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Assessment of the Determinants of Domestic Water Supply Scarcity in Keffi, Nasarawa State, Nigeria

Adamu Abubakar; N. M. Idris; M. A. Eya; U. A. Oseshi; & A. S. Ogah

Department of Urban and regional planning, Nasarawa State University, keffi, Nigeria
Department of Geogrphy, Nasarawa State University, Keff, Nigeria.
Corresponding Author: adamuogahjnr@gmail.com
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Abstract

This study assessed the determinants of domestic water supply scarcity in Keffi, Nasarawa State, Nigeria. The study was motivated by persistent challenges associated with inadequate, irregular and restricted access to domestic water among households in the study area. A descriptive survey research design was adopted, and data were collected from 311 respondents using a structured questionnaire, complemented by field observations of selected wells and boreholes. Descriptive statistics, particularly frequencies and percentages, were used to analyse the data, while the findings were presented in tables and figures. The results showed that poverty/low household income was the leading factor responsible for domestic water scarcity, accounting for 46.9% of responses, followed by lack of pipe-borne water supply (35.4%), irregular supply from boreholes (15.8%) and poor alternative water sources (1.9%). The study further established that water scarcity was predominantly an all-year-round problem, as reported by 57.56% of respondents, while 42.44% regarded it as seasonal. Access to wells and boreholes was also concentrated within limited morning periods, with no respondents reporting 24-hour accessibility, while queues and congestion were commonly experienced at available water points. These findings demonstrate that domestic water scarcity in Keffi was influenced by a combination of economic, infrastructural and accessibility-related factors, rather than by physical water availability alone. The study concluded that improving domestic water security requires expansion and rehabilitation of pipe-borne water infrastructure, improvement in the reliability and operational capacity of boreholes, regular maintenance of existing facilities, and measures to enhance the affordability of water for low-income households. The study recommends that relevant government agencies and stakeholders should adopt an integrated and sustainable water-supply strategy that addresses both the infrastructural deficiencies and socioeconomic constraints affecting household access to domestic water in Keffi.

Keywords: Determinants, Domestic water, Water supply, Scarcity, Keffi LGA, Nasarawa State.

Introduction

Water is a fundamental resource for human survival, household hygiene, public health, and socioeconomic development, making reliable access to adequate domestic water an essential component of sustainable communities. However, many urban and peri-urban settlements in developing countries continue to experience inadequate, irregular, and unequal water supply due to the interaction of demographic, infrastructural, economic, institutional, and environmental factors. Cominola et al. (2023) noted that household water demand and consumption are influenced by a combination of socioeconomic characteristics, household conditions, climatic factors, and water-service attributes, demonstrating that domestic water challenges cannot be explained by a single factor. Similarly, the World Health Organization and UNICEF Joint Monitoring Programme (WHO/UNICEF JMP, 2021) emphasized that inequalities in household water services persist across income groups and geographical locations, with affordability and service reliability constituting important dimensions of water access.

In Nigeria, domestic water supply remains a significant urban development challenge despite the availability of surface and groundwater resources. Population growth, rapid urbanization, inadequate water infrastructure, unreliable public water systems, high dependence on privately developed boreholes, rising household demand, and limited institutional capacity can collectively constrain the availability of reliable domestic water. Environmental and climatic variability may further affect water resources, particularly through changing rainfall patterns and periods of drought (Ogunjo et al., 2018). At the local level, evidence from Keffi and neighbouring areas indicates that groundwater constitutes an important source of domestic water, while concerns regarding the suitability and quality of water from different sources have also been documented (Daniel et al., 2020).

Keffi, a rapidly developing urban centre in Nasarawa State, provides an important setting for examining the determinants of domestic water supply scarcity. Increasing residential development and household demand may place additional pressure on existing water infrastructure and available sources. Consequently, households may depend on alternative sources when conventional supplies are inadequate, potentially increasing the time, financial cost, and effort required to obtain water. The problem therefore extends beyond the physical availability of water to include questions of accessibility, affordability, reliability, infrastructure, household socioeconomic conditions, and institutional effectiveness. Against this background, this study seeks to assess the determinants of domestic water supply scarcity in Keffi, Nasarawa State, Nigeria, with a view to identifying the major factors responsible for inadequate domestic water supply and providing evidence that can support more effective water-resource planning and service delivery.

STATEMENT OF THE PROBLEM

Access to adequate, safe and reliable domestic water supply is essential for human health, household welfare and sustainable community development. Water is required for drinking, cooking, bathing, washing, sanitation and other household activities. However, despite the importance of water to human well-being, many urban centres in developing countries continue to experience inadequate and unreliable domestic water supply. The problem is particularly significant in rapidly growing towns where population increase, urban expansion and

increasing demand for water place pressure on existing water supply infrastructure.

Keffi Local Government Area of Nasarawa State has experienced considerable population growth and urban expansion over the years. The town serves as an important educational, commercial and residential centre, resulting in increasing demand for domestic water. However, the availability of reliable water supply to households remains a major concern. Many residents depend on alternative sources such as privately owned boreholes, hand-dug wells, water vendors, streams and other sources to meet their domestic water needs. These alternatives may be inadequate, expensive, seasonal or exposed to contamination, thereby creating difficulties for households, particularly those with limited financial resources.

The scarcity of domestic water in Keffi may be influenced by several interconnected factors. These may include inadequate water supply infrastructure, irregular operation of public water schemes, rapid population growth, increasing household demand, poor maintenance of water facilities, unreliable electricity supply, financial constraints, seasonal variations in water availability and the physical characteristics of available water sources. In addition, differences in household income and location may influence the ability of residents to access and afford alternative water sources. However, the relative contribution of these factors to domestic water supply scarcity in Keffi has not been adequately established.

OBJECTIVES

· Identify and assess the major sources of domestic water supply available to households in Keffi;
· Examine the level and pattern of domestic water supply scarcity among households in the study area.

RESEARCH QUESTIONS

· What are the major sources of domestic water supply available to households in Keffi?
· What is the level and pattern of domestic water supply scarcity among households in the study area?

MATERIALS AND METHODS

Keffi L.G.A is an historic town located in Nasarawa State, North Central Nigeria between latitudes 8^0 51^1 and 8^0 53^1 North of the equator and longitudes 7^0 50^1 and 7^0 51^1 East of the Greenwich meridian. The area is surrounded by Karu and Kokona L.G. As all of Nasarawa State. Keffi is located about 128km away from Lafia, the Nasarawa State Capital and about 57km away from Abuja, the Federal Capital Territory of Nigeria. Keffi is the smallest L.G.A in the whole of Nasarawa State with a total land area of approximately 140km^2. In compares Keffi is about 20 times smaller than Awe, Doma, Karu, Lafia and Toto L.G. As and about 41 times smaller than Nasarawa L.G.A, the largest in the State.

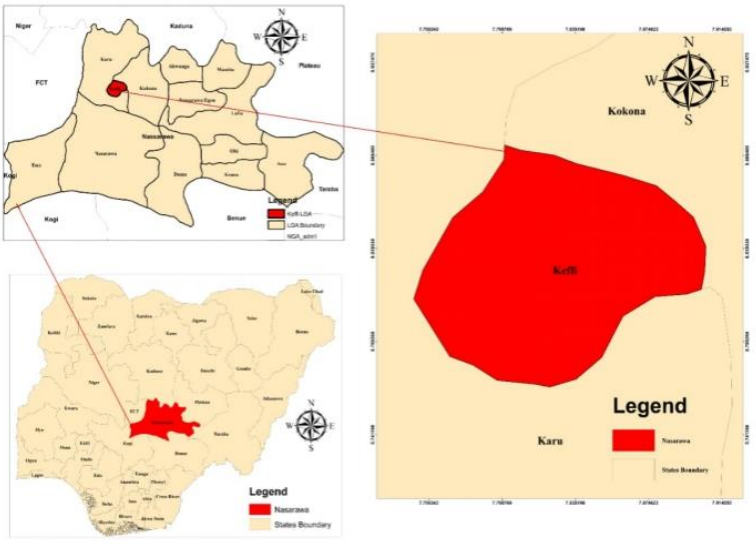


Figure 1: The Study Area.

Source: Archive of Department of Urban and Regional Planning

The study adopted a descriptive survey research design to assess the determinants of domestic water supply scarcity in Keffi, Nasarawa State, Nigeria. The study population comprised households/residents within Keffi metropolis who relied on one or more domestic water sources. A sample of 311 respondents was selected from the study population using an appropriate sampling procedure to ensure adequate representation of residents across the study area. Primary data were collected through a structured questionnaire administered to selected respondents, while field observation was used to obtain additional information on the condition, accessibility and use of wells, boreholes and other domestic water sources. The questionnaire contained questions on household water sources, frequency and accessibility of supply, seasonal variation, factors responsible for scarcity, waiting time and congestion at water points, and the challenges experienced by residents in obtaining domestic water. Direct field observations were also undertaken to document the physical conditions of selected water facilities, while relevant secondary information was obtained from scholarly publications, government documents and other reliable sources relating to domestic water supply and scarcity.

The data collected from the respondents were coded, organized and analyzed using descriptive statistical techniques, particularly frequency counts and percentages. The results were presented using tables, figures and charts to facilitate clear interpretation of the major patterns emerging from the responses. The analysis focused on identifying the principal determinants of domestic water scarcity, the extent to which scarcity occurred throughout the year or seasonally, the periods during which water sources were accessible, and the occurrence of queues and congestion at water collection points. Field observations were used to complement the questionnaire findings and provide contextual evidence concerning the operation and accessibility of wells and boreholes.

Factors Responsible for the Domestic Water Supply Scarcity

The findings presented in Table 1 indicate that poverty or low household income was the most prominent factor responsible for domestic water supply scarcity, as reported by 146 respondents, representing 46.9% of the total respondents. This suggests that the capacity of households to obtain adequate domestic water was substantially influenced by their economic circumstances. Low-income households may be unable to afford the costs associated with privately provided water, including payments to water vendors, borehole charges, construction of wells, pumping costs and water-storage facilities. This finding is consistent with the study of Aluko et al. (2022), which examined household water security in Osun State, Nigeria, and found that household characteristics and socioeconomic conditions were important predictors of water security. The result also agrees with the more recent assessment of domestic water access in Keffi by Adamu and Eya (2026), which found a statistically significant relationship between household income and access to improved water sources, with income emerging as the strongest predictor of water accessibility. Although the latter study was published after the 2024 field survey, its findings provide particularly strong local evidence supporting the present result that economic inequality can constrain household access to reliable water services.

The second major factor identified was lack of pipe-borne water supply, reported by 110 respondents (35.4%), while 49 respondents (15.8%) identified irregular supply from boreholes. Together, these findings demonstrate the important role of inadequate and unreliable water infrastructure in explaining domestic water scarcity in the study area. The relatively high proportion identifying lack of pipe-borne water suggests that many households depend on alternative sources because formal public water infrastructure does not adequately meet domestic demand. This observation is consistent with Oyesanmi

(2023), whose study of household water consumption in Lokoja found that households depended on a combination of pipe-borne water, wells, rivers and mechanized boreholes, reflecting variations in the availability and reliability of water sources. Similarly, Adamu and Eya (2026) reported that government water supply accounted for only 14.1% of household water sources in Keffi, while boreholes, private piped connections and vendors constituted the dominant sources; only 20.9% of households reported receiving water daily. These findings closely correspond with the present study and suggest that dependence on alternative sources is partly a consequence of weaknesses in formal water-supply infrastructure and service reliability.

The findings show that economic and infrastructural constraints were the dominant determinants of domestic water supply scarcity in Keffi, with poverty/low income and lack of pipe-borne water jointly accounting for 82.3% of responses. The relatively low proportion of respondents (1.9%) who identified poor alternative water sources suggests that alternative sources were available to some extent, but their availability did not necessarily eliminate scarcity because affordability and reliability remained important constraints. The reliance on boreholes as an alternative source is particularly significant in Keffi, where Daniel et al. (2020) examined groundwater from boreholes and hand-dug wells and demonstrated the importance of these sources for domestic water supply in Keffi and Karu. However, dependence on groundwater does not automatically guarantee adequate domestic water access, particularly where supply is irregular or households cannot afford the associated costs. The evidence therefore suggests that reducing domestic water scarcity in Keffi requires a combined approach involving expansion and rehabilitation of pipe-borne water infrastructure, improvement of the reliability of existing borehole systems, and policies that make domestic water services more affordable to economically disadvantaged households.

Table 1: Factors Responsible for Domestic Water Supply Scarcity in the Study Area

S/N	Factors Responsible for Water Scarcity	Frequency (f)	Percentage (%)	Rank
1	Poverty/low household income	146	46.9	1st
2	Lack of pipe-borne water supply	110	35.4	2nd
3	Irregular supply from boreholes	49	15.8	3rd
4	Poor alternative water sources	6	1.9	4th
Total		**311**	**100.0**	

Source: Field Survey, 2026.

Seasonality of the water scarcity

The findings in Table 2 indicate that domestic water supply scarcity in the study area was predominantly perceived as an all-year-round problem, with 179 respondents representing 57.56% reporting that households experienced water scarcity throughout the year. This finding suggests that water scarcity in Keffi was not merely a temporary phenomenon associated with particular seasons but constituted a persistent challenge affecting household access to domestic water. The result is consistent with Adamu and Eya (2026), who reported that access to reliable domestic water supply in Keffi remained limited, with only a relatively small proportion of households receiving government water supply on a daily basis. Their finding that households relied substantially on boreholes, private piped connections and water vendors further supports the present observation that formal water provision may be inadequate to meet household demand throughout the year. Similarly, Aluko et al. (2022) found that household water security in Osun State was influenced by socioeconomic and environmental conditions, indicating

that water insecurity can persist beyond specific periods of the year when underlying supply constraints remain unresolved.

However, 42.44% (132 respondents) reported that domestic water scarcity was seasonal, indicating that a substantial proportion of households experienced greater difficulty obtaining water during particular periods of the year. This result demonstrates that although year-round scarcity was more widely reported, seasonal variations remained an important dimension of the water-supply problem. Seasonal scarcity may be associated with changes in rainfall, groundwater recharge, water-source yield and household demand. During periods of reduced rainfall, some surface and shallow groundwater sources may become less productive, thereby increasing household dependence on boreholes and other alternative sources. This finding corresponds with Ogunjo et al. (2018), who documented the occurrence and spatial variability of drought conditions across different climatic zones of Nigeria, highlighting the potential influence of climatic variability on water availability. It also agrees with Oyesanmi (2023), who found that households in Lokoja depended on multiple water sources because the availability and reliability of individual sources varied, demonstrating the importance of temporal and infrastructural variations in determining household water access.

The findings indicate that domestic water scarcity in Keffi had both persistent and seasonal characteristics, although the persistent dimension was more dominant. The fact that more than half of the respondents identified scarcity as an all-year-round problem suggests that the major challenge was rooted in structural deficiencies in water supply rather than seasonal fluctuations alone. At the same time, the substantial proportion reporting seasonal scarcity indicates that climatic and hydrological variations may intensify an already existing water-supply deficit during particular periods. This finding has important implications for water-resource planning in Keffi because interventions should not focus exclusively on emergency responses during dry periods but should also address the underlying infrastructure and service-delivery deficiencies responsible for persistent scarcity. Adamu and Eya (2026) similarly demonstrated that household access to reliable domestic water in Keffi was constrained by limited dependence on government water supply and greater reliance on alternative sources. Therefore, improving the reliability and coverage of public water infrastructure, strengthening groundwater-source management, and developing adequate storage facilities could help reduce both the year-round and seasonal dimensions of domestic water scarcity in the study area.

Table 2: Seasonality of Domestic Water Supply Scarcity in the Study Area

S/N	Seasonality of Water Scarcity	Frequency (f)	Percentage (%)	Rank
1	All year round	179	57.56	1st
2	Seasonal	132	42.44	2nd
Total		**311**	**100.00**	

Source: Field Survey, 2026.

Time at Which the Well/Boreholes are Accessible Daily

Figure 2 presents respondents' views on the periods during which wells and boreholes were accessible for domestic water collection in the study area. The findings indicate that the morning period was the principal period of accessibility, with 79.4% of respondents reporting that wells and boreholes were accessible within the early morning period, particularly between 6:00 a.m. and 9:00 a.m./10:00 a.m. This concentration of access within a limited period suggests that households may have had restricted opportunities to obtain water during the day. Such restricted accessibility can increase the time households spend securing water and may require household members to adjust their daily activities

around the availability of water. This finding is consistent with Adamu and Eya (2026), who found that domestic water access in Keffi was characterised by substantial dependence on alternative sources such as boreholes, private connections and water vendors, while reliable daily access to government water supply remained limited. The present finding therefore suggests that the challenge in the study area was not only whether water sources existed, but also when households could practically access them.

The finding that 18.3% of respondents reported accessibility within the 6:00 a.m. to 10:00 a.m. period, while only 1.9% indicated other periods, further demonstrates that access to groundwater sources was concentrated within specific hours rather than being continuously available throughout the day. Importantly, the figure indicates that none of the respondents reported 24-hour accessibility to wells or boreholes. This is significant because restricted operating hours may reduce household flexibility, particularly for residents who are engaged in work, trading, schooling or other daytime activities. Similar concerns were identified by Aluko et al. (2022), who demonstrated that household water security in Nigeria was influenced by multiple socioeconomic and service-related factors, including the reliability and accessibility of water sources. In addition, the World Health Organization and UNICEF Joint Monitoring Programme (WHO/UNICEF JMP, 2021) emphasised that the adequacy of household drinking-water services should be considered not simply in terms of the existence of a water source but also in relation to accessibility and availability when needed.

The findings indicate that domestic water sources in the study area were characterised by limited daily accessibility, with the majority of households depending on a relatively narrow morning period to obtain water and no respondents reporting continuous 24-hour access. This pattern may contribute to water insecurity because households that fail to obtain sufficient water during the available period may have to wait until the following access period or seek alternative sources, potentially increasing the time and financial costs associated with domestic water collection. The finding also reinforces the earlier result that water scarcity in Keffi was predominantly an all-year-round problem, since the existence of wells and boreholes did not necessarily translate into unrestricted access to water. Consequently, improving domestic water supply in the study area should involve not only increasing the number of available water sources but also improving their operational reliability and accessibility throughout the day. This is particularly important in light of the findings of Adamu and Eya (2026), which showed persistent limitations in reliable domestic water access among households in Keffi.

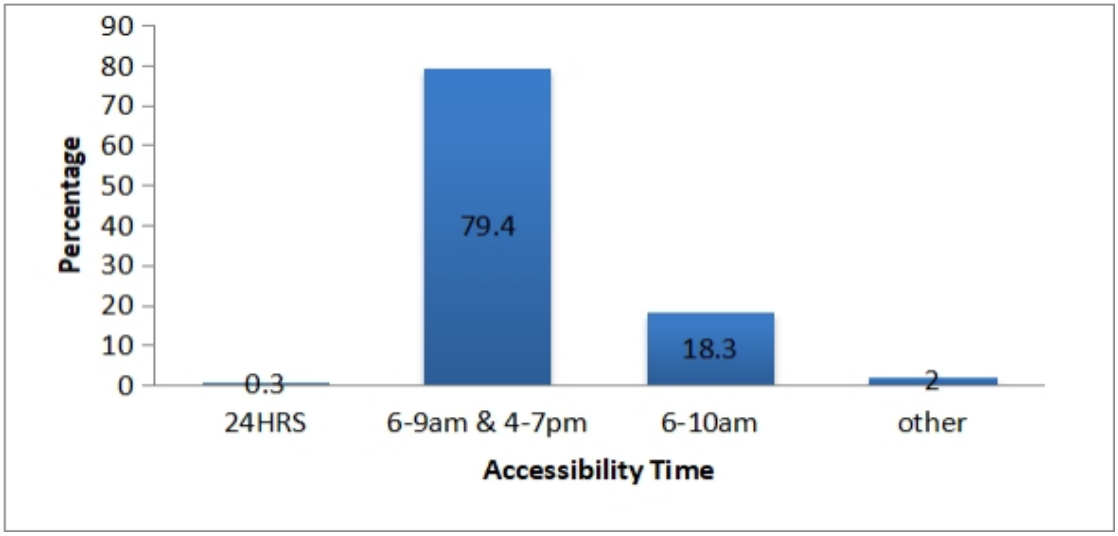


Figure .2: water source accessibility period Source: Field work, 2026.

Queue and Congestion during the Process of Fetching Water

Figure 3 illustrates the occurrence of queues and congestion during the process of fetching domestic water from wells and boreholes in the study area. The findings indicate that the majority of respondents reported experiencing queues and congestion, suggesting that waiting for access to available water sources had become a common feature of household water collection in the study area. This situation reflects the imbalance between the demand for domestic water and the capacity of existing water sources to meet that demand. When a limited number of wells and boreholes serve a relatively large population, households are likely to converge at the available sources, resulting in prolonged waiting periods. The finding is consistent with Adamu and Eya (2026), who reported that households in Keffi relied substantially on alternative water sources because of inadequate access to reliable public water supply. The present result therefore suggests that the dependence on alternative sources has created considerable pressure on the few functioning facilities available to residents.

The occurrence of persistent queues may also be associated with inadequate water infrastructure, irregular operation of water facilities and increasing population pressure in the study area. Where water facilities have low pumping capacity, experience mechanical breakdowns or operate only during particular periods of the day, demand can accumulate and result in congestion at the points of collection. This interpretation is supported by Aluko et al. (2022), whose study of household water security in Osun State demonstrated that access to adequate water was influenced by socioeconomic and household-level conditions, while deficiencies in reliable water access could contribute to household water insecurity. Similarly, Oyesanmi (2023) found that households in Lokoja relied on several alternative sources, including wells and boreholes, reflecting the limitations of formal water supply and the need for households to adapt to variations in water availability. The present finding extends this evidence by showing that dependence on alternative sources may produce not only financial costs but also time costs associated with waiting in queues.

The finding demonstrates that queues and congestion constitute an important dimension of domestic water scarcity in the study area. The problem extends beyond the physical shortage of water to include the difficulty and time required to obtain available water. Long waiting periods can interfere with household members' work, education, trading and other daily activities, particularly where water must be collected repeatedly. The situation observed at Ungwan Makera Baki, as illustrated in Plate 4.5, provides visual evidence of the pressure placed on wells and boreholes as alternative sources of domestic water supply. The finding is therefore consistent with the broader observation that improving domestic water security in Keffi requires an expansion of reliable water infrastructure rather than continued dependence on a limited number of alternative sources. In particular, rehabilitation of dysfunctional facilities, expansion of pipe-borne water networks, improvement of borehole capacity and regular maintenance of existing infrastructure could reduce congestion and shorten the time households spend accessing domestic water.

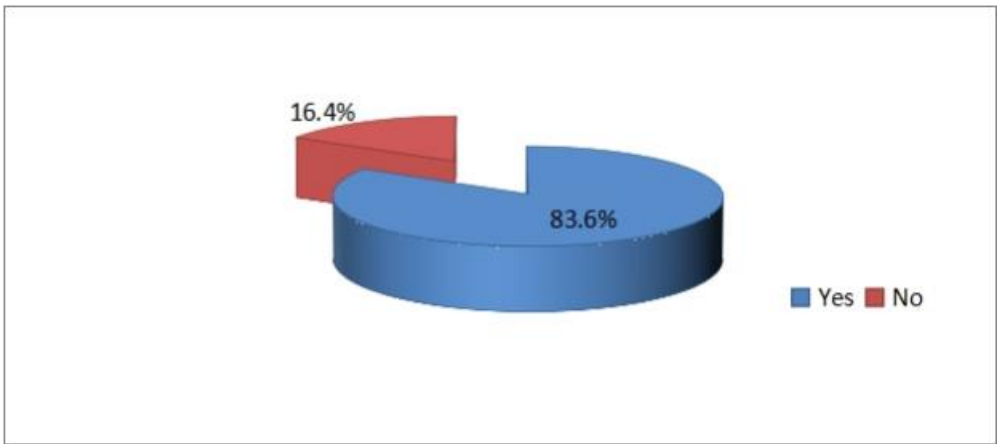


Figure 3: Queue and Congestion during the Process of Fetch Water
Source: Field work, 2026.



Plate 1: Queue at Well/Borehole as an alternative source of Water Supply in Ungwan Makera Baki.
Source: Field work, 2026.

CONCLUSION

The study concludes that domestic water supply scarcity in Keffi, Nasarawa State, is a persistent problem influenced by interconnected economic, infrastructural and accessibility factors. Poverty or low household income emerged as the leading determinant, followed by inadequate pipe-borne water supply and irregular borehole services. The findings further established that water scarcity was experienced predominantly throughout the year, although a substantial proportion of households also experienced seasonal variations. Limited accessibility to wells and boreholes and the occurrence of queues and congestion further demonstrated that the challenge extends beyond the availability of water sources to the reliability, accessibility and capacity of existing facilities.

The study therefore concludes that addressing domestic water scarcity in Keffi requires a comprehensive and sustainable approach rather than reliance on individual alternative water sources. Expansion and rehabilitation of pipe-borne water infrastructure, regular maintenance of boreholes, provision of additional functional water points and improvement in the affordability of domestic water are necessary to reduce household water insecurity. Strengthening water-supply planning and management would also help reduce congestion and improve the regularity and accessibility of water services. Ultimately, effective intervention should combine infrastructure development with socioeconomic considerations to ensure that households across Keffi have reliable, affordable and sustainable access to adequate domestic water.

RECOMMENDATIONS

- Relevant government agencies should expand and rehabilitate public water-supply networks in Keffi to reduce overdependence on wells and boreholes.
- Existing boreholes should be regularly maintained and equipped with reliable power and pumping systems to ensure consistent water availability.
- Government and other stakeholders should develop measures that make domestic water more affordable for low-income households, particularly those affected by poverty.
- More functional wells and boreholes should be provided in areas experiencing high demand to reduce long queues and congestion at existing facilities.
- A coordinated water-management system should be established to monitor water sources, identify breakdowns promptly and ensure that domestic water facilities remain accessible and operational throughout the day.

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