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From Infrastructure Coverage to Effective Access to Drinking Water: Analysis of Territorial Disparities in the Rural Communes of Ganzourgou (Burkina Faso)

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Abstract

This article analyzes the spatial organization of water infrastructure and disparities in effective access to drinking water across seven rural municipalities in the Ganzourgou province (Burkina Faso). The methodology combines an inventory of water points, a survey of 764 households, cartographic analysis using buffer zones, and bivariate statistical analyzes (chi-square test, Cramer's V). An "effective accessibility" index incorporates four dimensions: physical availability, temporal accessibility, financial accessibility, and service reliability. The water infrastructure (89.9% of which consists of human-powered pumps) is relatively dense and mostly functional, yet spatially unbalanced, with a bias toward central areas. While 96% of households use "compliant" (improved) water sources and 76% of dwellings are located within 500 meters of a water point, actual access remains limited: 46% of households collect water in under 30 minutes, 43% of breakdowns are repaired within 72 hours, and only 40% of households me*et al.,*l four criteria for access simultaneously. Disparities between municipalities are significant: the index ranges from 20% in Zoungou to 54% in Méguet, with the gap between theoretical coverage and effective access reaching 61 percentage points in Zoungou. The study concludes that it is necessary to move beyond a purely quantitative approach to infrastructure deployment and instead prioritize preventive maintenance, equitable spatial distribution, harmonized pricing, and sustainable local management—with a specific focus on the peripheral areas of Boudry, Zam, Kogho, and Zoungou.

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Introduction

Access to drinking water is a key issue. major public health and development issue on a large scale global. Since the Decade international drinking water and sanitation proclaimed by the Assembly United Nations General Assembly for the period 1981-1990, important investments have summer carried out in the sector. However, disparities persist in terms of the balance between infrastructure availability and supply conditions in drinking water. In 2022, still 2.2 billion people still lacked managed drinking water in all security, including 703 million without basic water service (Z. Kodmon and J. Szoke, 2025, p. 8967). This situation highlights access to safe drinking water as a universal right. This still remains a challenge and must be articulated availability of books hydraulics, equitable distribution spatial, functional, and accessible to populations. In Africa, 418

million people out of 1.3 billion Africans still lacked a basic drinking water service in 2020 (WHO, UNICEF, 2020). This crisis related to access to managed drinking water services in all security is persistent and more important in rural Africa because in this environment, 4 out of 5 people do not have access to the service. Always According to the same report, the achievement of access universal access to drinking water will require a twelvefold increase in current efforts supplied in the sector on the continent. For a country in development as in Burkina Faso, 71.2% of the population had By 2025, access to a basic drinking water service (National Inventory of Infrastructure, 2025). To improve sustainably access to drinking water for the Burkinabè inhabitants, the National Water Supply Program in Drinking water is adopted in 2015. Then, in 2019, decree no. 2019-0204/PRES/PM/MEA/MINEFID/MATDC/MS is adopted to specify the criteria and standards access to drinking water with regard to the functionality, availability and capacity of the service to provide drinking water for domestic needs.

Accessibility analysis will also take into account the water service availability and accessibility in rural communities. Indeed, a municipality can present a high number of water points while preserving remote concessions, works overloaded or insufficient availability (A. A. Sodoré *et al.,* 2021, p. 13; S. C. G. Hounguevou *et al.,* 2014, p. 5954). Access to drinking water is therefore physical, social or economic (T. P. Zoungrana, 2007, p. 35). Inequalities in physical access to drinking water also call for intervention strategies in rural areas. D. Dahani (2018, p. 247) links the bad distribution of drinking water infrastructure to a real issue for intervention in rural areas, given the large number of stakeholders. The drilling is SO carried out without notifying the relevant authorities. In the province of Ganzourgou, public interventions and those of partners have contributed to the structuring of the hydroelectric park. Nevertheless, intermunicipal disparities still exist in terms of access rates, going from 67.7% in the municipality of Mogtédo to 98.2% in the municipality of Méguet (National Inventory of Infrastructure, 2025). The unserved population, particularly in a municipality like Boudry (population 30,919) questions the capacity of the hydroelectric park to ensure balanced service and access to drinking water. From this, the following question emerges: in what measures do the distribution and functionality of the works hydraulics allow access to drinking water? What is the effectiveness of access to drinking water in rural communities? This article therefore aims to analyze the spatial organization and distribution of hydraulic infrastructure and disparities in access to drinking water in rural areas.

Geographical framework and methodological approach

Presentation of the study area

The research area encompasses the rural communes of Ganzourgou province, in the Central Plateau region, located between 11°54'00" and 12°42'00" north latitude and 01°06'00" and 00°30'00" west longitude, as shown in Figure 1 below. It primarily includes seven communes: Boudry, Kogho, Méguet, Mogtédo, Salogo, Zam, and Zoungou.

Data source and collection

The study relied on the use of primary and secondary data to analyze the distribution of water infrastructure, its functionality, and population access. An inventory of water points was conducted to record the location, type, condition, and functionality of each structure in the seven study municipalities. This inventory allowed for an assessment of the intervention strategies of stakeholders, an evaluation of progress made, and an assessment of drinking water needs to achieve SDG 6. In addition to the infrastructure assessment, quantitative data were collected from a sample of 764 households. The sample size was determined using a proportion estimation formula based on the reference population of 67,245 households from the General Population and Housing Census (RGPH) in 2019 with a 95% confidence level (Z=1.96), a 5% margin of error (e=0.05), and an expected proportion of 50% (p=0.5) retained in the absence of a baseline estimate. A population correction was applied, resulting in a minimum sample size of 382 households, extrapolated to 764 based on an anticipated response rate of 50%. The study covers seven municipalities. Therefore, the sample was allocated proportionally to the population size of households in each municipality and distributed equally among the villages within each municipality.

In terms of tools, the Mwater platform was used for data collection, both for diagnosing infrastructure and for collecting data from households. Stata software was used for statistical analysis, and Excel for processing data from the previous software. Google Earth Pro enabled the digitization of rural buildings, and QGIS 3.0, coupled with Google Satellite, was also used for mapping.

Data processing and analysis method

Spatial accessibility at water points has been assessed based on the distance separating the concessions from water sources. Buffer zones have been generated around the water sources in order to distinguish three situations: concessions located less than 500 m away, those between 500 and 1,000 m away, and those located above 1,000 m. The intersection of these zones with the distribution of concessions and populations then allowed estimation of the number of households concerned by each level of distancing.

This study uses bivariate analysis to examine the relationships between certain variables. Variables such as the functionality of the works, their technical characteristics, methods of their administrative and institutional management, or the financial conditions of their accessibility have for example summer integrated into this bivariate analysis was used to highlight the relationships between these variables. Access to drinking water and household characteristics were also considered. The chi-square test was performed and allow to appreciate if there is a statistical association relevant significant relationship between certain variables and allow a certain key to understanding relationships and dynamics of appropriation of public policy. When this statistical association is established, Cramer's V is used to measure the intensity of this association.

Results and Discussion

Structure and spatial distribution of the hydroelectric park

Access to drinking water in rural communities is basically ensured by four types of works, which are wells equipped with drive pumps, boreholes equipped with PMH, stations water autonomous (PEA), and simplified drinking water supply (AEPS) systems. The framework infrastructural East widely dominated by PMHs which represent 89.9% of the structures recorded. This predominance is more pronounced in the commune of Kogho, where PMHs represent 96.5% of the structures, and in Zoungou (95%). In the communes of Mogtédo and Méguet, PMHs represent 82.9% and 83.2%, respectively, indicating a greater concentration of access infrastructure in networks. Spatially, an imbalance emerges in Distribution terms. The analysis space revealed a concentration of water points in the center of the towns, with a weak density in the periphery. Figure 2 shows this weak density in the south, in the communes of Boudry, Zoungou and Mogtédo, west of the commune of Zam and north of the commune of Kogho.

The disparities presented in this map provide evidence of the issue of spatial equity in the distribution of facilities. The number of facilities per locality must be correlated to their spatial distribution to allow for a response that optimally meets the needs of communities and reduces the distance to travel to access water points.

Functionality of the works

The functionality of the works is an important condition for the provision of drinking water. The municipal facilities exhibit certain levels of functionality that differ depending on the municipality. Table 1 shows that the infrastructure in the municipality of Zam has a functionality rate of 88.64%. In the municipalities of Boudry and Zoungou, the functionality rates are respectively 88.13% and 85.59%. Conversely, the works of the commune of Kogho display the lowest functionality rate. In the municipality of Méguet, 9.24% of the structures have been abandoned. Field data collection reveals that the non-functionality is related to recurring breakdowns, outdated equipment, lack of preventive maintenance, and poor use. Table 1 presents the operational status of the park.

It also appears that in the municipalities, 78% of the works are community works. School and private hydraulic parks represent 10% of the park's assets, and those belonging to health represent 2%. This is in accordance with the regulations in Burkina Faso where private and religious institutions hydraulic parks are not included in the provision of drinking water services. Figure 3 shows the distribution of the facilities according to the statutes.

Change in the rate of access to drinking water

In terms of improving supply conditions, several actions have been taken by companies. However, the evolution of access rates between 2010 and 2024 contrasts depending on the municipalities and periods. Over the period 2010-2015, corresponding to the final phase of the National Supply Program in Drinking Water and Sanitation (PN-AEPA), the municipality of Méguet recorded the best progress, rising from 44.19% to 86.95%, followed by Salogo, which went from 62% to 82.24%. In contrast, the commune of Zoungou recorded only 2.62 points of progress and Kogho less than one point.

Table.1 Operating status of the hydraulic park

Municipality	Functional (%)	Non -functional (%)	Abandoned (%)	In equipment (%)
Salogo	84.97	8.80	5.18	1.03
Boudry	88.13	9.88	1.35	0.61
Mogtédo	85.35	7.57	5.80	1.26
Zoungou	85.59	4.66	8.47	1.27
Zam	88.64	10.14	0.48	0.72
Meguet	81.26	7.78	9.24	1.94
Kogho	80.12	13.46	5.12	1.28

Source: KAMBIRET Oswald Augias Eros, field data, 2024.

Table.2 Accessibility of concessions by municipality

Municipality	< 500 m (%)	500–1000 m (%)	> 1000 m (%)	Total concessions	Provincial share (%)
Boudry	72.6	16.1	11.4	15,029	23.84
Kogho	68.3	24.4	7.3	2,927	4.64
Meguet	79.6	17.5	2.9	5,453	8.65
Mogtédo	81.0	15.1	3.9	24,308	38.56
Salogo	80.9	13.9	5.2	3,252	5.15
Zam	65.1	19.3	15.5	8028	12.73
Zoungou	77.8	17.4	4.9	4,050	6.42
Total	**76.1**	**16.6**	**7.4**	**63,047**	**99.99**

Source: KAMBIRET Oswald Augias Eros, field data, 2024.

Table.3 Municipal summary of conditions of access to the drinking water service

Municipality	Conforming sources (%)	Collection < 30 min (%)	Financial accessibility (%)	Breakdowns ≤ 72 h (%)	Management satisfaction (%)
Boudry	96	43	93	45	> 90
Kogho	85	50	76	43	77
Meguet	100	24	95	54	> 90
Mogtédo	97	73	96	48	> 90
Salogo	100	35	39	30	100
Zam	98	51	97	49	> 90
Zoungou	97	43	93	23	> 90
Total / Together	**96**	**46**	**82.66**	**43**	**90**

Source: KAMBIRET Oswald Augias Eros, field data, 2024.

Table.4 Analysis bivariate access to drinking water

Explanatory variable	Modality / value	Accessibility temporal (%)	chi -square	V de Cramer	
Municipality	Boudry	43	_	_	
	Kogho	50	_	_	
	Meguet	24	_	_	
	Mogtédo	73	_	_	
	Salogo	35	***	0.14	
	Zam	51	_	_	
	Zoungou	43	_	_	
Physical availability	Yes	82.86	ns	ns	
Financial accessibility	Yes	11.43	*	0.05	
Service reliability	Yes	51.43	ns	ns	

Legend: ** Significant at the 1% level; * Significant at the 5% level; ns: not significant.
Source: KAMBIRET Oswald Augias Eros, field data, 2024.

Figure.1 Map of the study area

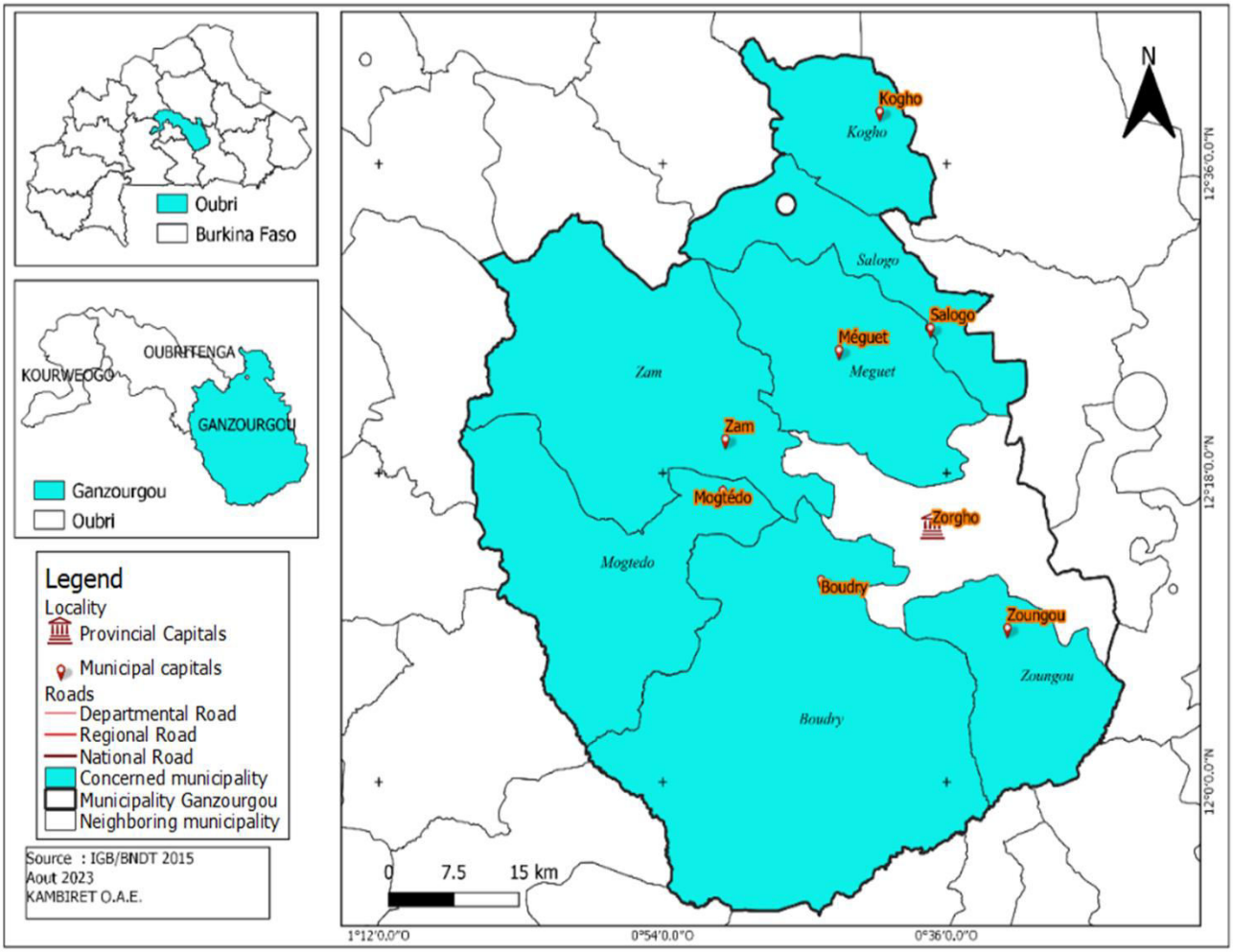


Figure.2 Spatial distribution of the structures supply in drinking water

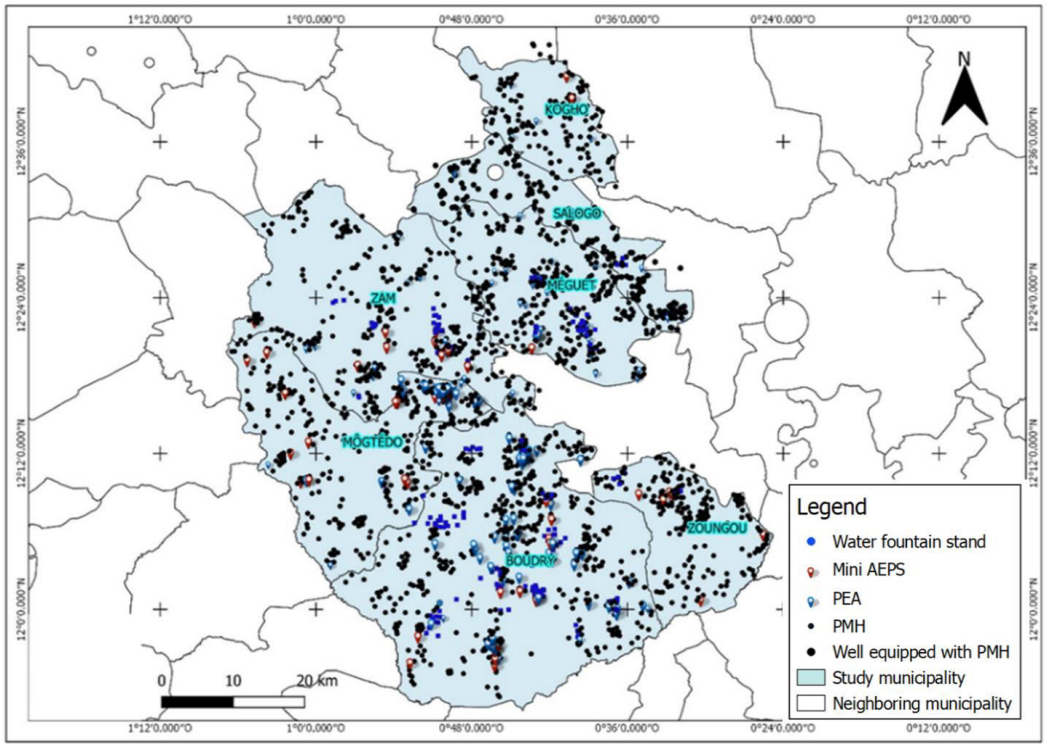


Figure.3 Status of access to drinking water.

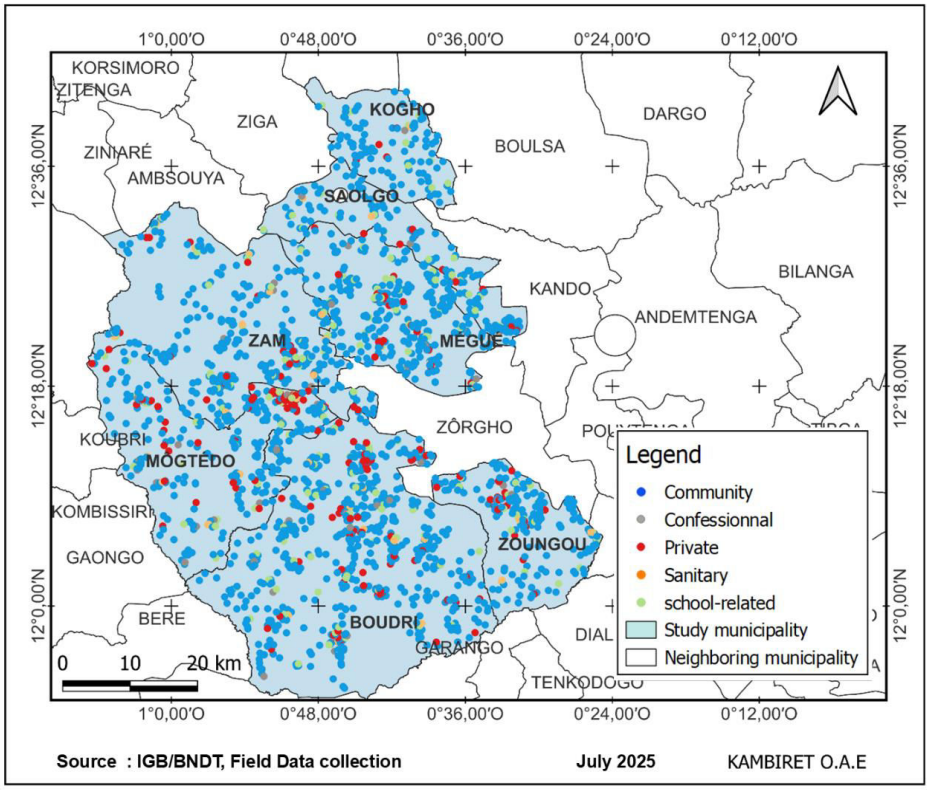
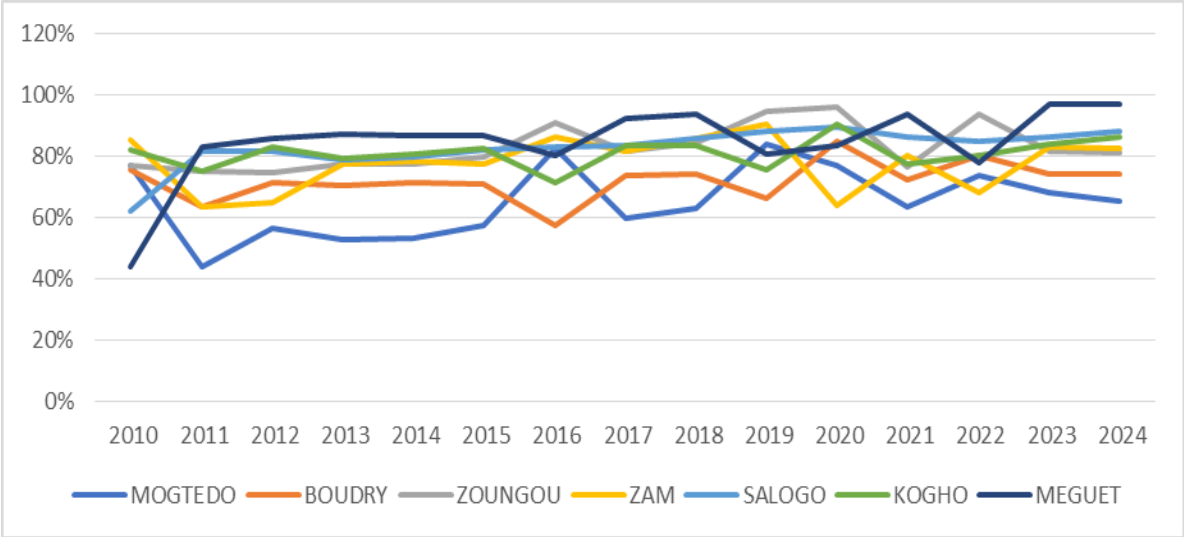


Figure.4 Evolution of the rate access from 2010 to 2024



Source: General Office of Resources in Water and Hydraulics, 2025.

Figure.5 Spatial distribution of water point coverage areas

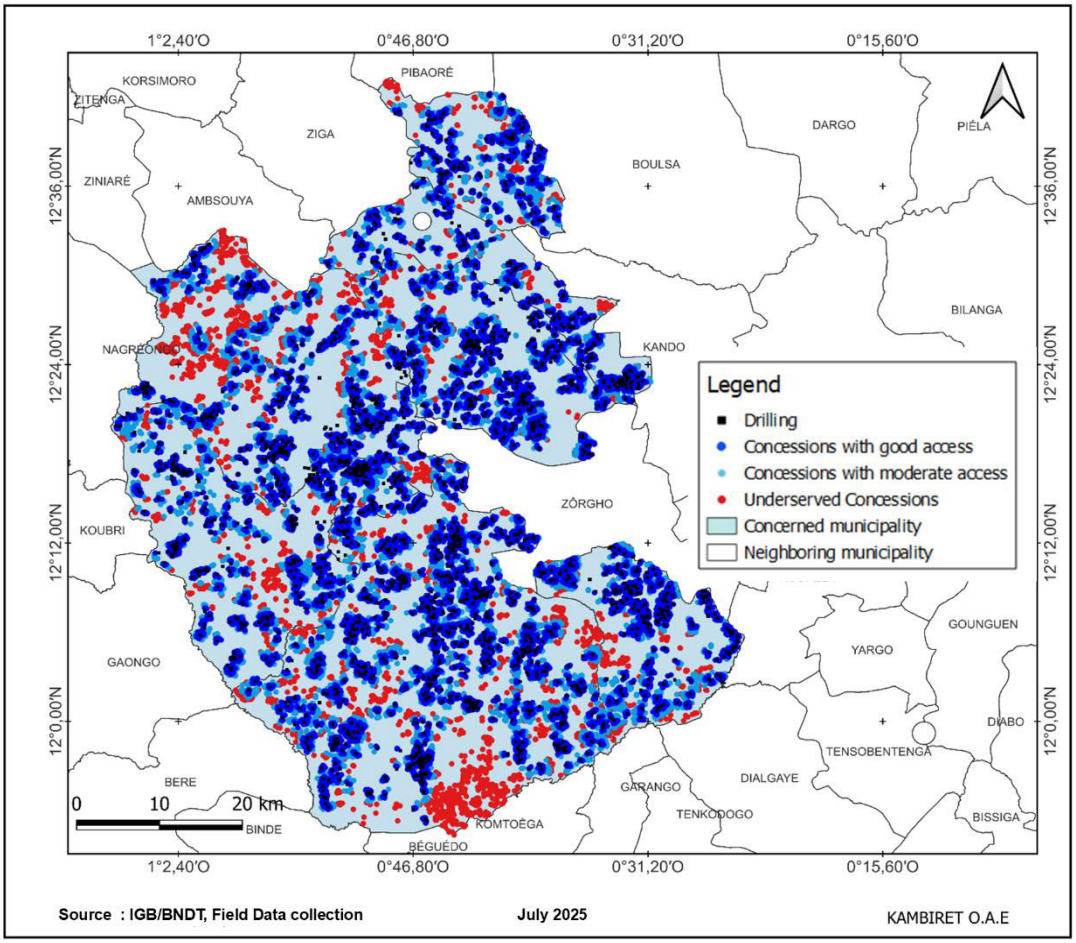
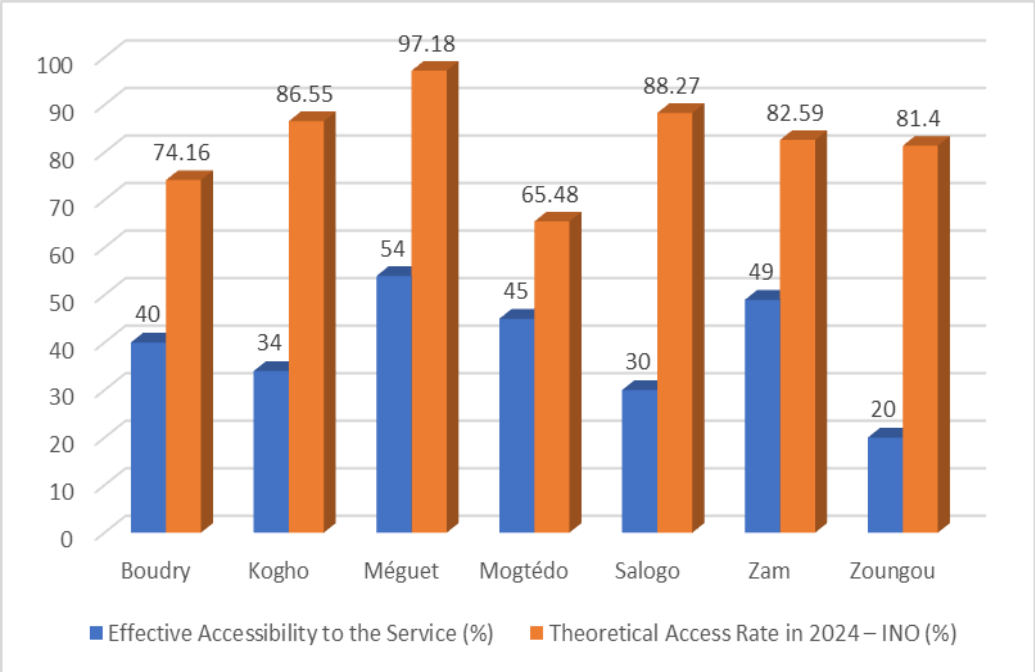


Figure.6 Discrepancies between services theoretical and actual service



Source: KAMBIRET Oswald Augias Eros, field data, 2024.

The municipalities of Mogtédo, Zam and Boudry display the weakest results. Between 2015 and 2024 which is the implementation period of the National Procurement Program in Drinking Water by 2030, all municipalities show a net improvement as shown in Figure 4.

The municipality of Méguet maintains the strongest growth (+10.23 points), ahead of Mogtédo (+7.92), Salogo (+6.03), Zam (+5.00), Kogho (+3.91), Boudry (+3.05) and Zoungou (+1.72). Figure 4 illustrates these trajectories.

At the village level in 2014, five villages out of the seven municipalities had zero access rates, and 87 had rates of 100%. In 2024, 96 localities have reached a rate of 100%, and no locality displays a rate of zero. This evolution generally suggests positive effects of the new program regarding the offer of hydraulic territorial. However, the trajectories remain irregular: in Mogtédo, for example, the rate went from 57.56% in 2015 to 82.57% in 2016, fell back to 59.92% in 2017, rose again to 83.86% in 2019, then settled at 65.48% in 2024.

These fluctuations are explained by breakdowns, rehabilitations, growth in demographics, and the construction of new water infrastructure. Overall, it shows progress for all municipalities, with differentiated performances between the different municipalities.

Accessibility spatial dimensions of concessions

In assessing accessibility spatially, the standard distance of 1,000 meters has been used to assess the spatial coverage of water points. Three thresholds have been retained: less than 500 meters (favorable accessibility), from 500 to 1,000 meters (intermediate accessibility), and over 1,000 meters (deficit accessibility). Only the works functional and community have been taken into account (Table 2).

The table shows that the proximity of the concessions to water points is relatively favorable. In fact, 76% of concessions are located less than 500 meters, 16.6% between 500 and 1,000 meters, and 7.4% beyond one kilometer. However, this average hides significant internal disparities. The municipalities of Mogtédo, Salogo and Méguet present the best conditions for access to drinking water within 500 meters, at 81.0%, 80.9% and 79.6% respectively, while the municipalities of Zam (65.1%), Kogho (68.3%) and Boudry (72.6%) are less well served over short distances. The municipalities of Zam and Boudry are distinguished primarily by the proportion of remote concessions: 15.5% and 11.4% of concessions, respectively, are located more than one kilometer from a water source, compared with less than 8% in the other municipalities. Boudry concentrates on her only 37% of provincial concessions located more

than a kilometer away. These gaps are explained by the dispersion of the habitat, the extent of spatial planning of municipalities, choices in the siting of the structures, and the constraints of hydrogeological areas. Deficit zones and accessibility are mainly south of Boudry, Mogtédo and Zoungou, west of Zam and north of Kogho, as shown in Figure 5.

Conditions of access to the service at the household level

Accessibility was assessed according to four dimensions: physical availability, temporal accessibility, financial accessibility, and service reliability. Surveys did not reveal explicit social exclusion, but forms of differentiated access may exist, particularly for remote households or certain pastoral populations (N. Martin *et al.,* 2008, p. 4). Source compliance is high (96%), but consistent and sufficient availability is only available to approximately 72% of households, ranging from 58% in Kogho to 93% in Zoungou. Temporal accessibility remains low: only 46% of households collect water in less than 30 minutes. Financial accessibility is widespread but highly uneven, ranging from 39% in Salogo to 97% in Zam. Finally, 43% of outages are resolved in 72 hours or less, while 90% of households report being satisfied with the service management, reflecting social acceptability rather than technical performance (E. Ostrom, 1990, p. 92; F. Cleaver, 2017, p. 123). Table 3 summarizes access conditions in terms of time, cost, and service reliability.

The results put in evidence of a significant gap between infrastructural coverage high in the occurrence of 96% of supply sources compliant and 85.77% of works functional and access much lower service effectiveness, estimated at around 40% of households when are combined the conditions of availability and accessibility temporal, financial accessibility, and reliability. This gap holds less to the physical availability of water than accessibility temporal insufficient (only 46% of the collection) water done in less than 30 minutes) and reliability (43% of outages) treated in less than 72 hours), to which additional constraints are financial, particularly in Salogo (39% of households unable to pay) and in Kogho (76%). Territorial disparities are strong. As an illustration, an index of access to staffing levels vary from 20% in Zoungou to 54% in Méguet, while accessibility temporal is very restrictive in Méguet (24%). It emerges therefore the necessity interventions differentiated in terms of maintenance, local management and fairness pricing, especially given the stated satisfaction reaches 90%, but management by water user associations only concerns 36.29 % of the works.

Construction of an index effective accessibility to drinking water services

The index of effective accessibility to the service has been built in combining four complementary dimensions of access: the physical availability of water, accessibility temporality, financial accessibility, and service reliability. For each dimension, situations meeting the criteria retained have been coded as compliant; their combination allowed identification of households comprising the conditions of access Satisfactory simultaneously. The index of 40% achieved means that four out of ten households have access that is not based solely on the presence of a water point, but which satisfies, in conjunction with the various conditions adopted. Municipal situations are strongly differentiated (figure 6). The municipality of Méguet presents the highest index (54 %), followed by the commune of Zam (49%) and Mogtédo (45%). Boudry is at the average general level (40%), while Kogho (34%), Salogo (30%) and especially Zoungou (20%) remain in withdrawal.

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