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Impact of Urban Density on Water Resources Management in Informal Communities of Kabong District, Jos North Local Government Area

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ABSTRACT

Equitable access to safe and reliable water is a major concern in informal settlements, where high population density, limited infrastructure, and weak governance intensify water insecurity. This study examines the water management strategies employed by residents and the local authority in Kabong, focusing on their effectiveness in the context of dense population and informal settlement dynamics. A mixed-method approach was adopted for this study, with a cross-sectional survey conducted among 262 respondents. The selection of respondents was based on the Respondent-Driven Sampling technique due to the absence of official data on population, household listing, and the hidden nature of informal water vendors in Kabong, while purposive sampling was used to select 6 Key Informants for the interview. Results revealed that high population density, inadequate water infrastructure, power outages, poor management, limited income, and seasonal rainfall variability, among other factors, hamper resilient water resource management mechanisms that address both household and livelihood water needs in Kabong. The water infrastructure is dominated by boreholes (49.6%) and shallow hand-dug wells (17.9%); however, 77.4% of respondents indicated that the existing infrastructure was inadequate for community needs, with non-functional boreholes (43.1%), broken pipes (18.7%), and a combination of other issues (24.8%) being the most reported problems. Findings also showed that the management and maintenance of water infrastructure are fragmented, mainly handled by private entities (40.1%) or individual residents (25.2%), with only a few communities receiving minimal government support. Common coping strategies used by residents include reducing water use (35.9%), storing water (29.0%), and a combination of various methods (25.2%), though only 58.4% perceive these measures as effective. The study recommended integrated community-driven approaches supported by government interventions to improve water accessibility, reliability, and sustainable management in Kabong.

Keywords: Density, infrastructure, equitable, management, unsafe

INTRODUCTION

Urbanisation is increasingly influencing how water is produced, distributed, and consumed globally, particularly in rapidly growing cities of low and middle-income countries (UN-Water, 2023). As the urban population continues to grow, the pressure on water resources becomes critical, especially in informal settlements (Dijkstra, de Groot, & van der Meer, 2021) This situation is further intensified by the lack of formal infrastructure and governance frameworks, making it challenging to deliver reliable and safe water services to residents in such communities (Reddy & Sharma, 2023). For example, densely populated informal settlements with inadequate or absent piped water networks and sewage systems can lead to over-reliance on unsafe water sources, increasing the risk of waterborne diseases and other health-related risks (Patel & Smith, 2022). Moreover, the limited space in high-density areas prevents the implementation of traditional water management infrastructure, such as large-scale water treatment facilities, further complicating efforts to provide adequate water services (Lee & Kim, 2022).

The fast-growing nature and the absence of formal planning in informal settlements lead to overstraining the water supply systems, which are unable to meet the increasing demands, making it difficult to provide reliable and safe water (Dijkstra et al., 2021; Patel & Smith, 2022). Furthermore, the informal nature of the settlements

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leads to their exclusion from official urban planning and development initiatives, leaving them without the necessary infrastructure to support effective water management, including piped water networks, sewage systems, and stormwater drainage (Abah & Egwu, 2019). Similarly, water contamination is caused by high urban density resulting from poor sanitation and inadequate waste disposal systems, which often lead to the contamination of local water sources (Smit, Smith, & McLean, 2020).

Additionally, in Kabong and neighbouring informal districts, the topography and local geomorphology (granitic outcrops, shallow regolith) further restrict reliable groundwater abstraction and increase drilling costs, with urban density compounding the already difficult hydrogeological setting, resulting in water scarcity and poor sanitation (Ocheri, Onugba, & Atoma, 2014). Place-based research in Jos metropolis highlights the lived consequences, including long queuing times, high unit costs from vendors, spatial inequities tied to terrain and location, which push households toward expensive or unsafe options (Nanle, Benshak, & Mailumo, 2023; Bello & Oyebanji, 2020).

Despite policy emphasis on urban resilience, clean water, and sanitation (SDG 6), significant evidence gaps remain on how urban density, informal dynamics, in addition to the topography, alter the technical, economic and institutional pathways through which informal communities secure water (Nwachukwu, Anugwo, & Amadi, 2020). This study, therefore, investigates how urban density shapes water resource management, supply reliability, source status, the cost burden on households, and the institutional responses available or missing at the community and municipal levels.

LITERATURE REVIEW

As cities continue to expand due to population growth and rural-urban migration, pressure on water systems increases, especially in informal settlements where infrastructure is often inadequate. The high concentration of residential, commercial, administrative, and industrial activities also amplifies the demand for water in urban areas because densely populated areas frequently experience higher water withdrawal rates, which can strain available resources (World Resources Institute, 2020). For example, in urban areas like Lagos and Nairobi, the water demand has outpaced supply, leading to severe water shortages and over-reliance on unsafe sources (WHO & UNICEF, 2021; Adeniyi, Ogunwumi, & Alabi, 2021).

The distribution of water is increasingly becoming complex in high-density areas because the water infrastructure often fails to keep up with rapid urbanisation, resulting in unequal access to water resources (Ademiluyi & Odugbesan, 2020). Informal communities face the greatest challenges due to the lack of investment in water infrastructure, causing residents to resort to alternative sources, such as water vendors, which are not only expensive and unreliable but also unsafe. For instance, a study by Da Silva, Lucas, & Thompson (2019) on informal settlements in Nairobi, Kenya, revealed that high population density coupled with inadequate infrastructure led to severe water shortages and increased reliance on unsafe water sources. More findings have been reported in other densely populated informal settlements across Africa and Asia facing water scarcity and poor water quality (Satterthwaite, Archer, Colenbrander, Dodman, Hardoy, et al., 2020; Smit, Smit, & McLean, 2020).

Informal settlements are repeatedly excluded from official urban planning and development programs. This exclusion from formal governance structures leaves residents to manage water and other resources on their own, resulting in inadequate water supply systems, sewage networks, etc. Similarly, these settlements are characterised by unregulated development and a lack of proper sanitation facilities, often leading to the contamination of surface and groundwater resources (Ezeh, Oyebode, Satterthwaite, Chen, Ndugwa, et al., 2022).

The situation in Kabong and most parts of Jos is similar to other informal settlements the world over. Studies by Audu, Wazis, & Suleiman (2020) have shown that water infrastructure development lags behind the expansion of informal settlements in Jos, leading to significant disparities in access to safe and reliable water. The Plateau State Water Board (PSWB), responsible for the state's water supply, has, however, struggled in keeping up with the growing demand for water in these high-density, rocky areas, particularly due to limited financial resources and outdated infrastructure (Gyang & Akpan, 2019).

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Furthermore, factors such as poverty, education, and access to resources play a big role in water resources management. Residents often lack the financial means to invest in private water solutions or proper sanitation facilities, making them dependent on unsafe and unreliable water sources (Ezeh et al., 2020). Additionally, low levels of education and awareness about safe water practices and hygiene contribute to the spread of waterborne diseases (Nkuna, Madonsela, & Nzimande, 2019).

The hilly terrain and rocky landscape of Kabong limit groundwater recharge, making it difficult to access enough water through wells and boreholes (Nwachukwu et al., 2020; Agada & Ijeoma, 2021). Furthermore, seasonal variations such as the dry season intensify water scarcity, and the rainy season often leads to flooding, resulting in the contamination of water sources and damaging the limited infrastructure in most cases (Ochonma & Oghenero, 2021). Therefore, addressing the challenges of water resources management in informal settlements requires a multi-faceted approach that includes enhancing governance, improving infrastructure, and raising awareness about safe water practices.

The Hydrosocial Cycle Framework

This theory conceptualises water not simply as a biophysical resource but also as a *socionatural construct* shaped by the interactions of ecological systems, infrastructure, governance, and social practices (Linton & Budds, 2014). Access to safe and adequate water is produced through a complex interplay of population density, institutional arrangements, market actors, and everyday coping strategies of households in the context of informal communities (Popartan, 2023; Rodríguez, 2024).

The hydrosocial framework is particularly relevant to Kabong because it provides a means for addressing the objectives of this study, where rapid urban density and informal settlement dynamics intensify the strain on water infrastructure. It identifies and assesses water sources within physical and social domains, recognising that boreholes, wells, and vendor systems are embedded in power relations and informal governance arrangements. This theory also links the safety and adequacy of water to institutional maintenance and household management practices, acknowledging that contamination and unreliability often reflect governance gaps rather than natural scarcity (Keough, 2021). Furthermore, it highlights how population density, coping mechanisms, and fragmented governance reshape water infrastructure and inequitable access, thereby informing proposed interventions that integrate technical innovation with community-driven governance (Ricart, 2023).

Thus, this framework enables this study to go beyond a technical evaluation of water infrastructure to interrogate the socio-political processes that connect water access, safety, and equity in water management within Kabong.

Research Aim And Objectives

This study aims to investigate the impact of urban density on water resources management in Kabong, an informal settlement in Jos North LGA, with the following objectives;

1. To identify and assess the primary sources of water in Kabong.
2. To determine the safety and adequacy of the water sources.
3. To examine the effects of high population density on water infrastructure in the study area.
4. To evaluate the strategies employed by residents and local authorities in managing water infrastructure and their effectiveness.
5. To propose interventions that could improve water resources management in informal settlements.

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METHODOLOGY

Research Design

Kabong is an unplanned settlement situated within Jos North Local Government Area of Plateau State, predominantly inhabited by low-income earners with a diverse demographic profile (Audu et al., 2020). Informal settlement patterns characterise Kabong and are undergoing rapid population growth, like many urban areas in Nigeria (Gyang & Akpan, 2019). The settlement is also known for its rocky terrain and high population density, which contribute to various urban challenges, including inadequate housing, poor sanitation, and limited access to basic services.

This research integrates both quantitative and qualitative methods (Creswell & Plano, 2018). However, due to the absence of an official household listing and the hidden nature of informal water vendors in Kabong, probability-based sampling methods were not feasible. Hence, the Respondent-Driven Sampling (RDS) approach was adopted to select 262 households for the survey. The RDS enables access to hidden populations through peer recruitment, allowing a more systematic chain-referral process than simple snowball sampling. The method has also been widely applied in urban informal settlements where hidden groups lack census records (Johnston, Hakim, Dittrich, Burnett, Kim, & White, 2021).

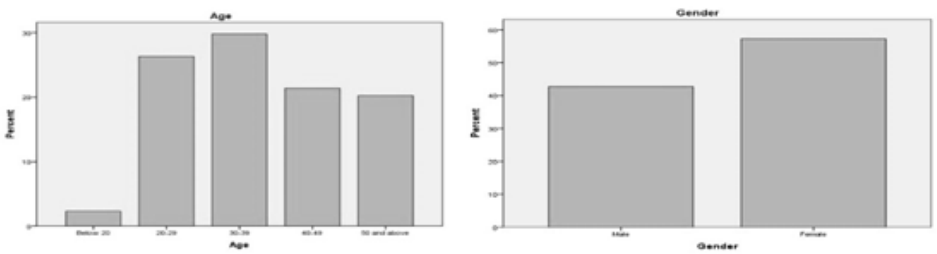
Sampling Technique

The purposive random sampling was employed to select three (3) communities/nodal points within Kabong (consisting of Kabong Central, Angwan Mata, and Angwan Chaweh) based on criteria such as population density, water scarcity issues, and informal settlement dynamics, while households were randomly selected within each stratum to ensure a fair representation and minimise sampling bias (Kumar, 2019). A total of 262 structured questionnaires were randomly administered, and semi-structured questionnaires were used for the six Key Informant Interviews (6 KIIs), consisting of community leaders, water vendors, and officials from the local Plateau State Water Board. The discussions were audio-recorded, transcribed and analysed. The descriptive statistical analysis, such as frequencies and percentages, was used to summarise data using SPSS 20, and transcripts from interviews were analysed using NVivo 16.

RESULTS

The demographic profile of respondents in Kabong consists of predominantly young and active population, aged between 30–39 years (29.8%), followed closely by 20–29 years (26.3%), which suggests a high demand for water resources, as younger and middle-aged adults are typically engaged in activities that require regular use of water. Additionally, the gender distribution of respondents reveals a slightly higher proportion of females (57.3%) compared to males (42.7%), which has implications for water management, as women are often the primary managers of household water in informal settlements, as shown in Fig. 1(i & ii).

Figure 1(I & ii). Age and Sex Distribution



Source: Author's Research Findings, 2025

Table 1. Marital Status

Marital Status	Frequency	Percentage

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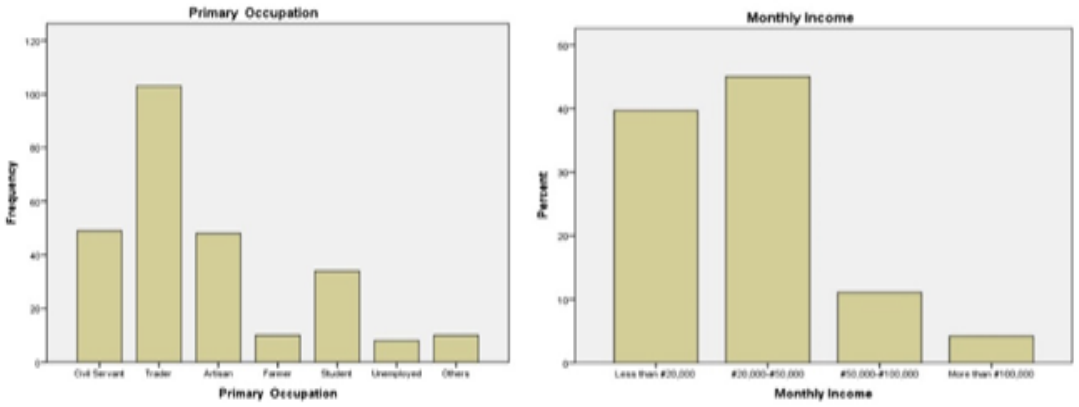
Single	84	32.1
Married	161	61.5
Divorced	7	2.7
Widowed	9	3.4
Others	1	4
Total	262	100.0

Source: Author's Research Findings, 2025

Similarly, the majority of respondents are married (61.5%), which can intensify water demand due to larger household sizes (Table 1), while the occupational status indicates that 39.3% of the residents are traders, followed by civil servants (18.7%) and artisans (18.3%), indicating a mixed economic base with both formal and informal employment. Consequently, the income levels reflect economic vulnerability, with 84.7% of respondents earning less than ₦50,000 per month. This limited income base may restrict household capacity to invest in water storage, purification, or alternative supply systems, making affordable, community-managed solutions crucial (Fig. 2i and ii). The high population density, economic diversity, and limited income further stress the need for equitable, resilient, and gender-sensitive water resource management strategies in Kabong.

Figure 2 (I & ii). Occupation and Monthly Income



Source: Author's Research Findings, 2025

Additionally, responses from the interviews indicated that residents highly depend on multiple sources for water supply in the area, with more than half of respondents (55.3%) relying on a combination of boreholes, wells, public taps, stream, and water vendors to meet daily needs, see Fig. 3. While this diversification reflects community adaptability, it also points to inadequacies in any single water source. Although results from the KIIs revealed that boreholes are the most common standalone infrastructure, frequent power outages, occasional borehole failures (43.1%), and frequent infrastructure failures (78.5%) show significant maintenance and reliability problems (Table 2).

Safe and adequate water supply is a matter of concern, with only 11.5% of respondents rating their main source as "very reliable/adequate," and 64.9% have observed contaminations in the commonly unpleasant taste, smell, colouration, or a combination of more than one factor, as shown in Figs. 3, 4 and Tables 2 & 3. Despite these risks, 55% of the households do not treat water before consumption, and 39.7% report experiencing health challenges such as typhoid, cholera, and diarrhoea. Quality perceptions skew towards the moderate range, with 42.7% rating water as "good" and 18.7% describing it as "poor."

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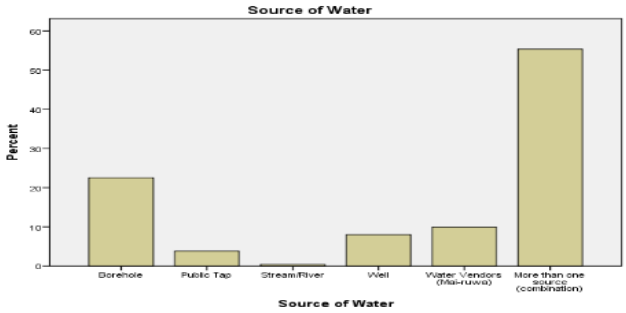
Figure 3: Water Sources



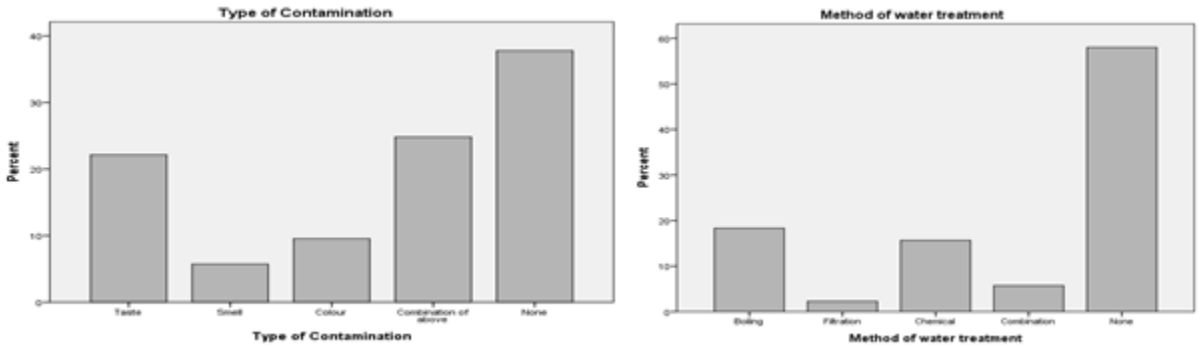
Source: Author's Research Findings, 202.

Table 2. Reliability/Adequacy of Water Sources

Reliability/Adequacy	**Frequency**	**Percent**
Very reliable/adequate	30	11.5
Moderately reliable/adequate	115	43.9
Rarely reliable/adequate	55	21
Reliable but not adequate	34	13
Adequate but not reliable	3	1.1
Not reliable/not adequate	25	9.5
Total	262	100

Source: Author's Research Findings, 2025

Figure 4(i & ii). Type of Water Contamination and Methods of Treatment:



Source: Author's Research Findings, 2025

Table 3. Water Quality Health Risks

Health-Risks	**Frequency**	**Percent**

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Typhoid	100	38.2
Cholera/Diarrhoea	4	1.5
All	47	17.9
None	111	42.4
Total	262	100

Source: Author's Research Findings, 2025

High population density, reflected in large household sizes (39.3%) with 7–9 members and 18.3% with 10 or more, see Table 4, exacerbates pressure on the already strained infrastructure, resulting in the high cost of water ranging from N60 – N100 per 20 liters jerrican depending on the distance from the water source, demand and season of the year. Most residents adopt strategies like reduced consumption (35.9%), storage (29%), and water reuse (4.2%) to cope with water scarcity. However, these strategies are only moderately effective, with just 23.3% describing them as "very effective."

Table 4. Household Size

Household Size	**Frequency**	**Percent**
1-3	55	21
4-6	56	21.4
7-9	103	39.3
10 and above	48	18.3
Total	262	100

Source: Author's Research Findings, 2025

Boreholes are the predominant water infrastructure in Kabong (49.6%), followed by shallow hand-dug wells (17.9%) and mixed systems (27.9%), Table 4 & 5. However, 77.4% of respondents reported that the existing infrastructure is highly inadequate for a community with such a high population.

Table 5. Water Infrastructures

Adequacy	**Frequency**	**Percent**
Yes	59	22.5
No	202	77.1
Total	261	99.6
Missing	1	.4
Total	262	100.0

Source: Author's Research Findings, 2025

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Infrastructure failure is a significant challenge, and its management is largely undertaken by private entities (40.1%) and individual residents (25.2%), with government involvement reported by only 11.1% of respondents. The physical condition of the infrastructure is rated as poor (22.9%) or abysmal (25.2%), as shown in Tables 6 &7.

Table 6. Infrastructure Failure/Damage

Type of Breakdown	**Frequency**	**Percent**
Broken pipes	49	18.7
Rusted and blocked pipes	27	10.3
Non-functional boreholes	113	43.1
A combination of the above	65	24.8
None	8	3.1
Total	262	100.0

Source: Author's Research Findings, 2025

Table 7. State of Water Infrastructure

State of Infrastructure	**Frequency**	**Percent**
Very Good	14	5.3
Good	60	22.9
Fair	62	23.7
Poor	60	22.9
Very poor	66	25.2
Total	262	100.0

Source: Author's Research Findings, 2025

Respondents suggested that the government construct more water sources (45.4%) by drilling additional solar-powered boreholes (34.0%) due to the unstable power supply in the area, to improve access to safe water. Overall, while local strategies exist, the high rates of infrastructure inadequacy and failure indicate a pressing need for coordinated investment, improved maintenance, and stronger government involvement to ensure sustainable water access.

Table 8. Managers of Water Infrastructures

Owners/Managers	Frequency	Percent
Government	29	11.1
Private	105	40.1

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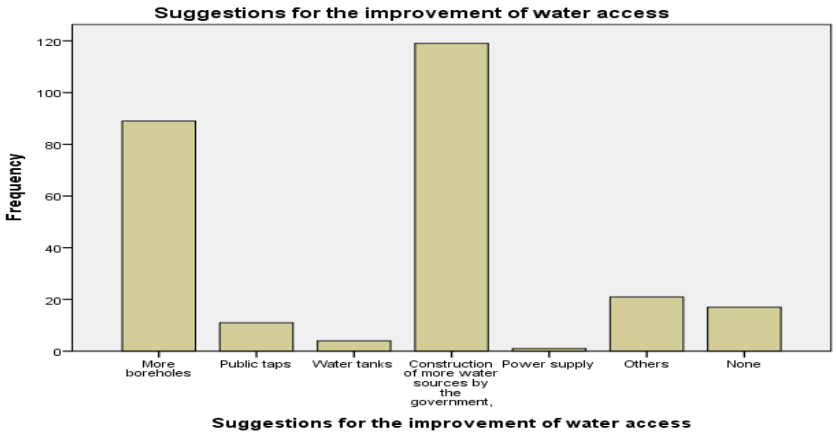
Individual residents	66	25.2
CBOs	45	17.2
Combination	17	6.5
Total	262	100.0

Source: Author's Research Findings, 2025

Figure 5. Improvement of Water Access:



Source: Author's Research Findings, 2025

CONCLUSION

Kabong residents employ various adaptive measures, including water storage and reduced consumption, to manage water scarcity, although perceived as inefficient in addressing the challenges in water provision. However, inadequate water infrastructure, unstable power supply, and persistent infrastructure failures significantly heighten the vulnerability of the community's water supply system, leading to unequal access. These local findings align with broader patterns in Nigerian informal settlements, where residents bear disproportionate responsibilities for securing water amid institutional neglect (Nchor & Ukam, 2024; IWSA, 2023).

RECOMMENDATIONS

1. Engage the Plateau State Water Board and local governments in rehabilitating and expanding water infrastructure in Kabong to shift from reliance on private/resident-led management to institutional support.

2. Prioritise repair and maintenance of non-functional boreholes and replacement of broken or rusted pipelines to ensure a consistent supply.

3. Promote collaborative management between government agencies, private operators, and community-based organisations to ensure sustainability and equitable access.

4. Address electricity shortages affecting borehole pumping to enhance water supply reliability.

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REFERENCES

1. Abah, R. C., & Egwu, S. O. (2019). Challenges of urban water supply in Nigeria: A case studyof Jos, Plateau State. Journal of Environmental Management and Safety, 10(1), 87101. https://doi.org/10.5897/JEMS2019.0310
2. Ademiluyi, I. A., & Odugbesan, J. A. (2020). Challenges of urban water supply in Sub-Saharan Africa: A case study approach. Journal of Urban Studies, 34(2), 123–135.
3. Adeniyi, O., Ogunwumi, O., & Alabi, T. (2021). Water quality and access in Makoko, Lagos: Addressing the challenges of urban water management in informal settlements. Water International, 46(4), 533 - 547. https://doi.org/10.1080/02508060.2021.1935814
4. Agada, P. O., & Ijeoma, O. (2021). Water scarcity and urban resilience in Jos, Plateau State, Nigeria. Water Resources Management, 35(5), 1587-1602. ttps://doi.org/10.1007/s11269-021-02823-y among the Residents of Informal Settlement in Jos Metropolis, Nigeria. Afropolitan Journals, 11(1),67–81.
5. Audu, M. D., Wazis, H. C., & Suleiman, I. (2020). Water quality assessment and health risks in Angwan Rukuba, Jos, Plateau State, Nigeria. Environmental Monitoring and Assessment, 192(3), 156. https://doi.org/10.1007/s10661-020-08153-2
6. Bello, A. R., & Oyebanji, O. A. (2020). Spatial inequalities in access to potable water supply in Jos, Nigeria. Journal of Geography and Regional Planning, 13(3), 41–51. https://doi.org/10.5897/JGRP2019.0774
7. Creswell, J. W., & Plano Clark, V. L. (2018). Designing and Conducting Mixed Methods Research (3rd ed.). SAGE Publications.
8. Da Silva, J., Lucas, K., & Thompson, M. (2019). The challenges of water management in informal settlements: A case study of Nairobi, Kenya. Water Policy, 21(1), 45-60. https://doi.org/10.2166/wp.2018.192
9. Dijkstra, L., de Groot, W., & van der Meer, J. (2021). Urban density and water resource management in informal settlements. Urban Studies Research, 2021, 1-15. https://doi.org/10.1155/2021/8803294
10. Ezeh, A., Oyebode, O., Satterthwaite, D., Chen, Y.-F., Ndugwa, R., Sartori, J., ... & Lilford, R. J. (2020). The history, geography, and sociology of slums and the health problems of people who live in slums. The Lancet, 389(10068), 547-558. https://doi.org/10.1016/S0140 6736(16)31650-6
11. Ezeh, C., Adebayo, S., & Madu, E. (2022). Impacts of informal settlements on water quality in African cities: A review. Environmental Research, 15(6), 231–245.
12. Gyang, J. D., & Akpan, E. A. (2019). The impact of urbanisation on water resources in Jos, Plateau State, Nigeria. Urban Water Journal, 16(4), 267-275. https://doi.org/10.108
13. IWSA. (2023). Water infrastructure sustainability in Nigeria: A systematic review. Water Supply, 25(11).
14. Johnston, L. G., Hakim, A. J., Dittrich, S., Burnett, J., Kim, E., & White, R. G. (2021). Emerging Approaches to sampling hidden populations in public health research: A scoping review. Public Health, 191, 149–156.
15. Keough, S. B. (2021). Water delivery and the creation of hydrosocial routes: House-to-house water delivery in Niamey, Niger. Journal of Hydrology, [volume], [pages].
16. Kumar, R. (2019). Research Methodology: A Step-by-Step Guide for Beginners (5th ed.). SAGEPublications.
17. Lee, J., & Kim, H. (2022). Technological innovations for water management in informal communities: A review. Water Research, 201, 117-129. https://doi.org/10.1016/j.watres.2021.117415
18. Linton, J., & Budds, J. (2014). The hydrosocial cycle: Defining and mobilising a relational–dialectical approach to water. Geoforum, 57, 170–180.
19. Nanle, V. Y., Benshak, A. B., & Mailumo, A. S. (2023). Exploring the State of Municipal Water Supply Infrastructure: Towards a Sustainable Water Provision in Informal Settlements of Jos Metropolis, Nigeria. Afropolitan Journals, 14(2), 110–123.
20. Nchor, J. U., & Ukam, L. E. (2024). Decreasing access to water and coping strategies for shortage in the informal settlements of Calabar, Nigeria. Sustainability, 16(11), 4603. https://doi.org/10.3390/su16114603

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue VIII August 2025

21. Nkuna, Z., Madonsela, B., & Nzimande, N. (2019). Community engagement in informal settlements: A case study of Durban, South Africa. Journal of Urban Affairs, 41(6), 744- 763. https://doi.org/10.1080/07352166.2018.1470913
22. Nwachukwu, C. M., Anugwo, M. N., & Amadi, A. N. (2020). Water supply challenges in peri-urban settlements of Nigeria: Case study of Jos metropolis. International Journal of Environmental Studies, 77(2), 312–327. https://doi.org/10.1080/00207233.2019.1687029
23. Ocheri, M., Onugba, A., & Atoma, C. N. (2014). Hydrogeological and geotechnical characteristics of Jos Plateau and implications for groundwater development. Journal of Geology and Mining Research, 6(3), 51–60. https://doi.org/10.5897/JGMR2013.0192
24. Ochonma, L. O., & Oghenero, D. E. (2021). Health impacts of waterborne diseases in informal settlements in Jos, Nigeria. Journal of Water, Sanitation and Hygiene for Development, 11(2), 199-207. https://doi.org/10.2166/washdev.2021.190
25. Patel, R., & Smith, A. (2022). Challenges and solutions for water management in informal urban settlements. Journal of Urban Planning and Development, 148(3), 04022014. https://doi.org/10.1061/JUPDDM.0000657
26. Popartan, L. A. (2023). The urban hydrosocial cycle: Why should engineers care? Open Research Europe, 3(23), 1–15.
27. Reddy, B., & Sharma, P. (2023). Infrastructure development for water management in high-density informal communities. International Journal of Water Resources Development, 39(1), 58-73. https://doi.org/10.1080/07900627.2023.2048376
28. Ricart, S. (2023). Reinforcing the hydrosocial cycle to foster water governance: A perspective. Frontiers in Agronomy, 5, 1146262.
29. Rodríguez, C. (2024). The hydrosocial cycle and inequalities in access to urban water: A case from Santiago.Water, 16(19), 2811.
30. Satterthwaite, D., Archer, D., Colenbrander, S., Dodman, D., Hardoy, J., Mitlin, D., & Patel Smit,B., Smit, B., & McLean, R. (2020). Water contamination and health risks in informal urban settlements: A global perspective. Environmental Research Letters, 15(7), 074021. https://doi.org/10.1088/1748-9326/ab9d5b
31. Smit, B., Smit, B., & McLean, R. (2020). Water contamination and health risks in informal urban settlements: A global perspective. Environmental Research Letters, 15(7), 074021. https://doi.org/ 10.1088/ 1748-9326/ab9d5b
32. UN-Water. (2023). SDG 6 synthesis report on water and sanitation 2023: A global blueprint for acceleration. UN-Water. https://www.unwater.org/publications/sdg-6-synthesis-report 2023
33. WHO & UNICEF. (2021). Progress on drinking water, sanitation, and hygiene in urban areas: 2021 update. Geneva: World Health Organisation.
34. World Resources Institute. (2020). The state of urban water security in developing nations. Urban Water Review, 20(1), 12–29.