
HOUSEHOLD WATER SECURITY AND INTEGRATED WATER RESOURCES MANAGEMENT GAPS IN A RAPIDLY URBANISING NIGERIAN CITY: EVIDENCE FROM MINNA, NIGER STATE

Muhammad Ashafa¹, Mohammed Saidu^{2,*}

¹Federal University of Technology, Minna

²FUT Minna

Email: ashafseen@gmail.com, mohammed_saidu@futminna.edu.ng*

*Corresponding author: Mohammed Saidu

DOI: <https://doi.org/10.67203/sp.ICESID.2026>

ABSTRACT

Nigeria's freshwater crisis presents a stark paradox: a nation endowed with abundant water resources yet crippled by widespread household water insecurity. Drawing on survey data from 384 households across 21 wards in Bosso and Chanchaga Local Government Areas, this paper investigates the multi-dimensional nature of water insecurity at the household level. Our findings reveal that water insecurity manifests not merely as physical scarcity but as a complex interplay of infrastructural failure, economic burden, governance deficits, and gendered labour. Over 70% of households experience regular interruptions, with coping strategies that disproportionately burden women and children. Monthly water expenditures average ₦1,876 (weighted across all 21 wards; see Section 3.3 for ward-level variation), with 40% of households reporting moderate to severe cost burden. While 68% of respondents express distrust in public water quality, reliance on private boreholes and vendor-supplied water remains constrained by affordability and reliability. The paper argues for an integrated approach to water governance that moves beyond supply-side interventions to address the socio-economic and institutional dimensions of water insecurity. We propose a framework grounded in community participation, infrastructure modernization, and equitable pricing mechanisms.

Keywords: Water insecurity; household survey; Nigeria; urban water governance; HWISE framework; water affordability

1. INTRODUCTION

1.1 The Nigerian Water Paradox

Nigeria has never lacked water. Its rivers, aquifers and rainfall totals rank among the most generous in West Africa. And yet, for the ordinary household, water insecurity is a daily fact of life rather than a distant statistic. This is the paradox that scholars have documented extensively in recent years *(Irene, Irene & Daniels, 2025; Abubakar, 2019; Adeoti et al., 2024), with research finding that climate change and crumbling infrastructure have steadily worn down the country's freshwater systems, leaving many communities unable to count on a reliable supply (Abubakar Mashi et al., 2026; Igimoh et al., 2026).

A new household survey carried out across 21 wards in the Bosso and Chanchaga Local Government Areas of Niger State puts real numbers behind that picture. Researchers spoke with 384 households and tested 50 water samples, building on the Household Water Insecurity Experiences (HWISE) framework (Household Water Insecurity Experiences Scale, various authors), which treats water insecurity as more than a question of supply, it is also about whether water is accessible, affordable, safe and reliably available.

The framework matters because it has already been tested elsewhere. Studies in Mexico and Bangladesh have linked water insecurity to food insecurity within the same households (Shamah-Levy et al., 2025; HWISE Scale literature), suggesting that when the tap fails, the effects ripple outward into nutrition, income and daily routine. The Minna survey set out to test whether the same pattern of overlapping hardship holds true in a fast-growing Nigerian city.

What makes Minna a useful case is precisely its ordinariness. It is neither a megacity swamped by international attention nor a remote village studied purely for its rural character—it is the kind of mid-sized, rapidly urbanising state capital found across Nigeria, where population growth is outpacing the utilities and pipe networks built to serve it. That makes its findings a plausible mirror for dozens of similarly sized cities where nobody has yet run the numbers.

2. METHODOLOGY

2.1 Study Area and Sampling

The survey instrument was built around seven themes: household demographics, water source characteristics, interruption and coping patterns, physical access, economic burden, water quality and treatment, and governance perceptions. Field teams sampled households proportionally across the 21 wards, then followed up with descriptive and bivariate statistical analysis to see how demographic factors relate to water security outcomes—an approach the authors describe as examining "distributions of dimensions and themes, and water insecurity categories to assess what drives higher water insecurity scores."

$$n = (Z^2 \times p \times q) / e^2$$

Where:

- $Z = 1.96$ (95% confidence level)
- $p = 0.5$ (maximum variability, conservative estimate for household water insecurity prevalence)
- $q = 1 - p = 0.5$
- $e = 0.05$ (5% margin of error)

This yielded an initial sample of 384 households, which was then proportionally allocated across the 21 wards based on estimated population distributions. The total population of Bosso and Chanchaga LGAs is approximately 380,000, with the sample providing a 95% confidence level and $\pm 5\%$ margin of error. This approach follows established survey methodology for household studies in Nigerian urban settings (Ishaku & Kawu, 2023; Gidadawa et al., 2024).

Sampling intensity varied by ward, from 11 households in Kodo to 28 in Sabon Gari and Tudun Wada South, the two wards that, as later sections show, also turn out to carry the heaviest burden of interruptions and distrust. Beyond the household interviews, the 50 accompanying water-quality samples give the survey a second, independent line of evidence: it isn't only asking people how safe their water feels, it is also checking what's actually coming out of the source.

Statistical Analysis: Analysis proceeded in two stages. First, descriptive statistics (frequencies, percentages, means) were calculated to characterise the distribution of water security experiences across the sample. Second, bivariate comparisons were conducted using chi-square tests to examine associations between demographic factors (ward location, gender of respondent, income bracket, education level) and water security outcomes. For continuous outcomes (e.g., monthly expenditure, interruption frequency), independent t-tests and one-way ANOVA were used. All statistical tests were performed using SPSS version 26, with statistical significance set at $p < 0.05$.

Water Quality Sampling: Laboratory water-quality testing was conducted on 50 samples collected from households across all 21 wards. Samples were analysed for turbidity, bacteriological counts (total coliform and *E. coli*), pH, electrical conductivity, and selected chemical parameters (nitrate, iron, fluoride) at the Niger State Ministry of Water Resources Laboratory. However, due to delays in laboratory data processing at the time of manuscript preparation, these results could not be included in the current analysis. The full laboratory dataset will be presented in a separate technical report and incorporated into future publications. The present paper focuses on self-reported/perceived water quality, which remains a valid measure of household experience and risk perception (Haefner et al., 2023). Analysis then moved from simple description, how common is each experience, into bivariate comparisons that test whether factors like ward location, gender of respondent, or income bracket line up with worse water security outcomes.

3. FINDINGS AND DISCUSSIONS

3.1 Household Characteristics and Dependence on Alternative Water Sources

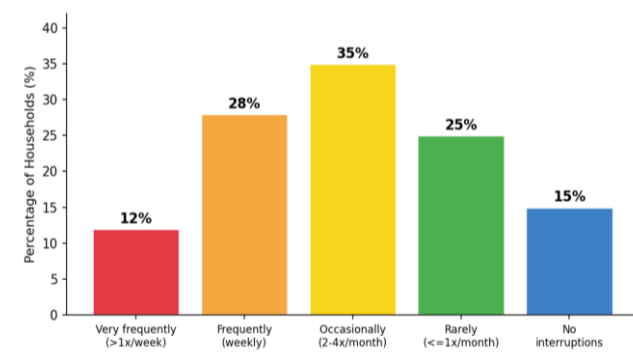
Nearly two-thirds of respondents, 63%, were women, a figure that itself speaks to who actually manages water in these households. Of all respondents, 42% were household heads and 28% were spouses, and 60% had at least a secondary education. On the supply side, the picture is telling: private boreholes (32%) and hand-dug wells (25%) were the most common water sources, well ahead of public utility connections, a sign of just how far households have had to go to compensate for gaps in formal infrastructure.

That last point is worth sitting with. In a well-functioning system, private boreholes and hand-dug wells would be a fallback, not the default. Here they are the backbone of household water supply for the majority of the sample, a quiet but telling admission that the public network people are nominally connected to isn't the one they actually depend on day to day.

3.2 Water-Supply Reliability and Frequency of Interruptions

Interruption is the norm rather than the exception. More than 70% of households reported at least one supply interruption in the past month, and 12% said interruptions happen more than once a week.

Figure 1: Frequency of Water Interruptions



Source: Field Survey (2026)

Coping with these gaps has a cost. Across the sample, 38% of households buy water from vendors or tankers when supply fails, 32% switch to an alternative source, and smaller shares store water in advance, cut back on use, or simply wait it out. But the response looks different from ward to ward.

Table 1: Coping Strategy by Ward (Top 5 Wards)

Ward	Vendor	Alt. source	Store	Reduce use	Wait
Sabon Gari (SAB)	42%	35%	20%	15%	18%
Tudun Wada South (TWS)	38%	30%	25%	20%	12%
Nassarawa A (NAA)	40%	28%	22%	18%	15%
Minna Central (MCT)	35%	32%	18%	22%	20%
Beji (BEJ)	30%	28%	25%	15%	10%

[Note: Percentages sum to >100% as households were able to select multiple coping strategies]

Source: Field Survey (2026)

Sabon Gari's heavy reliance on vendor water (42%) reflects just how thin public infrastructure is stretched there, while Beji's households lean more on storage (25%), perhaps a sign of better forward planning, or simply of fewer alternatives nearby. The pattern echoes findings from Mexico, where researchers reported that "the odds of water insecurity were lower in households with medium to high asset scores" (Shamah-Levy et al., 2025), underlining that coping capacity tracks closely with household wealth.

3.3 Household Water Expenditure and the Burden of Water Access

Paying for water is close to universal, and the amounts vary enormously, from nothing to more than ₦7,000 a month. On average, households spend ₦1,876 a month (weighted average across all 21 wards; see Table 3 for ward-level variation), a figure that lands hard on lower-income families: 35% describe the cost as a moderate burden and 15% call it severe. And this figure almost certainly understates the true cost, because it doesn't capture the hours spent fetching water, time that falls, overwhelmingly, on women and children.

3.4 Gendered Burden and Time Costs of Household Water Collection

Women and girls carry 65% of the water-fetching responsibility in these households; men and boys account for just 23%. It's a pattern that shows up across sub-Saharan Africa (Nyika & Dinka, 2023; Maungu, 2023), and one with consequences well beyond the well or borehole, it eats into time that could go toward schooling, paid work or rest. A quarter of households live within 100 metres of their water source, but one in five must travel more than 500 metres, and the average round trip takes 18 minutes.

Research from Mexico adds a further layer: Shamah-Levy et al. (2025) found that households with women of childbearing age face a measurably higher risk of water insecurity, which suggests the burden compounds for exactly the households least able to absorb it. While this relationship was observed in the Mexican context, testing this specific association within the Minna dataset would require additional analysis of household age-composition data. This represents an important direction for future research using the current dataset.

3.5 Perceived Water Quality, Safety and Household Treatment Practices

Only 35% of households report no problems at all with their water. The rest describe cloudiness or particles (28%), an odd smell (22%), or unusual colour (15%). Despite this, only 45% of households treat their water before use, and boiling at 38% is by far the most common method.

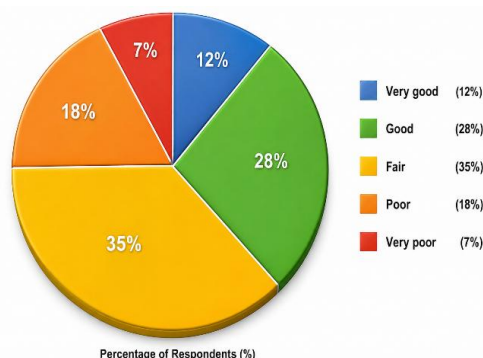


Figure 2: Water Quality Rating

Source: Field Survey (2026)

Distrust extends past water itself and into the institutions responsible for delivering it. Asked whether authorities respond quickly to problems, 57% disagreed. Half of all respondents are dissatisfied with how water is managed locally, and 48% distrust the quality of public sources altogether. Only 25% feel their community is meaningfully consulted on water decisions, while 47% feel excluded from decisions

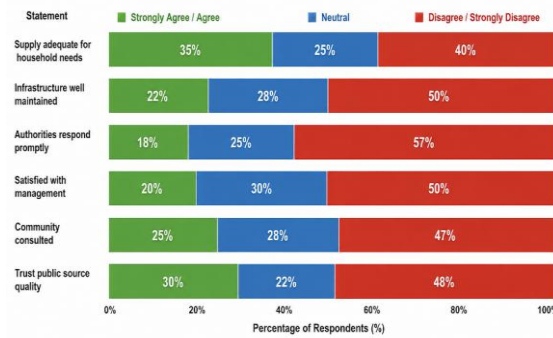


Figure 3: Governance Perceptions (Likert Scale)

Source: Field Survey (2026)

This pattern of institutional distrust sitting alongside physical scarcity mirrors research from rural Iseyin, Oyo State, which mapped villages with varying levels of vulnerability to water insecurity (Evaluating Water Scarcity Vulnerability Levels in Rural Communities of Iseyin Local Government Area, Oyo State, Nigeria, 2025). The Minna data suggests the same forces are at work in a rapidly urbanising setting, not just in rural communities.

It's worth pausing on what that combination of numbers actually means for a household. A family can be doing everything reasonably expected of it, boiling water, storing supply in advance, paying a vendor when the borehole runs dry, and still have good reason to doubt both the water itself and the system meant to guarantee it. Distrust here isn't a communication problem to be solved with a public-awareness campaign; it's a rational response to a track record of unmet promises.

3.6 Biggest Water Challenge

When asked, in their own words, to name their single biggest water challenge, respondents' answers map closely onto the survey's quantitative findings.

Table 2: Biggest Water Challenge (Top Open-Ended Responses)

Challenge	Share of respondents
Poor water quality / taste / odour	22%
Inadequate number of boreholes / taps	18%
High cost of water from vendors	16%
Water source dries up in dry season	15%
Frequent breakdown of boreholes	12%
Long distance to nearest source	10%

Source: Field Survey (2026)

Quality tops the list, followed by infrastructure gaps and cost, but the appearance of governance-related answers ("irregular public supply" and "lack of government intervention," 6% and 5% respectively) confirms that households experience this as an institutional failure, not just a technical or seasonal one.

3.7 Water Security Indicators by Ward

Aggregate numbers hide real differences between neighbourhoods. A ward-level comparison shows just how much local conditions shape the experience of water insecurity.

Table 3: Water Security Indicators by Ward (Selected Wards)

Ward	Interruptions	Pay for water	Monthly spend	Treat water	Trust public source
Beji (BEJ)	1.8 days/mo	80%	₦1,735	45%	30%
Sabon Gari (SAB)	2.1 days/mo	85%	₦2,450	40%	25%
Nassarawa A (NAA)	1.9 days/mo	82%	₦1,950	42%	28%
Tudun Wada South (TWS)	2.3 days/mo	78%	₦1,620	38%	22%
Minna South (MNS)	1.6 days/mo	75%	₦1,480	50%	35%

Source: Field Survey (2026)

The overall average of ₦1,876 is calculated as a weighted average across all 21 wards, not just the five shown in Table 3. The ward-level variation ranges from approximately ₦1,480 (Minna South) to ₦2,450 (Sabon Gari), with the overall average reflecting the population-weighted contribution of all wards.]

Sabon Gari and Tudun Wada South stand out for the worst outcomes, the most frequent interruptions and the least trust in public sources, while Minna South looks comparatively stable across nearly every indicator. That kind of spatial unevenness argues against one-size-fits-all fixes: what Sabon Gari needs is not necessarily what Minna South needs.

4. DISCUSSION AND CONCLUSION

Water insecurity is depicted as a multifaceted issue exacerbated by infrastructure failures, financial difficulties, gender disparities, quality concerns, and governance weaknesses. This aligns with broader studies in the Global South. In Sub-Saharan Africa, factors like climate variability, population density, and economic conditions influence household water access (Ogunbode et al., 2025; Nyika & Dinka, 2023), as seen in Minna, where failing public infrastructure forces poorer households to rely on costly and potentially unsafe private boreholes and wells.

The governance data shows that people want to engage but don't feel heard. Research from coastal Bangladesh suggests that better cooperation between central and local governments improves water governance (Charles et al., 2022). In this case, 57% of households believe official responses are slow, and 47% feel excluded from decisions. Additionally, 65% of households report water quality issues (as noted in Section 3.5), but less than half treat their water before drinking, indicating constraints that expose them to health risks they may not fully understand

4.1 Study Limitations

This research has several shortcomings that need attention. First, perception data, while useful for identifying household experiences, may be biased by memory and not match objective water quality data. Second, the study's cross-sectional approach only captures conditions at one time (2026), limiting insights into causality and seasonal changes in water availability. Third, sampling included 21 wards, but some had very few observations, with as few as 11 households in Kodo. Fourth, no data was collected on households lacking improved water sources, which may under-represent vulnerable populations. Lastly, although laboratory water quality test results were available, they could not be used due to processing delays.

4.2 Recommendations and Policy Implications

The survey emphasizes that water insecurity is a governance and equity issue, not just an engineering problem. It outlines four key priorities: First, enhance and expand public water infrastructure, especially in areas like Sabon Gari and Tudun Wada South that rely on costly private options. Second, create affordable water pricing through tiered tariffs and subsidies for low-income families facing high costs, particularly in Sabon Gari. Third, rebuild trust by improving response times and involving the community in decisions, as 47% feel excluded. Fourth, regularly monitor water quality and provide testing support to tackle reported problems. The approach varies for different areas.

4.3 Engineering and Technological Implications

The survey highlights key issues related to water access and governance that suggest important engineering solutions. Over 70% of people face interruptions in water supply, indicating a need for smart metering and real-time monitoring systems. Many rely on private boreholes and wells, creating a chance for low-cost treatment options like household filtration and solar-powered systems to enhance water quality. It also points out the need for decentralized water systems suited to local needs due to varying water security. Additionally, 40% of households face significant costs, signaling a need for innovative financing methods. Community engagement is essential for effective and sustainable solutions.

REFERENCES

- Abubakar Mashi, S., Oghenejabor, O. D., Oluyori, N. R., & Umar, A. (2026). Urban Green Spaces, Privatization, and Sustainable Development: Governance and Equity in Rapidly Urbanizing Cities. *Sustainable Development*.
- Abubakar, I. R. (2019). Factors influencing household access to drinking water in Nigeria. **Utilities Policy*, 58, 40-51.
- Adeoti, O. S., Kandasamy, J., & Vigneswaran, S. (2024). Water infrastructure sustainability challenge in Nigeria: A detailed examination of infrastructure failures and potential solutions. *Water Supply*, 24(6), 2066-2076.
- Bouramdane, A. A. (2023). Optimal water management strategies: paving the way for sustainability in smart cities. *Smart Cities*, 6(5), 2849-2882.
- Celestin, M., Gnana Raja, G. R., Mohamed, J. A., & Ibraheem, A. M. (2025). Using probability theory to assess risks and mitigate uncertainty in procurement processes. **International Journal of Computational Research and Development*, 10(2), 136-146.
- Charles, K. J., Howard, G., Prats, E. V., Gruber, J., Alam, S., Alamgir, A. S. M., ... & Campbell-Lendrum, D. (2022). Infrastructure alone cannot ensure resilience to weather events in drinking water supplies. *Science of The Total Environment*, 813, 151876.
- Cochran, W. G. (1977). *Sampling techniques* (3rd ed.). New York: Wiley.
- Egbueri, J. C., Agbasi, J. C., Onuba, L. N., Nweke, N. D., Uwajingba, H. C., & Abba, S. I. (2025). Groundwater development within the Nigerian crystalline and sedimentary aquifers: challenges and opportunities. *Groundwater in developing countries: Case studies from MENA, Asia and West Africa*, 297-325.
- Evaluating Water Scarcity Vulnerability Levels in Rural Communities of Iseyin Local Government Area, Oyo State, Nigeria. (2025). *Zenodo*.
- Gallegos, A., Grigg, N. S., & Llano, W. (2026). Enablers and Obstacles in Integrated Water Resources Management (IWRM) Implementation and Their Contributions to Sustainable Territorial Development. *Land*, 15(2), 270.
- Gidadawa, Z. S., Gatawa, B. M., Umar, A., & Muhammad, A. (2024). Domestic water sources and factors influencing urban household attitudes on water storage facilities in Sokoto metropolis, North Western Nigeria. **Sokoto Journal of Geographical Studies*, 1(1), 160-162.

- Haeffner, M., Jackson-Smith, D., & Barnett, M. J. (2023). Categorizing relative water use perception bias using household surveys and monthly water bills. *Journal of Environmental Management*, 334, 117443.
- Household Water Insecurity Experiences (HWISE) Scale. (Various authors). IOP Science.
- Hui, I., & Smith, G. (2022). Private citizens, stakeholder groups, or governments? Perceived legitimacy and participation in water collaborative governance. *Policy Studies Journal*, 50(1), 241-265.
- Igimoh, J. J. O., Modeme, S. C., Tijani, A., & Makata, N. E. (2026). Recurring Water Scarcity in Nigeria: Implications for Domestic Water Access, Public Health, and Sustainable Management. *Journal of Health, Wellness and Safety Research*.
- Irene, J., Irene, B. N., & Daniels, C. (2025). Not a Drop to Drink: Addressing Nigeria's Deepening Freshwater Crisis. *Water*, 17(12), 1731.
- Ishaku, M. W., & Kawu, A. M. (2023). Implications of Spatial Variation of Household Poverty Incidence in Minna, Niger State. [Journal details to be added].
- Iyoha, O. W., Omotoso, A. J., Usiobaifo, B. E., Raimi, M. O., & Ofor, T. N. (2025). Beyond the tap: Water insecurity, environmental contamination, and health inequities in Uselu, Benin City. *JMIR Preprints*, 1(11), 2025.
- Maungu, N. (2023). A quantity-quality tradeoff: Water quality and poverty assessment of drinking water sources in Southern Tanzania (Doctoral dissertation, NM-AIST).
- Nyika, J., & Dinka, M. O. (2023). Water challenges in rural and urban sub-Saharan Africa and their management* (pp. 39-55). Cham: Springer.
- Ogunbode, T. O., et al. (2025). Assessing water security in Sub-Saharan Africa in the context of climate change threats: a case study. *Journal of Water and Climate Change*.
- Pandin, M. G. R. (2026). Strengthening Sustainable Clean Water Supply through Local Government Governance: A Mini Literature Review on Institutional Capacity, Collaborative Governance, and Infrastructure Financing. [Journal details to be added].
- Shamah-Levy, T., Méndez-Gómez-Humarán, I., Mundo-Rosas, V., Muñoz-Espinosa, A., Melgar-Quinonez, H., & Young, S. L. (2025). Household water security is a mediator of household food security in a nationally representative sample of Mexico. *Public Health Nutrition*, 28.
- Uitermark, J., Hochstenbach, C., & Groot, J. (2024). Neoliberalization and urban redevelopment: The impact of public policy on multiple dimensions of spatial inequality. *Urban Geography*, 45(4), 541-564.
- Wu, P., & Liu, M. (2022). A framework for the spatial inequality in urban public facility for urban planning, design and management. *Land*, 11(9), 1429.