Article

Not peer-reviewed version

Exploring the Key Factors Influencing Water Scarcity for Domestic Use in Rural Communities of uMkhanyakude District, KwaZulu-Natal Province, South Africa: A Qualitative Analysis

Nkeka P. Tseole *, Tinashe Innocent Mutero , Moses John Chimbari

Posted Date: 23 October 2024

doi: 10.20944/preprints202410.1854.v1

Keywords: Water scarcity; hygiene; sanitation; rural areas

 doi:10.20944/preprints202410.1854.v1

Article

Exploring the Key Factors Influencing Water Scarcity for Domestic Use in Rural Communities of uMkhanyakude District, KwaZulu-Natal Province, South Africa: A Qualitative Analysis

Nkeka Peter Tseole *, Tinash Innocent Mutero and Moses John Chimbari

University of KwaZulu-Natal (UKZN), School of Nursing and Public Health, in Durban, South Africa.
* Correspondence: nkekathabiso@gmail.com

Abstract: Water scarcity persists to be a pressing health concern globally and rural South Africa is not exempted. It exacerbates exposure to waterborne pathogens, resulting in substantial negative health consequences. Despite access to clean water being a constitutional right in South Africa, water scarcity remains a formidable challenge contributing to poor hygiene and sanitation in the country. This qualitative study investigated the factors contributing to water scarcity and the coping mechanisms employed by rural communities in KwaZulu-Natal. Semi-structured interviews and focus group discussions were conducted to collect data. The findings revealed infrastructural challenges, political inaction, climate change and population growth as key determinants of water scarcity in uMkhanyakude. Community members primarily relied on greywater reuse and storing of water in multiple containers to mitigate the effects of water scarcity. It is essential for South African government to prioritize initiatives addressing water scarcity in neglected rural areas to ensure equitable access to clean water and to mitigate the associated health risks.

Keywords: Water scarcity; hygiene; sanitation; rural areas

Introduction

Water scarcity is a significant global health concern, affecting over one billion people worldwide [1–8]. The contributing factors to water scarcity comprise economic growth and population growth which contribute to the increasing pressure on water sources [2]. Water shortages threaten the livelihood of many communities around the world [2]. In developing countries, inadequate access to safe drinking water and sanitation exacerbates the risk of waterborne and neglected tropical diseases [9–11]. The risk to waterborne diseases is raised by the use of alternative water sources which in most cases are contaminated and unsafe for human consumption [5]. In addition to the heightened risk exposure to illnesses, socio-economic development is also constrained immensely by water scarcity [2]. For instance, water availability plays a critical role in various industries including agriculture which is dependent on water [12]. The United Nations recognizes access to safe water and sanitation as human rights [13], yet many countries, including South Africa, struggle to meet this basic need [14]. South Africa's water, sanitation and hygiene (WASH) challenges are compounded by inadequate water infrastructure [14] despite the constitutional guarantees of access to safe water [15].

South African rural areas are disproportionately affected by limited access to improved water and sanitation services [14,16–20]. In South Africa, water scarcity is a political invention that excluded and marginalized black people from accessing improved water sources [21,22]. This invented limitation to access clean water for domestic use was integral to colonial and apartheid strategies [21,22]. Almost 20% of the rural communities in South Africa still lack access to reliable sources of clean water, and about 25% have no access to basic sanitation facilities [23]. Post apartheid era in South Africa, different factors including climate change, agriculture, population growth and inadequate water infrastructure worsen the challenge of water scarcity particularly in rural South Africa [24,25]. An understanding of water scarcity plays a critical role in the formulation of policies

 doi:10.20944/preprints202410.1854.v1

at global to local levels [2]. This study investigated factors that influenced water scarcity in rural communities of uMkhanyakude district, KwaZulu-Natal province, South Africa, with a focus on community engagement and locally driven development processes.

Material and Methods

Study Design

This qualitative study explored the key factors influencing water scarcity for domestic use in rural KwaZulu-Natal, South Africa. It further identified the strategies employed by rural communities to address water scarcity in uMkhanyakude district. The study was conducted at different times from September 2020 and March 2021 using semi-structured interviews and focus group discussions. The qualitative research design enabled the collection, analysis, and interpretation of non-numerical data to gain a deeper understanding of participants' behaviors, opinions, and experiences of water scarcity in their community [26].

Study Area

The study was conducted in uMkhanyakude district, which covers an area of 12,818 km² and is bordered by Zululand district to the west, Mozambique to the north, Swaziland to the northwest, and uThungulu district to the south [25,27]. Ten villages, representing three wards, were purposively selected for this study (Fig. 1). These villages were chosen due to their information-rich profiles related to water scarcity. The population in uMkhanyakude district is predominantly young, with over 25% lacking formal education and relying on subsistence agriculture and animal husbandry as their primary source of livelihood [28,29].

Sampling

The villages selected were Makhane, Makwakwa, and Mahlabeni (Ward 13); Ndumo, Ziphosheni, and Magwangu (Ward 16); and Impala, Mbandleni, Madeya, and Mgedula (Ward 17). Majority of these villages are characterized by limited infrastructure, limited access to piped water, and a reliance on rain and contaminated water sources, including dams and rivers [27].

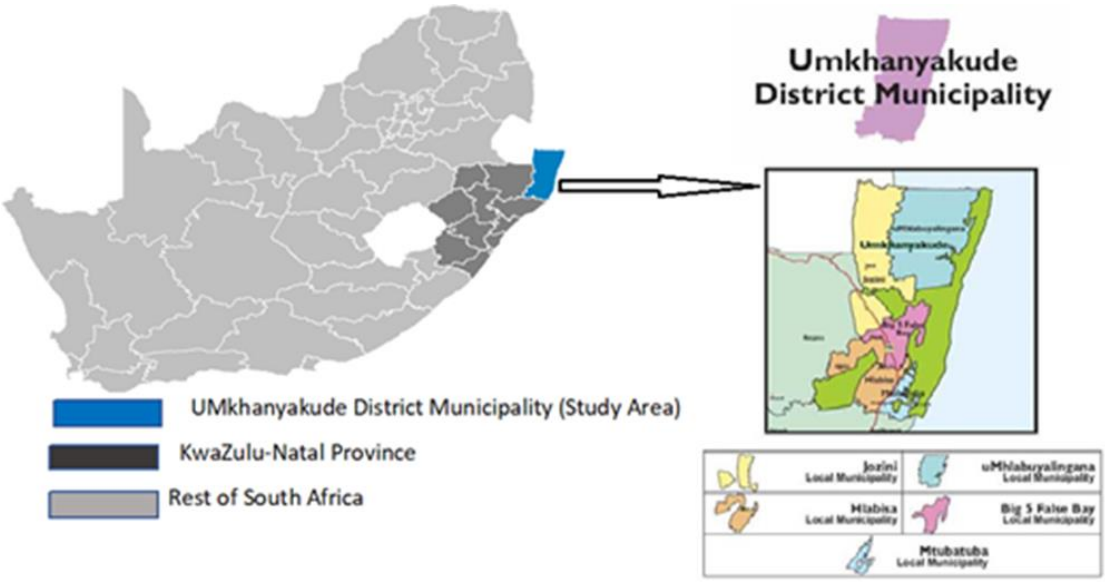

Figure 1. A map showing the area where the study was conducted [25,27].

 doi:10.20944/preprints202410.1854.v1

Data Collection

The study employed a qualitative approach, utilizing in-depth interviews and focus group discussions (FGDs) to collect data from key informants and the general community members in uMkhanyakude district.

In-depth Interviews

Nine key informants, representing the three wards, participated in in-depth interviews conducted by a trained research assistant fluent in the local language, isiZulu. The key informants held leadership positions within their communities, including traditional leaders, religious leaders, teachers, nurses, and community health workers. We used semi-structured interview guide which was translated into isiZulu. This allowed for in-depth probing while maintaining focus on the research objectives. Interviews were audio-recorded, and field notes were taken by the researcher. Each interview lasted between 55-90 minutes.

Focus Group Discussions

Nine FGDs were conducted with community members, comprising three adult male groups, three adult female groups, and three mixed-gender groups. Each FGD had 6-12 participants, recruited purposively with the assistance of community health workers to ensure diversity and information-rich discussions. The community health workers facilitated the recruitment process, identifying participants who would effectively contribute to the discussions. The FGDs sought to realise gender balance and targeted only adult individuals. The semi-structured FGD guide was translated into isiZulu, and refreshments were served after each session.

Data Management

Following data collection, the recorded interviews were transcribed verbatim and translated from isiZulu to English by a professional language transcriber. The transcripts were saved in word documents for analysis.

Data Analysis

The collected data were manually analyzed using thematic analysis [30–32]. This approach involved a systematic four-stage process: (a) familiarization where researchers thoroughly read the interview notes to comprehend the respondents' comments and views, (b) initial coding during which codes were generated from the data, and themes began to emerge, (c) theme revision where the initial themes were refined and revised, and lastly (d) theme definition and naming where the final themes were defined and named [30–32].

Results

The findings indicate that the water scarcity challenges in uMkhanyakude community were attributed to a trifecta of factors: inadequate infrastructure, political inaction, climate change and population growth.

Infrastructural Challenges

Almost all the participants from both the KII and the FGDs reported lack of water infrastructure as the main contributor to water scarcity in uMkhanyakude District. Out of ten participating villages, only Ndumo and Makhana had basic water infrastructure in place. Majority of villagers from these two villages had piped water in their yards with exemption to community members who had recently relocated to these two areas. Residents from the remaining eight villages reported extreme water scarcity which forced them to access water from contaminated alternative water sources for domestic use. The alternative sources of water used included rivers and community excavated well which were often shared with animals. Some participants reported:

 doi:10.20944/preprints202410.1854.v1

We fetch water from the river, which is also used by cows and goats, resulting in dirty water. We must wait for the water to clear before drawing it for human use.

A male aged 40, FGD, Mbandleni with no water tap

We share wells dug by the community with donkeys and cattle.

A female aged 50, mixed FGD, Madeya with no water tap

During the drought, we had to dig for water by the river, but it was hard to find and dirty, leaving red marks on the bucket.

A female aged 46, KII, Madeya

In addition to infrastructural challenges, lack of efficient tools for communities to construct safe water sources by themselves was a major obstacle. This deficiency rendered the task laborious, straining, and environmentally degrading. Participants reported relying on rudimentary tools, such as picks and shovels, for digging water sources. This approach resulted in prolonged construction periods, with villagers dedicating long hours per day to this task. The environmental degradation was likely due to the destructive nature of manual digging, which led to soil erosion, habitat destruction, and water source contamination:

We dig with picks and shovels, and it takes the whole day. Sometimes we get tired and try digging at another spot if the water does not surface.

A male religious leader aged 65, KII, Madeya

We walk long distances to collect water, about 3km away. We use donkeys because it's far, and even then, we have to dig for water.

A male religious leader aged 65, KII, Madeya

We depend on rain for water supply. During dry seasons, we hire vehicles to fetch water from other villages with water.

A male aged 65, KII, Madeya

These findings highlight the significance of adequate water infrastructure in ensuring access to clean water, improved sanitation and reduced risk of waterborne diseases. The findings further highlight the urgent need for alternative, more sustainable solutions to support water source construction in villages lacking infrastructure. The physical and the environmental burdens associated with manual digging methods underscore the importance of investing in efficient tools and technologies to support the development of safe and reliable water sources.

Political Gesturing

Political gesturing emerged as a significant factor to water scarcity during the interviews. The phenomenon was also perceived as a hinderance to effective service delivery, particularly in communities plagued by inequality and poverty. Politicians leveraged the water crisis for political gain, frequently making unfulfilled promises to address the issue. This was evident in the participants' narratives:

We engage with ward councillors, who promise to provide water, but these promises remain unfulfilled due to lack of budget allocation.

A male aged 50, KII, Mgedula

In 2019, we met with the mayor, who promised to deliver water, but we are still waiting; it's a waiting game, as promises are not kept.

A female aged 41, FGD Mbandleni

We complain to councillors, who promise assistance but fail to deliver.

A male aged 38, Mixed FGD Madeya

I have approached the Shemula Water Scheme authorities and municipalities, and they promised to address our water issues, but no action has been taken.

 doi:10.20944/preprints202410.1854.v1

A female aged 68, KII, Madeya

Inconsistent local government interventions were reported during the interviews. Participants were aware that infrastructural development solutions for safe water access would take a long time to put in place. In the interim, government authorities had promised to provide clean water through truck tankers to communities struggling with access to safe water. However, water deliveries were reported erratic and unreliable. Majority of the villages reported infrequent and long waiting periods for water deliveries:

Promises of regular water deliveries via truck tankers were made, but nothing materialized.

A female aged 51, FGD Mbandleni

Water trucks have not arrived in our village for almost 10 months.

A male aged 50, KII, Mgedula

We are still waiting for water cans to be dispatched to our tanks as promised by the mayor.

A female aged 47, FGD Mbandleni

The communities expressed a need for alternative solutions, such as boreholes, to address the inconsistencies in water supply as expressed by one of the female KII participants from Mahlabeni: *"Boreholes would be useful for accessing water during periods of tap water scarcity and delayed water truck arrivals".*

These findings highlight the need for reliable and consistent local government interventions to address the water crisis in these communities. The findings also show the negative consequences of poor accountability on officials which led to poor service delivery, exacerbating the water crisis in the affected villages. The findings also highlight the need for effective governance to address this critical issue.

Climate Change Impacts

The study findings revealed that drought, exacerbated by climate change, had far-reaching and devastating effects on the district's ecosystem and water resources. Participants consistently highlighted the struggles associated with drought:

We had to dig for water by the river due to drought and lack of rainfall.

A female aged 46, KII, Madeya

Water scarcity is alleviated by rainfall, but without it, accessing water becomes a significant challenge here.

A male aged 65, KII, Madeya

Drought forces us to fetch water from distant areas like Ndumo where they have piped water in their yards.

A male aged 35, FGD Mbandleni

Recent rainfall has temporarily alleviated water scarcity because we have collected water in our tanks.

A female aged 27, Mixed FGD Madeya

In South Africa, climate change manifests in increased temperatures, leading to rainfall unpredictability and droughts. These changes have compromised the already inadequate water supply and quality in the district, exacerbating the struggles faced by communities. The study's results underscore the urgent need for climate-resilient water management strategies to mitigate the impacts of drought and ensure sustainable water access in the district.

Population Growth

The villages with basic water infrastructure, namely Ndumo and Makhana, faced an additional challenge, population growth. As the population increased, so did the demand for water and other essential services, placing a significant pressure on existing supplies. This growth led to a surge in water demand, which outpaced the capacity of the current infrastructure. Qualitative data revealed that new community members, who migrated from other villages, did not have access to piped water

 doi:10.20944/preprints202410.1854.v1

in their yards yet. While waiting for their own water connection, they relied on fetching water from their neighbours' residences:

Not all houses have taps in their yards. Some people have connected their own pipes, but newcomers do not have taps yet. They usually access water to use at their homes from their enamours.

A male aged 45, KII, Ndumo

Not everyone in our area has a tap in their home. We heard that the water reservoir has limited water supply and on the other side our village keep growing because of the other people coming to stay here. That means some people will not have water until the current problem of limited supply is sorted.

A male aged 47, KII, Ndumo

This finding suggests that population growth has exacerbated the water supply challenges in these villages, highlighting the need for infrastructure expansion and upgrading to meet the increasing demand. The authorities' concerns about the limited water supply reservoir capacity further emphasize the urgency of addressing this issue.

Challenges Caused by Water Scarcity

Use of Unsafe Water Sources

As their last resort, some community members in the study areas relied on unprotected and untreated water sources, thereby exposing themselves to significant health risks. Participants revealed that they struggled to access clean water, and those who could afford resorted to pay for water transportation from elsewhere:

"*Water is generally not sold here. However, if we transport it to our village from other villages with water, then we have to pay for transport. It is difficult for the poorest who cannot afford to pay for water transport. Then they usually collect water from places shared with livestock. These rivers are also used to wash laundry and swimming*"

A male aged 37, FGD Mbandleni

The findings highlight the urgent need for interventions aimed at improving access to safe and clean water, as well as promoting hygienic practices and water management strategies. The findings also highlight the need for leaders to ensure access to safe and protected water sources to mitigate health risks. The reliance on unprotected and untreated water sources has significant implications for community health, particularly in the context of waterborne illnesses.

Gender Inequality

Water scarcity exacerbates gendered divisions of domestic labour, with women and children disproportionately burdened with fetching water for household consumption. Participants revealed varied perspectives on gender roles in water collection.

Women and children typically fetch water, but it's challenging for children due to the river's location in the forest.

A female aged 47 in a FGD at Mbandleni

Another female aged 52 from a mixed FGD from Madeya explained a cultural dynamic regarding fetching water: "*In Zulu culture, women traditionally fetch water, but now everyone contributes*". This was supported by one of the male participants aged 38 in the same mixed FGD: "*I don't fetch water; it's not my department. I might help with fetching water from the river using a car*". A minority of male participants explicitly rejected traditional gender roles, opting out of water collection duties:

Fetching water is everyone's chore; we all use water, so we should all contribute.

A male aged 33 from a FGD from Makhana

The results contribute to the existing research related to gender and water, emphasizing on the importance of considering the complex social dynamics and the evolving gender roles in the context

 doi:10.20944/preprints202410.1854.v1

of water scarcity. Additionally, this finding underscores the critical need to address gender disparities in house chores.

Navigating Water Scarcity

Despite facing severe water scarcity, participants demonstrated remarkable resourcefulness and resilience through various coping mechanisms. They relied on alternative water sources comprising wells and travelled to collect water for domestic use from neighbouring villages with available water. Community members used multiple containers to store water to mitigate the intermittent water supply. Furthermore, participants reused water for multiple purposes, such as washing dishes and watering gardens. Multiple service delivery protests were also organized to express dissatisfaction with water supply services, although these often did not yield expected outcomes. Repeated disappointments led some community members to become disengaged, opting not to act despite the ongoing water scarcity in the study area. Protests and alternative strategies provided only temporary relief, highlighting the need for sustainable solutions to water scarcity. This study highlights the resourcefulness of communities in navigating water scarcity. However, it also emphasizes the urgent need for effective, sustainable solutions to address this critical issue.

Discussion

This study investigated the factors contributing to water scarcity in rural KwaZulu-Natal, South Africa. The findings revealed that infrastructural challenges, political gesturing, climate change, and population growth were major contributors to water scarcity in the region. Lack of access to clean water increased the risk of waterborne illnesses, highlighting the need for improved Water, Sanitation, and Hygiene (WASH) services [33]. The scarcity of clean water compromises individuals' ability to practice good hygiene and sanitation [11].

The study found that rural communities relied on unprotected wells, rivers, and dams as their sources of water for domestic use. Unfortunately, these water bodies are risk factors for contaminated water [34]. Inadequate, and lack of water infrastructure forced residents to walk long distances to fetch water, leading to structural social problems and gendered division of labour [11,35–38]. In many rural settings confronted with water scarcity, women and children often take the responsibility to fetch water from distant alternative water sources [11,37,39,40] thereby exposing them to multiple health and social risks. The South African government should invest better in adequate water infrastructure to ensure access to clean water for domestic use in both urban and rural settings.

Political gesturing and lack of government commitment to improved public service exacerbate poor service delivery outcomes [41]. This phenomenon is consistent with existing literature, which highlights the negative impacts of political gesturing on service delivery and development outcomes [43,44]. The study's findings underscore the importance of addressing political gesturing to ensure effective service delivery and improve the lives of marginalized communities. Protests are a means for communities to communicate dissatisfaction, but complacency can lead to inaction [42]. Politicians and community leaders should avoid creating unrealistic expectations to gain favour with communities [43].

Climate change contributes to water scarcity, with anticipated negative impacts on equitable access to clean water [20,44–46]. Erratic rainfall and frequent droughts threaten water supply, agricultural sector, and food security [47,48]. It is critical that countries, including South Africa put in place climate-resilient water management strategies [49] to ensure sustainable water access even in rural areas.

Rapid population growth increases demand for water, leading to severe shortages [2,18,20,50,51]. The affected communities are usually forced to reuse greywater and store water to maximize limited resources [47]. This phenomenon is consistent with existing literature, which highlights the impact of population growth on water resources and infrastructure [52,53]. The integration of population growth projections into water resource planning and management strategies is critical to ensure sustainable and equitable access to water. Additionally, South African government should implement sustainable solutions to address water scarcity, including improved

WASH services, infrastructure development, and climate change mitigation strategies to mitigate water scarcity in rural areas.

Limitations

Our study was conducted in a restricted sample of ten villages in uMkhanyakude district, KwaZulu-Natal, South Africa. Consequently, the study findings cannot be generalized in other contexts. However, future research maybe replicated and expanded from this study findings in different settings.

Conclusions

This study investigated the determinants of water scarcity in rural KwaZulu-Natal, South Africa, and identified strategies the rural communities used to mitigate this challenge. The findings revealed four primary determinants of water scarcity: inadequate water infrastructure, political gesturing, climate change, and population growth. To cope with water scarcity, community members reused water, stored water in multiple containers for future use, harvested rainwater and relied on alternative unprotected water sources. It is imperative that the South African government prioritizes improving access to clean water in neglected rural areas through investing in water infrastructure development, promoting water conservation practices, and implementing effective climate change adaptation strategies. By addressing water scarcity, the government can contribute to the well-being and sustainable development of rural communities.

Acknowledgement: We acknowledge all members of the communities from the ten villages in uMkhanyakude district without whom this research would not have been possible, the area traditional leadership that allowed us to conduct this study and the KwaZulu-Natal EcoHealth Program (KEP) team at UKZN for all the help during data collection.

Authors' contribution: Conceptualization: Nkeka Tseole; Data curation: Nkeka Tseole; Formal analysis: Nkeka Tseole & Tinashe Mutero; Funding acquisition: Moses Chimbari; Methodology: Nkeka Tseole; Project administration: Moses Chimbari; Supervision: Moses Chimbari; Writing—original draft: Nkeka Tseole; Writing—review & editing: Nkeka Tseole, Tinashe Mutero & Moses Chimbari. All authors have read and agreed to the published version of the manuscript.

Conflict of interest: None declared.

Funding: None.

References

1. Mancosu, N., Snyder, R.L., Kyriakakis, G., Spano, D. Water Scarcity and Future Challenges for Food Production. *Water*, 2015;7(3), 975-992; https://doi.org/10.3390/w7030975.
2. Liu, J., Yang, H., Gosling, N.S., Kummu, M., Flörke, M., Pfister, S., Hanasaki, N., Wada, Y., Zhang, X., Zheng, C., Alcamo, J., Oki, T. Water scarcity assessments in the past, present, and future. *Earth's Future*, 2017;5, 545–559. doi:10.1002/2016EF000518.
3. Chakkaravarthy, D., Niruban, B.T. Water Scarcity- Challenging the Future. *International Journal of Agriculture, Environment and Biotechnology*, 2019;12(3), 187-193.
4. Irianti, S., Prasetyoputra, P. The struggle for water in Indonesia: the role of women and children as household water fetcher. *Journal of Water, Sanitation and Hygiene for Development*, 2019;9 (3): 540–548.
5. Mutono, N., Wright, J., Mutembei, H., Muema, J., Thomas, M., Mutunga, M., Thumbi, S.M. The nexus between improved water supply and water-borne diseases in urban areas in Africa: a scoping review protocol. *AAS Open Res*, 2020;8;3:12. doi: 10.12688/aasopenres.13063.2.
6. Liu, W., Liu, X., Yang, H., Ciais, P., Wada, Y. Global water scarcity assessment incorporating green water in crop production. *Water Resources Research*, 2022;58, e2020WR028570. https://doi.org/10.1029/2020WR028570.

7. Mulwa, F., Li, Z., Fangninou, F.F. Water Scarcity in Kenya: Current Status, Challenges and Future Solutions. *Open Access Library Journal*, 2021;8, 1-15. doi: 10.4236/oalib.1107096.
8. Shemer, H., Wald, S., Semiat, R. Challenges and Solutions for Global Water Scarcity. *Membranes*, 2023;13(6):612. https://doi.org/10.3390/membranes13060612.
9. Gleick, P.H. The human right to water. *Water Policy*, 2019;1(5), 1998, 487-503.
10. PLoS Medicine Editors. Clean Water Should Be Recognized as a Human Right. *PLoS Med*, 2009;6(6): e1000102.
11. Mulopo, C., Chimbari, M.J. Water, sanitation, and hygiene for schistosomiasis prevention: a qualitative analysis of experiences of stakeholders in rural KwaZulu-Natal. *Journal of Water, Sanitation and Hygiene for Development*, 2021;11 (2): 255–270. https://doi.org/10.2166/washdev.2021.182.
12. Israilova, E., Voronina, A., Shatila, K. Impact of water scarcity on socio-economic development. *E3S Web of Conferences*, 2023;458, 08027. https://doi.org/10.1051/e3sconf/202345808027.
13. Coswosk, E.D., Neves-Silva, P., Modena, C.M., Heller, L. Having a toilet is not enough: the limitations in fulfilling the human rights to water and sanitation in a municipal school in Bahia, Brazil. *BMC Public Health*, 2019;19:137.
14. Edokpayi, J.N., Rogawski, E.T., Kahler, D.M., Hill, C.L., Reynolds, C., Nyathi, E., Smith, J.A., Odiyo, J.O., Samie, A., Bessong, P., Dillingham, R. Challenges to Sustainable Safe Drinking Water: A Case Study of Water Quality and Use across Seasons in Rural Communities in Limpopo Province, South Africa. *Water*, 2018;10, 159.
15. Jaffe, R. Equity & ecology in South African water systems. University of Denver Water Law Review, 2020;23(2), 147-154.
16. Muller, M., Schreiner, B., Smith, L., van Koppen, B., Sally, H., Aliber, M., Cousins, B., Tapela, B., van der Merwe-Botha, M., Karar, E., Pietersen, K. *Water security in South Africa. Development Planning Division*. 2009; Working Paper Series No.12, DBSA: Midrand.
17. Bulled, N. The Effects of Water Insecurity and Emotional Distress on Civic Action for Improved Water Infrastructure in Rural South Africa. *Medical Anthropology Quarterly*, 2015;31(1), 133–154.
18. du Plessis, A. *Global Water Scarcity and Possible Conflicts*. In: Freshwater Challenges of South Africa and its Upper Vaal River. Springer Water. Springer, Cham. 2017. https://doi.org/10.1007/978-3-319-49502-6_3.
19. Hove J, D'Ambruoso L, Mabetha D, van der Merwe M, Byass P, Kahn K, Khosa S, Witter, S., Twine, R. 'Water is life': developing community participation for clean water in rural South. *Africa BMJ Global Health*, 2019;4: e001377.
20. Ningi, T., Taruvinga, A., Zhou, L., Ngarava, S. Determinants of water security for rural households: Empirical evidence from Melani and Hamburg communities, Eastern Cape, South Africa. *Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie*, 2021;40(1), 37-49. https://doi.org/10.36303/SATNT.2021.40.1.802.
21. O'Brien, M. *The Worth of Water: A Look at the Water Scarcity Crisis and the Perceptions of the Basic Need of Water in South Africa*. Senior Theses, Trinity College, Hartford, CT. Trinity College Digital Repository. 2014. https://digitalrepository.trincoll.edu/theses/431.
22. Kaziboni, A. Exclusion and invented water scarcity: a historical perspective from colonialism to apartheid in South Africa. *Water History*, 2024;16:45–63. https://doi.org/10.1007/s12685-024-00339-4.
23. WHO & UNICEF. *The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene*. 2017. Retrieved from: https://washdata.org/data/household#!/. (accessed August 2020).
24. Ofoegbu, C., Chirwa, P., Francis, J., Babalola, F. Assessing vulnerability of rural communities to climate change: A review of implications for forest-based livelihoods in South Africa. *International Journal of Climate Change Strategies and Management*, 2017;9(3), 374-386.
25. Patrick, H.O. Climate change and water insecurity in rural uMkhanyakude District Municipality: an assessment of coping strategies for rural South Africa. *H_2Open Journal*, 2021;4 (1), 29-46.
26. Aspers, P., Corte, U. What is Qualitative in Qualitative Research. *Qualitative Sociology*, 2019;42, 139–160.
27. Manyangadze, T., Chimbari, M.J., Gebreslasie, M., Mukaratirwa, S. Risk factors and micro-geographical heterogeneity of Schistosoma haematobium in Ndumo area, uMkhanyakude district, KwaZulu-Natal, South Africa. *Acta Trop*, 2016;159:176–84.
28. Lankford, B., Pringle, C., Dickens, C., Lewis, F., Chhotray, V., Mander, M., Goulden, M., Nxele, Z., Quayle, L. *The impacts of ecosystem services and environmental governance on human well-being in the Pongola region, South Africa*. University of East Anglia and Institute of Natural Resources. 2010.
29. Statistic South Africa (Stats SA). Annual Report. 2011. Available from: www.statssa.gov.za (accessed August 2020).
30. Braun, V., Clarke, C. Using thematic analysis in psychology. *Qualitative Research in Psychology*, 2006;3, 77-101.
31. Basit, T. Manual or electronic? The role of coding in qualitative data analysis. *Educational Research*, 2003;45 (2), 143–154.
32. King, N. Using interviews in qualitative research. *Essential Guide to Qualitative Methods in Organisational Research*. Sage, 2004;11-22.

33. Johnson, R.C., Boni, G., Barogui, Y., Sopoh, G.E., Houndonougbo, M., Anagonou, E., Agossadou, D., Diez, G., Boko, M. Assessment of water, sanitation, and hygiene practices and associated factors in a Buruli ulcer endemic district in Benin (West Africa). *BMC Public Health*, 2015;15:801.
34. Wardrop, N.A., Hill, A.G., Dzodzomenyo, M., Aryeetey, G., Wright, J.A. Livestock ownership and microbial contamination of drinking-water: Evidence from nationally representative household surveys in Ghana, Nepal and Bangladesh. *International Journal of Hygiene and Environmental Health*, 2018;221, 33–40.
35. Meeks, R.C. Water Works: The Economic Impact of Water Infrastructure. The Journal of Human Resource, 2017;5 2(4), 1119-1153.
36. Sikod, F. Gender Division of Labour and Women's Decision-Making Power in Rural Households in Cameroon. *Africa Development*, XXXII (3), 2007;58–71.
37. Geere, J.A., Cortobius, M. Who carries the weight of water? Fetching water in rural and urban areas and the implications for water security. *Water Alternatives*, 2017;10(2): 513-540.
38. Irianti, S., Prasetyoputra, P. The struggle for water in Indonesia: the role of women and children as household water fetcher. *Journal of Water, Sanitation and Hygiene for Development*, 2019;9(3), 540-548.
39. Sorenson, S.B., Morssink, C., Campos, P.A. Safe access to safe water in low-income countries: Water fetching in current times. *Social Science & Medicine*, 2011;72(9), 1522-1526. doi: https://doi.org/10.1016/j.socscimed.2011.03.010.
40. Mushaka, C., Maponga, T.F. Crux gender inequalities in household chores among full-time working married women aged 20-40: case of Gweru City Zimbabwe. *American International Journal of Research in Humanities*, Arts and Social Sciences, 2015;15-604; 271-276.
41. Harris, D., Wild, L. Finding solutions: making sense of the politics of service delivery. *Politics and governance*, 2013;1-7.
42. Haris, A.S., Hern, E. Taking to streets: protests as an expression of political preference in Africa. *Comparative Political Studies*, 2019;52(8), 1169-1199.
43. Akinboade, O.A., Mokwena, M.P., Kinfack, E.C. Protesting for Improved Public Service Delivery in South Africa's Sedibeng District. *Social Indicators Research*, 2014;119, 1–23. https://doi.org/10.1007/s11205-013-0377-9.
44. Mukheibir, P. Water Access, Water Scarcity, and Climate Change. *Environmental Management* 2010;45**,** 1027–1039.
45. Abedin, M.A., Collins, A.E., Habiba, U., Shaw, R. Climate Change, Water Scarcity, and Health Adaptation in Southwestern Coastal Bangladesh. *International Journal of Disaster Risk Science*, 2019;10, 28–42 (2019). https://doi.org/10.1007/s13753-018-0211-8.
46. Austin, E.K., Rich, J.J., Kiem, A.S., Handley, T., Perkins, D., Kelly, B.J. Rural Concerns about climate change among rural residents in Australia. *Journal of rural studies*, 2020;75, 98-109.
47. Radingoana, M.P., Dube, T., Mazvimavi, D. An assessment of irrigation water quality and potential of reusing greywater in home gardens in water-limited environments. *Physics and Chemistry of the Earth*, 2020;116, 102857.
48. Nhamo, G., Nhemachena, C., Nhamo, S. Is 2030 too soon for Africa to achieve the water and sanitation sustainable development goal? *Science of the Total Environment*, 2019;129–139.
49. Srivastav, A.L., Dhyani, R., Ranjan, M., Madhav, S., Sillanpää, M. Climate-resilient strategies for sustainable management of water resources and agriculture. *Environmental Science and Pollution Research*, 2021;28, 41576–41595. https://doi.org/10.1007/s11356-021-14332-4.
50. Arsiso, K.B., Tsidu, M.G., Hendrik, S.G., Tadesse, T. Climate change and population growth impacts on surface water supply and demand of Addis Ababa, Ethiopia. *Climate risk management*, 2017;18, 21-33.
51. Boretti, A., Rosa, L. Reassessing the projections of the World Water Development Report. *npj Clean Water*, 2019;2:15.
52. Tortajada, C., Biswas, K.A. Editorial: Infrastructure and development. *International Journal of Water Resources Development*, 2014;30(1), 3–7. https://doi.org/10.1080/07900627.2014.891927.
53. Adeniran, A., Daniell, K.A., Pittock, J. Water Infrastructure Development in Nigeria: Trend, Size, and Purpose. *Water*, 2021;13, 2416. https://doi.org/10.3390/w13172416.