climate change, there is the need for scholarly research in finding suitable approach to addressing emerging population explosion in the South African rural areas. Research linking this is just growing and this is why this theme is important to locating emerging research gap on the focus of this study.

4.2.4 Basic themes

These themes are characterized by low density but high centrality. This means that the significance of the themes is high but the volume of research in the area is scanty. Keywords in this category are rural areas and microbial tracking. This theme shared a similar feature with emerging themes as more research is desired in this area given the relative importance of the issues to the research field. The focus of this theme as noted in the constituting keywords is on the long-term health effect of consuming contaminated water in the South African rural areas. One basic feature of this theme is in its promotion of multidisciplinary studies. For instance, in exploring the microbial contaminants in open-sourced water in the rural areas, biologists, chemists, and related other professionals must work together. This multidisciplinary tendency as occasioned by the keywords in this theme is necessary for developing diverse approach to addressing the menace of water scarcity in the South African rural areas.

Sharing in this line of thought are [Sekgobela et al. \(2023\)](#), [Mudau et al. \(2023\)](#) and [Khabo-Mmekoa et al. \(2022\)](#) whose studies tracks and detect fecal markers (such as *Escherichia coli*, *Salmonella typhimurium*, *Shigella dysenteriae*, *Vibrio cholerae*, and rotavirus) and enteric pathogens (such as *Salmonella enterica* subsp. *enterica* serovar Typhimurium str. LT2, *Shigella flexneri*, and *Campylobacter jejuni* subsp. *jejuni*) in rural and groundwater sources. As pure scientists, results of these findings could enhance the understanding of social scientists in developing effective social policies toward managing water supply in the rural areas of South Africa.

The grouping of the adopted studies in this paper into themes has allowed for a proper exploration of their various research areas, even within the subject of rural water management in South Africa. This further expose research areas are saturated and those lacking in research attention. Principally, the analysis pointed out emerging areas that can shape this field of enquiry and this revolves around eco-friendly water sources, as well as the use of digital technologies in water management in the South African rural areas.

5 Discussion

In this section, an in-depth engagement with the adopted literature was observed. This is to gain insight into prevailing arguments and trends on sustainable water supply in the South African rural areas. Furthermore, the discussion will enhance the identification of emerging research gaps as well as future research direction necessary for developing scholarship in this research area ([Zhao et al., 2020](#)). This discussion is patterned along four main themes as found in [Figure 11](#).

5.1 Potable water supply and related health issues in the rural areas of South Africa

The acute shortage of safe drinking water in South African rural areas has been a subject of many studies ([Adom et al., 2023](#); [Bazaanah and Mothapo, 2024](#); [Davids et al., 2022](#); [Hove et al., 2023](#); [Ingwani et al., 2024](#); [Jovanović et al., 2023](#); [Kapwata et al., 2022](#)). While these studies examined the water situation in the study context, others (e.g. [Adom et al., 2023](#); [Maponya, 2023](#); [Kerdoun et al., 2022](#); [Khabo-Mmekoa et al., 2022](#); [Malima et al., 2022](#)) explored the health issues faced by the rurals, as a backdrop inadequate safe drinking water in the area. The central arguments of these studies were that the inadequate supply of water to the rural areas in the right quantity and quality has forced people to consume open-sources contaminated water ([Bazaanah and Mothapo, 2024](#); [Collins et al., 2024](#); [Mbanana and Sinthumule, 2024](#); [Mashabela et al., 2022](#)) that has resulted to a number of health issues such as skeletal or dental fluorosis from excessive fluoride intake ([Kerdoun et al., 2022](#)); skin lesions, respiratory and cardiovascular disorders from low levels of arsenic contamination in water ([Kapwata et al., 2023](#)).

Other health issues emanating from the consumption of contaminated water as found in literature adopted in this review were diseases like dysentery and typhoid ([Bazaanah and Mothapo, 2024](#); [Khabo-Mmekoa et al., 2022](#)). Further studies investigated and traced the source of rural water contamination to mining activities common in the rural areas of South Africa ([Bazaanah and Mothapo, 2024](#)). Aside from the mining contaminants, [Laauwen and Nowicki \(2024\)](#) added that open-sourced water is prone to contamination from open defecation ([Lalumba et al., 2022](#)). Given the over-reliance of rurals on open-sourced water, there is the need to decontaminate these water sources to avoid the spread of diseases among the people in the rural areas ([Khabo-Mmekoa et al., 2022](#)). Emerging water detoxification/treatment technologies such as passive chlorination and ultraviolet (UV) disinfection technologies are assuming prominence among developing economies for purifying drinking water ([Laauwen and Nowicki, 2024](#)). When this is done, access to safe water is enhanced, poverty, illness, and hunger become minimal in the areas ([Adom et al., 2023](#)).

5.2 Climate change and potable water management in the rural areas of South Africa

Another subtopic that has enjoyed considerable attention of scholars on the subject of this paper is climate change and water management in the rural areas of South Africa. Climate change has significantly altered the ecological balance of the global environment, posing threats to the health condition and well-being of people ([Kapwata et al., 2022](#)). More specifically in South Africa, drought, a direct consequence of climate change, has led to severe water shortages, particularly in rural areas ([Bazaanah and Mothapo, 2024](#)) as only one-third of the population receives sufficient rainfall to meet their water needs for both consumption and farming ([Fantoso and Yessoufou, 2022](#)). In regions such as Limpopo, repeated droughts have called for urgent actions from government in cushioning the growing water scarcity in the area ([Jovanović et al., 2023](#)).

While several studies have focused on the link between climate change, drought and water scarcity as noted above, others have explored available approaches to mitigating the effect of climate change in the

country. For instance, [Kom et al. \(2024\)](#) and [Fikileni and Wolski \(2022\)](#) identified hydrological forecasting as one of the approaches to addressing the impact of climate change. With this, people can predict the amount of rainfall and further plan for their water use. In addition, groundwater sources, particularly from boreholes, accounts for 45.3% of drinking water in the Vhembe district of South Africa ([Malima et al., 2022](#)). This shows that rural communities are exploring all available channels for sourcing their water needs. Other means such as the use of traditional storage tanks such as Nkgo and Ingqayi for water conservation methods were found in the literature ([Matimolane et al., 2023](#); [Fanteso and Yessoufou, 2022](#)). To complement these local initiatives, municipal officials in districts such as Vhembe provide water tankers to supply water to communities during droughts and prolonged water disruptions ([Malima et al., 2022](#)). These combined efforts help mitigate the effects of climate change on water supply in the rural areas of South Africa.

5.3 Water policy implementation in South Africa: issues and challenges

Water is an essential resource that sustains life ([Bazaanah and Mothapo, 2024](#)) and therefore requires consistent policy intervention to ensure its availability, safety, and accessibility to everyone. Policies are strategic efforts of governments to address critical issues that affect the state and its citizens. To be enforceable, these policies must operate within the framework of relevant state laws ([Olaiya, 2024](#)). Given the indispensable nature of water, many countries have embedded its provision into their legal frameworks. In South Africa, for instance, Section 27(1)(b) of the Constitution guarantees citizens' right to water in sufficient quantity and quality ([Masiangoako et al., 2022](#); [Mbana and Sinthumule, 2024](#)). Aside this constitutional provision, post-1994 South Africa has initiated multiple policy efforts, including periodic reviews, to address water supply and governance issues ([Adom and Simatele, 2024](#)), particularly in rural communities ([Mbana and Sinthumule, 2024](#)).

Despite these constitutional provisions and concerted policy efforts, sustainable water supply, especially in rural areas, remains a persistent challenge ([Adom et al., 2023](#); [Bazaanah and Mothapo, 2024](#)) in South Africa. Rural communities continue to struggle with the gap between their water needs and available water, both in quantity and quality ([Adom et al., 2023](#); [Bazaanah and Mothapo, 2024](#)). This gap has fueled citizens' dissatisfaction with the government and its agencies responsible for water management ([Bazaanah and Mothapo, 2024](#); [Hove et al., 2023](#)). Prominent issues prompting this dissatisfaction as found in the literature were decaying water infrastructure leading to significant water leakage ([Bazaanah and Mothapo, 2024](#); [Malima et al., 2022](#)); financial mismanagement ([Chamberlain and Potter, 2022](#)); inadequate skilled manpower ([Adom and Simatele, 2024](#); [Adom et al., 2023](#)) and institutional inefficiency ([Adom and Simatele, 2024](#)).

Although government, through the Department of Water and Sanitation (DWS), is making steady efforts to address these issues ([Malima et al., 2022](#)), however, reports from residents, mostly in the rural areas contradicted this claim ([Adom et al., 2023](#)), given the continued poor water supply services. In furtherance to this, [Masiangoako et al. \(2022\)](#) noted that imbalance exists in the supply of water in South Africa as some areas have unhindered access to water while other do not. In the latter category are the marginalized and

impoverished communities where water supply is characterized with severe inadequacies. [Mbana and Sinthumule \(2024\)](#) offered a clearer picture of this unequal water service which he captured as, while urban access to potable water has improved, rural areas still face significant challenges.

Given the role of policy in addressing social issues, scholars through their studies have recommended several policy actions to the government. For example, [Adom et al. \(2023\)](#) suggests the adoption of a Social Innovation Model (SIM). SIM is a comprehensive approach to water management in rural areas that involves leveraging multiple water sources, including rainwater harvesting, water recycling, and reuse. For SIM to be effective, community involvement is vital ([Hofstetter et al., 2023](#)), and this can be encouraged through awareness campaigns ([Hove et al., 2023](#); [Malima et al., 2022](#); [Mashabela et al., 2022](#)). Furthermore, municipalities also must play a critical role in this regard. Their role starts from the provision of adequate funding and skilled manpower necessary for maintaining water infrastructure. In reducing the tension with income disparity between the upper and middle class, water tariffs must be reduced or eliminated in underprivileged areas to ensure access to water in the areas ([Bazaanah and Mothapo, 2024](#)). The role of Civil Society Organizations (CSOs) was also not ignored in the literature. For instance, Wise Wayz Water Acre (WWWC) programme, launched in 2016 to remove litter from contaminated water sources, such as the Mbokodweni and Golokodo river systems, to improve water quality ([Davids et al., 2022](#)).

The literature captured above enumerated the need for government to deliberately channel its policies toward balancing access to water between the urban and rural areas in the country. The need for collaboration with communities, NGOs and related stakeholders in tackling the issue of inadequate water supply to the rural areas was also stressed. This confirms earlier submission on the need for collaborative approach toward solving the problem of water scarcity in the South African rural areas.

5.4 Gap in knowledge and future research directions

This bibliometric analysis has profiled relevant literature on sustainable water supply in South African rural areas as found in the Scopus database. The literature was mainly journal articles that underwent rigorous peer reviews, thereby indicating their quality in the academic parlance. This review process is fundamental in academic as research is an important platform for guiding government. Research is critical to achieving practical improvements in the social condition of societies given its roles in guiding policy decisions and actions of governments. Over the years, the academic community in South Africa has contributed to the enhancement of water service delivery in rural areas through their research. For instance, the Social Innovation Model (SIM) recommended by [Adom et al. \(2023\)](#) informed the integration of multiple stakeholders in tackling the menace of water shortages in rural communities. This model is often understood through the lens of a "Fivefold Helix" approach, encourages collaboration and co-creation between government, business, universities, civil society, and communities in addressing social problems. This model emphasizes a network of actors working together to solve challenges and build more sustainable and inclusive communities. This

multi-stakeholder approach has dominated government policies toward addressing water supply shortages to the South African rural areas. Even though this study and several others have impacted government's water management policies in the country, there are still areas requiring scholastic attention, the outcome of which could enhance government's decision-making capacity. These areas are as noted in subsequent paragraphs.

The potential of ICT in solving societal problems cannot be overemphasized. Given the recent challenges with sustainable water supply in the rural areas of South Africa, there is the need for the integration of technologies as done in other climes such as Dubai to boost water availability. In all the literature examined in this study only one touches on the use of passive chlorination and ultraviolet (UV) disinfection technologies for drinking water purification (Laauwen and Nowicki, 2024). Others dwelled on traditional approach to solving sustainable water problems such as increasing funding, infrastructural upgrading and skill upscaling (Bazaanah and Mothapo, 2024; Malima et al., 2022).

Possible technology-driven solutions that could be adopted in South Africa range from smart water management systems. With electronic devices such as sensors, data analytics and Internet of Things (IoT), water resources can be better monitored, leakages tracked and water distribution enhanced. In addition, there is the need for research to study the application of rainwater harvesting technologies to replace the traditional process of storing rain water in drums (Fanteso and Yessoufou, 2022), which is susceptible to contamination. Other technology-driven initiatives and techniques that future studies need to explore are water recycling, drone and satellite remote sensing and fog harvesting.

6 Conclusion and limitations

Water is significant to the survival of humans, animals and the physical environment. It is on this understanding that ensuring the consistent supply of water to communities assumed importance. More importantly, rural areas that are characteristically poor and marginalized face acute water scarcity in South Africa. Literatures have examined water supply in the South African rural areas in varied contexts. To understand these contexts while identifying prolific authors, their collaboration network, institution and countries, this study conducts a bibliometric analysis of recent papers on sustainable water supply in the rural areas of South Africa. Other objectives pursued in the paper were to thematically analyze the papers to present their research focus, limitations and subsequently present research gaps that subsequent researchers can investigate.

In the thematic analysis of the papers, there is the understanding that inadequate supply of drinking water led to the consumption of contaminated water by rural dwellers and this has prompted the spread of diseases. In addition, it was found that the effect of rapid climate change has occasioned the emergence of traditional water harvesting and conservation techniques among the people. And lastly, several challenges confronting the effective implementation of public policies toward the provision of sustainable drinking water to the rural areas were exposed. The basic knowledge gap observed in this paper is the absence of research effort on the use of ICT and IoT for

promoting water management, rain and fog harvesting. In setting research agenda for subsequent studies, this paper suggests a wholistic exploration of the various interlinking variables bothering on rural water supply in South Africa. For instance, studies adopted in this paper indicated an interlink among climate change, drought and water scarcity. Studies with specific focus in this regard is lacking. Furthermore, the nexus among climate change, environmental degradation and farm output was also found to be prominent but specific studies on this is also lacking.

The major limitation of this study is its limit to Scopus database. More elaborately, it focused mainly on journal articles written in English. In addition, only recent studies between 2022 and 2024 were adopted. This is to enable proper focus on recent issues regarding water supply in the South African rural areas. Consequently, the omission of studies in other languages and from other database reduces the extent of generalization that this study could claim. Yet, the study contributes to scholarship and real-time problem solving by providing a comprehensive overview of recent research effort in sustainable water supply in the South African rural areas. In addition, it exposes the research focus of exiting paper while recommending areas for future research. Equally, it aggregated recommendations to the challenges confronting government and its agencies in the sustainable supply of drinking water in the country. Thus, both academics and policy experts will benefit greatly from the findings of this paper.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: Scopus Database.

Author contributions

AI: Formal analysis, Methodology, Writing – original draft. TG: Conceptualization, Supervision, Writing – review & editing. TM: Data curation, Supervision, Visualization, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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