

Potable Water Accessibility in the Slums of Douala IV Municipality, Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The proliferation of slums in sub-Saharan Africa validates the need for renewed interest on access to basic services—potable water in this case. In the context of Bonaberi Douala, recent evidence on potable water accessibility is lacking, amidst rising population growth. To close this knowledge gap, this paper draws from a sample of 1115 households in 8 neighborhoods of Bonaberi to: (1) assess potable water accessibility and (2) examine the regularity of water flow. The results revealed that only 51.3% of slum dwellers have pipe water connections, while 33.4% rely on public standpipes. Furthermore, 28.4% make use of boreholes, while 46% use rainwater. About 12.5% of the population cover a distance of more than 200 m to fetch water. The pattern of water flow in several neighbourhoods is irregular; this precipitates the spread of waterborne diseases. The paper recommends that a control committee should be set aside to check water quality and reduce the spread of water-related diseases. The government and other local stakeholders should promote community water projects that can supply potable water in these slums.

Keywords: Adaptation; water scarcity; vulnerability; accessibility.

1. INTRODUCTION

In 2003, an estimated 1 billion persons inhabited urban slum environments worldwide. This figure rose to 2 billion in 2020 [1]. Such growth puts pressure on the resources of cities, making it difficult for city governments to provide adequate social services such as potable water, housing infrastructures amongst others. In developing countries, informal urbanism, therefore, emerges along formal city growth to cater for the influxes of rural-urban migrants and displaced citizens. An estimated 72% of urban residents in Sub-Saharan Africa live in such informal settlements [2]. The proportion of informal settlements in Africa may as well increase [3]. Such an influx constitutes a major health and environmental hazard, due to the disproportionate access to potable water and other necessities.

Globally, it is estimated that 89% of people have access to water suitable for drinking [4]. Adequate, clean and safe drinking water supply has to be available for various users [5]. There is no universally accepted definition of "safe drinking water." Safe drinking water is defined as the water that does not represent any significant risk to health over a lifetime of consumption [6]. The safe drinking water must be delivered that is pure, wholesome, healthful and potable. Safe water is not necessarily pure, it has some impurities in it. It contains some traces of salts such as magnesium, calcium, carbonates, bicarbonates and others. The degree of purity and safety is a relative term and debatable. Clean/pure water has no minerals and it only contains H and O. According to the Monitoring organizations under the supervision of the Joint Monitoring Programme (JMP), "safe drinking water" is defined as water from an "improved water source," which includes household connections, public standpipes, boreholes, protected dug wells, protected springs and rainwater collections. According to the same organization, "access to safe drinking water" is defined as the availability of at least 20 l per person per day from an "improved" source within 1 km of the user's dwelling.

Research from the United Nations World Water Assessment Programme has shown that the majority of people without access to safe water are from developing nations [7]. This shows that many people in the developing world, especially Africa, still depend on unsafe water sources for

daily water need and affected by chronic water problems and water-borne diseases. Millions of people die due to water-related diseases like cholera, diarrhea, malaria, dengue fever, and so on.

Safe drinking (potable) water is the water that can be delivered to the user and is safe for drinking, food preparation, personal hygiene and washing [5]. The water must meet the required (chemical, biological and physical) quality standards at the point of supply to the users [8]. Therefore, safe drinking water is a relative term, which depends on the standards and guidelines of a country; the standards set for the different quality parameters are different. The standard of WHO is not exactly the same as that of USA, Canada, European Commission, Russia, India, South Africa, Ethiopia, and so on. The term "safe" depends on the particular resistance ability of an individual. Water that is safe for drinking in some African countries might not be safe in European countries. Some African countries already developed resistance to some of the water-related diseases.

The UN-HABITAT [9] noted that a household is considered to have access to improved drinking water if the household members use a facility that is protected from outside contamination, in particular from faecal matter contamination. Access to water is one of the major criteria to consider during housing construction as this is the key to improved health and wellbeing of all citizens. The World Health Organization [10] stated that basic access can be defined as the availability of at least 20 litres of potable water per person per day within a distance of not more than 1 km of the dwelling, corresponding to a maximum water hauling round trip of 30 minutes. While this definition is deemed adequate for rural areas, it does not apply to urban areas where the distance to a source is usually not a problem. In such densely populated areas, a water hauling trip of 30 minutes or less, including queuing time would be a more appropriate indicator of access. The proliferation of slum environments in sub-Saharan Africa validates the need for renewed interest on access to basic services – potable water in this case. In the context of Bonaberi Douala, recent evidence on potable water accessibility is lacking. To close this knowledge gap, this paper draws from a sample of 1115 households in 8 neighborhoods of Bonaberi to (1) assess potable water accessibility, and (2)

examine the regularity of water flow. The supply of water to the Bonaberi slums is almost non-existent, at worse and irregular. In most slums, water is provided by public standpipes or underground wells with manual pumps installed on them. This seems to be the same situation faced by the inhabitants of Bonaberi as they solely depend on the public provider (CAMWATER), for potable water, while others depend on doubtful sources.

1.1 Analytical Framework

Water is a key determinant of human well-being in slum environments. Its availability and accessibility can be assessed in terms of water

source and the regularity and reliability of water flow to meet household chores and personal hygiene and sanitation (Fig. 1).

In addition, water accessibility can also be assessed in terms of distance covered and time spent at the water point. All these determine water self-sufficiency and slum/urban water security [1]. This paper, therefore, falls within the context of the global development agenda, with an overarching emphasis on some Sustainable Development Goals (SDGs), namely SDG-6 (ensure availability and sustainable management of water and sanitation for all) and SDG-11 (sustainable cities and communities).

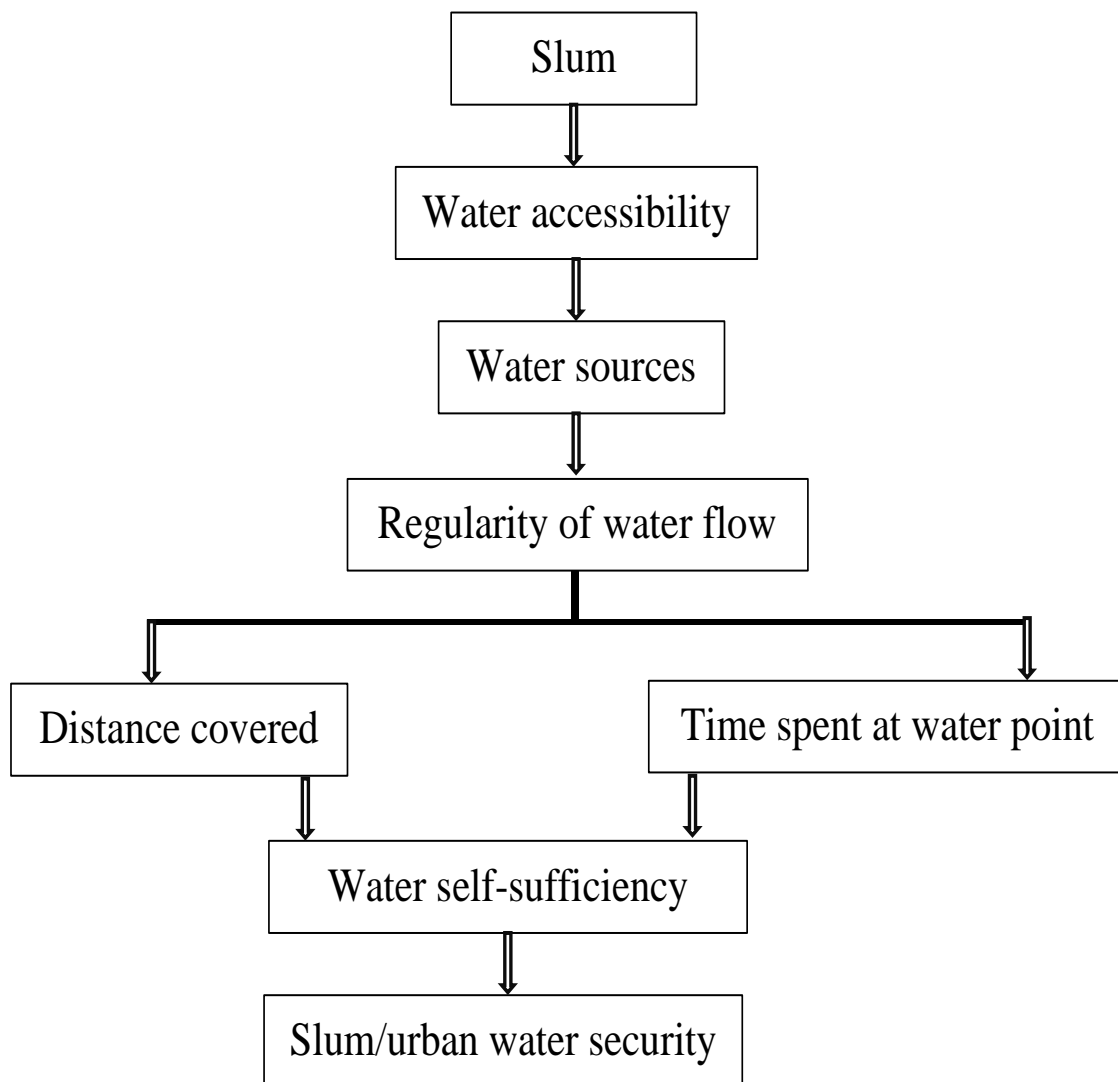


Fig. 1. A framework for water accessibility in Bonaberi slums

Source: Authors' construct

2. STUDY AREA AND METHODOLOGY

Located in the inter-tropical zone in the Gulf of Guinea, Douala IV has a tropical humid climate. The annual rainfall is more than 4000 mm with temperatures ranging between 24°C and 27°C. hence, the area is characterized by wet and dry

seasons. Douala IV has an estimated surface area of 21,000 hectares with a population density of 145 persons/km². It is the second-largest Municipality after Douala III. It is bounded to the north by the Nsape Drainage Basin, to the west by Douala II, to the west by the Wouri River, and to the east and south by Douala III (Fig. 2).

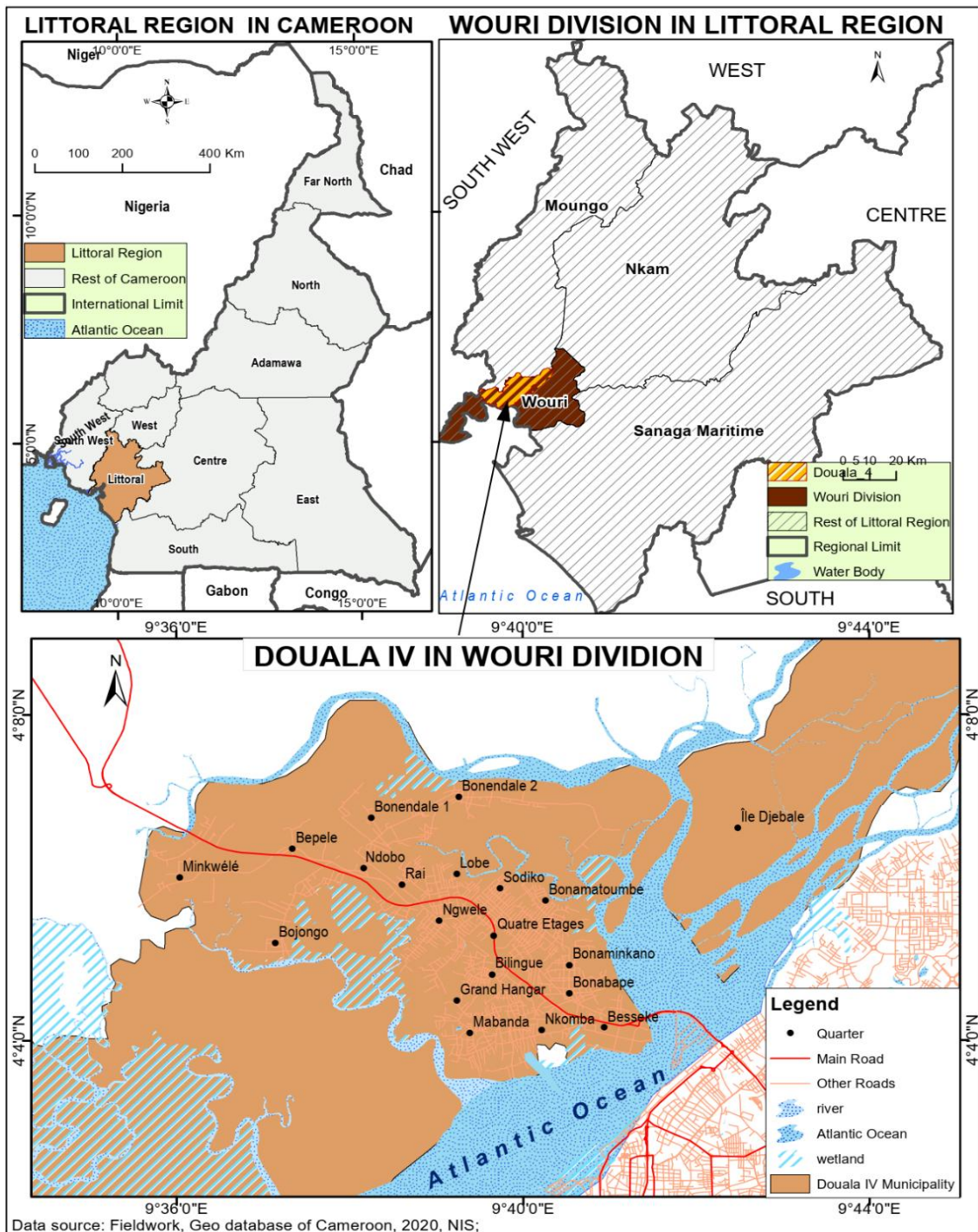


Fig. 2. Location of Bonaberi

Table 1. Distribution of the sampled population in Slum Areas

Quadrants	Neighbourhoods	Population	%	Questionnaires administered	%
1	Ngwele	55373	13.54	50	4.5
	Bojongo	41972	10.26	242	21.7
2	Mambanda	92849	22.70	302	27.0
	Grand Hangar	35455	8.67	89	8.0
3	Bonandale	64441	15.76	21	1.9
	Ndobo	33481	8.19	315	28.3
4	Quatre Etages	48397	11.83	40	3.6
	Sodiko	37018	9.05	56	5.0
Total		408986	100	1115	100

Source: Researcher's Construct, August 2020

2.1 Data Collection and Analysis

The study focused on 8 out of the 12 neighborhoods under study. The 8 neighborhoods were subdivided into 4 quadrants with each quadrant made up of 2 slum neighborhoods. It draws from a sample of 1250 households, using structured questionnaires. The 1250 questionnaires formed 5% of the total number of households in the 8 slum communities chosen (Table 1).

The questions framed in the questionnaire were organized to obtain information about access to potable water, distances to the nearest water point and the regularity of water flow. The questionnaires were treated using the Statistical Package for Social Sciences (SPSS) Version 20 software. From there, frequencies were generated and exported to Microsoft Excel 16, wherein, tables and graphs were generated.

3. RESULTS

3.1 Access to Water

The sources of potable water in Bonaberi are pipe-borne, public standpipes, boreholes, wells, springs and rainwater (Table 2).

Access to potable water in slum environments has always been a concern, as varied sources of

water exist for both domestic and industrial purposes. In the study area, six different sources of water were identified that served the population of the slum. Pipe borne water connected to houses was one of the sources of water the sampled population acknowledge exists in the community. Additionally, 51.3% of the sampled population use this source of water for their daily activities, whereas 44.8% of the sampled population do not have access to pipe born water. Another source of water that was identified include public standpipes. 33.4% of the sampled population used this source of water in their homes, while 56.3% did not have access to public standpipes. This shows that public standpipes are not fairly distributed in the area. 10.3% of those sampled did not reveal if they depended solely on public standpipes. As water scarcity increases, so too do the number of children waiting to have water for domestic use increases. The more the waiting time and number of children waiting to fetch water; this renders them vulnerable to other societal ills like rape and violence. Boreholes are a growing means of water supply in the country now and in many parts of the country, as the supply of pipe-borne water has been irregular. In the study area, 28.4% of the sampled population agreed that they depend on the boreholes for water, whereas 53.8% of the population indicated that they do not use this source (Fig. 3).

Table 1. Access to water

Water access	Yes		No		Not applicable	
	F	%	F	%	F	%
Piped water connection to house or plot	572	51.3	500	44.8	43	3.9
Public standpipe	372	33.4	628	56.3	115	10.3
Borehole	317	28.4	600	53.8	198	17.8
Protected dug well	542	48.6	484	43.4	89	8.0
Protected spring water	461	41.3	553	49.6	101	9.1
Rainwater collection	513	46.0	521	46.7	81	7.3

Source: Fieldwork, November 2020

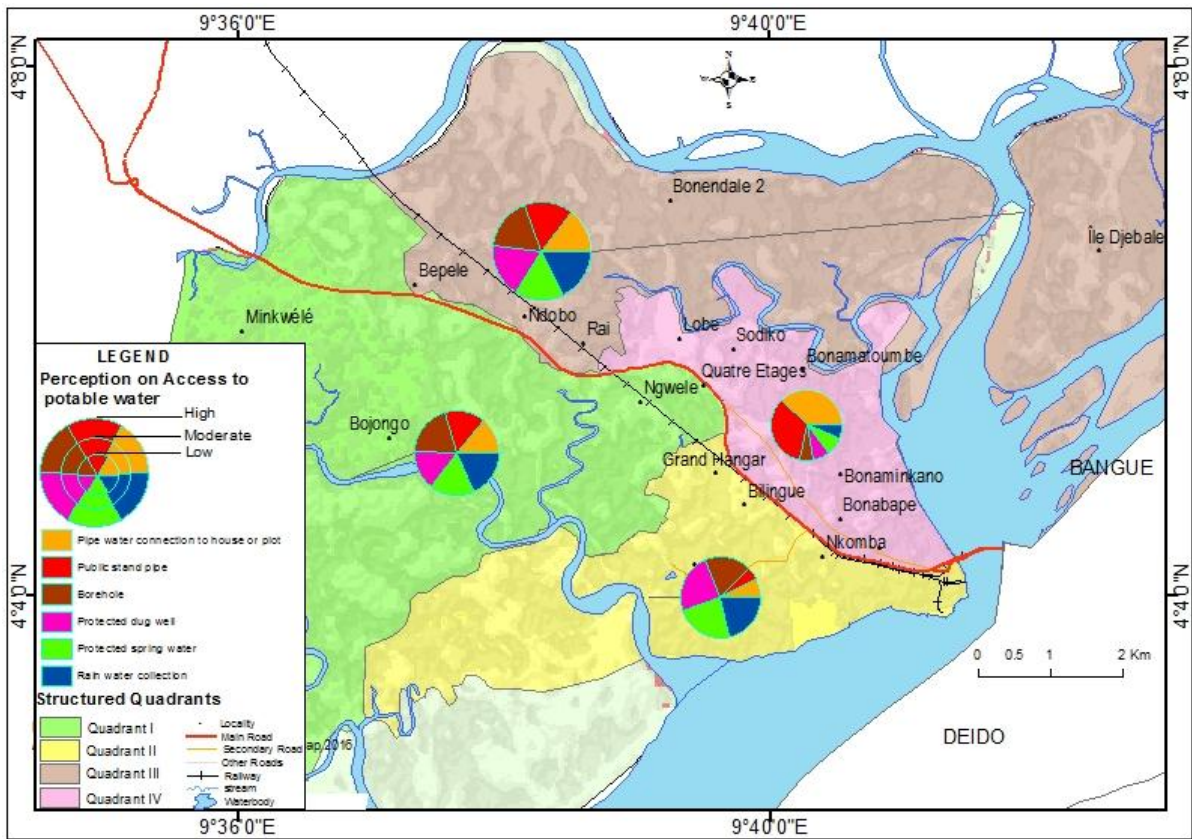


Fig. 3. Access to potable water

The use of protected dug wells and open wells was another source of water used by the population of Bonaberi; 48.6% of the population acknowledged using well water for domestic activities. During a discussion with some of the women, they indicated that they use well water just for cleaning and washing in the homes while they buy water from those who sell pipe-borne water for consumption in their homes. 43.4% of the respondents noted that they do not use wells in their homes. 8% of the sampled population did not give an opinion. The sampled population gave their opinion on the source of water they depend on: Boreholes are common in these slum environments because maintenance and affordability are easy. A key concern here is that these wells are just 3-5 meters deep, implying that the influence of the underground flow of solvents could affect the quality of water and wastewater could easily flow into the wells especially during the rainy season.

Springs are sometimes a source of water for both the rural and urban poor who are not adequately served by water points. In the study area, 41.3% of the population use spring water for their domestic activities; these springs happen to act

as dump sites for some households and factories. 49.6% of the sampled population did not use spring water. Urban agricultural activities were also seen to be common in the study area, as farmers depended solely on these springs for irrigation during the dry season. Even though most of the sampled population acknowledged not using springs for domestic activities, legumes and vegetables cultivated in the area with the use of springs were consumed by almost all inhabitants of the locality. The last source of water which was identified here was rainwater collection where 46% of the sampled population used this source of water for their domestic activities. 46.7% responded that they do not collect rainwater. Worthy of note here is the fact that in slum environments, the collection of rainwater was mainly through corrugated sheets or what is commonly called 'intercepted roof collection method' where water is intercepted by the roof and retained for domestic activities in the home. Because these roofs are old, the quality of water obtained from this method is doubtful as there is no assurance of quality. Another concern with this method is that Bonaberi is a growing industrial belt of Cameroon economic capital; pollution is inevitable. Enterprises exist giving

room to excessive pollution to the air which settles on the roof and during rainfall, it is washed down to the surface so those who depend on rain collection also are exposed to several risk factors. Again, with water scarcity in these localities, the probability of proper washing of vegetables before consumption is low or better still, some of the households still use the contaminated water to wash vegetables. This only increases the rate of infection caused by contamination in the localities.

3.2 Distances Covered to the Nearest Water Point

Regarding the distance covered by households to obtain potable water, it was revealed that some households had pipe-borne water in their communities, or they use pipe-borne water. The distance covered to get this water was also a concern, as the longer the distance covered, the lesser the effectiveness and efficiency to which people can comfortably use pipe-borne water in their homes as the quantity of water used reduces with increasing distance to water points (Table 3, Fig. 4).

The least distance covered by the participants were less than 50meters, while 29.6% of the

sampled population revealed that they cover less than or equal to 50 meters to access potable water. Another 24.7% were those who cover distances between 51-100meters estimated to get potable water, 19.4% travel distances between 101-150 meters to get potable water while 3.3% estimated distance covered to the nearest water point to be between 151-200meters. Finally, 23% of the sampled population cover more than 200meters to get potable water in their homes. Those who cover such long distances are those who depend on other sources of water for domestic activities and only go for potable water as a source of drinking water. As the distance between the home and water point increases, so too does the possibility of households storing water for long days for consumption increase.

3.3 Regularity of Water Flow

The regularity of water flow was also observed to be a concern to the study because water does not flow on a regular basis. 43% of the sampled population held that water flows twice in a week, 26% said water flow daily, and 17% thought that water flows three times a week, while 11% attest that water flows one time per week (Table 4, Fig. 5).

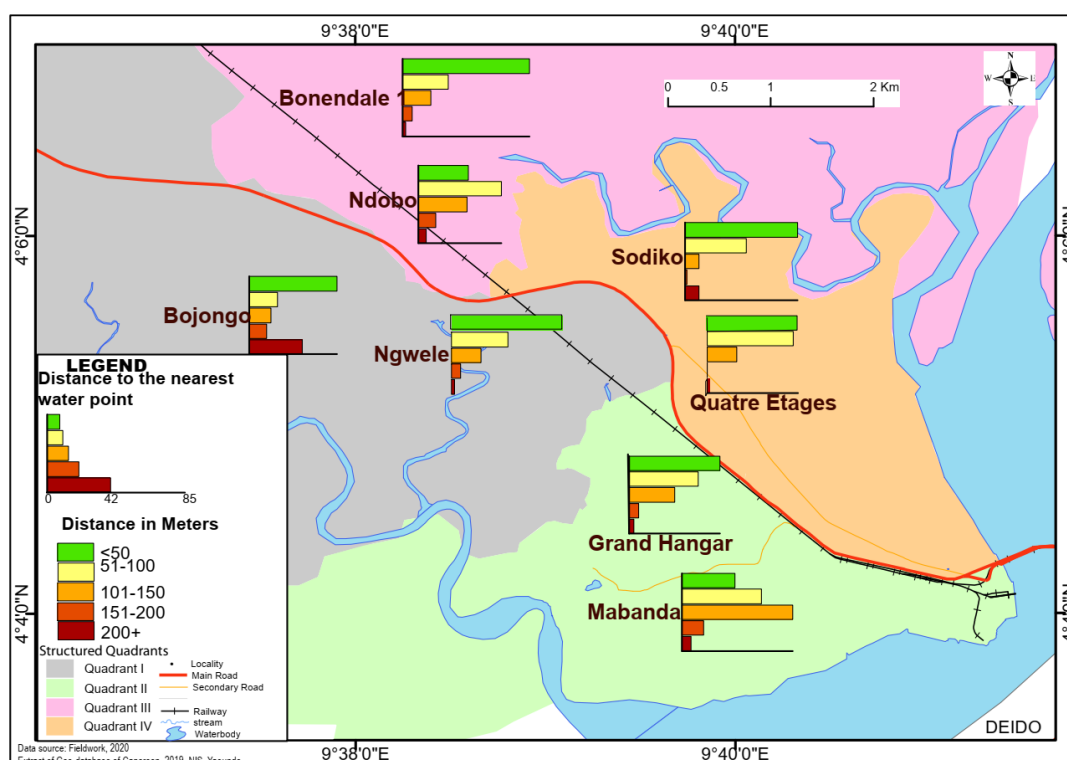


Fig. 4. Distances to potable water points in Bonaberi

Table 3. Spatial variation in distances to the nearest water points in the different quadrants

Quadrants	Neighbourhoods	Distance to the nearest water point									
		<50 m		51-100 m		101-150 m		151-200 m		200 m+	
		F	%	F	%	F	%	F	%	F	%
Quadrant 1	Ngwele	30	9.09	5	1.82	10	4.63	4	10.81	1	0.39
	Bojongo	14	4.24	58	21.09	55	25.46	8	21.62	107	41.63
Quadrant 2	Mambanda	154	46.67	61	22.18	45	20.83	8	21.62	34	13.23
	Grand Hangar	29	8.79	29	10.55	25	11.57	1	2.70	5	1.95
Quadrant 3	Bonandale	11	3.33	2	0.73	8	3.70	0	0.00	0	0.00
	Ndobo	47	14.24	97	35.27	57	26.39	15	40.54	99	38.52
Quadrant 4	Sodiko	25	7.58	14	5.09	7	3.24	1	2.70	9	3.50
	Quatre Etages	20	6.06	9	3.27	9	4.17	0	0.00	2	0.78
Total		330	100	275	100.00	216	100.00	37	100	257	100

Source: Fieldwork, November 2020

Table 4. Regularity of water flow

Quadrants	Neighbourhoods	Regularity of water flow									
		Everyday		Two times a week		Three times a week		Once a week		Water never flows at all	
		F	%	F	%	F	%	F	%	F	%
Quadrant 1	Ngwele	31	11	13	3	1	1	0	0	5	12.82
	Bojongo	28	10	140	29	22	12	44	35	8	20.51
Quadrant 2	Mambanda	76	26	95	20	97	52	24	19	10	25.64
	Grand Hangar	46	16	24	5	7	4	7	6	5	12.82
Quadrant 3	Bonandale	9	3	12	3	0	0	0	0	0	0.00
	Ndobo	61	21	156	33	40	21	47	38	11	28.21
Quadrant 4	Sodiko	11	4	25	5	18	10	2	2	0	0.00
	Quatre Etages	25	9	11	2	3	2	1	1	0	0.00
Total		287	100	476	100	188	100	125	100	39	100

Source: Fieldwork, November 2020

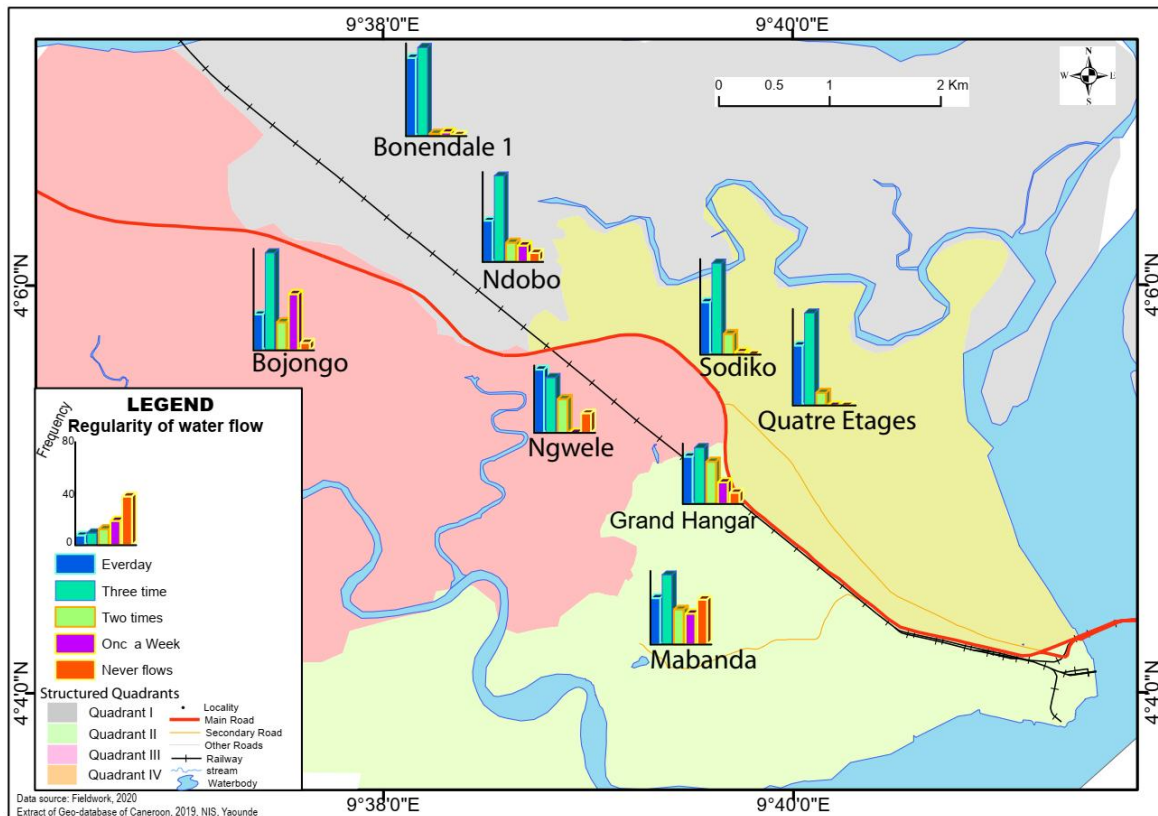


Fig. 5. Regularity of water flow in the Bonaberi slums

In homes with constant water flow, only 26% of the sampled population indicated that water supply was regular. Others have resorted to sinking a well in their home to ease the problem of water scarcity in the locality. This is because sometimes, they stay for months without water, not because water is unavailable but because of broken pipes and lack of electricity in their locality. They use well water for cleaning and washing and go to other areas to buy potable water for drinking. This phenomenon was common in most of the neighbourhoods under investigation.

3.4 Spatial Distribution of Access to Water

It was observed that quadrant four had the highest number of households with pipe-borne water connected to their homes (39.33%), while quadrant three was the second area with the highest number of households having water connected to their homes (29.55%). Quadrant one was third with 21.32% of the sampled population acknowledging that their homes and plots had a pipe-borne water connection (Table 5).

Finally, quadrant two had the least number of households connected to pipe-borne water with a 9.79% of households having pipe-borne water. The distribution of public standpipes in the study area showed that the different quadrants had different frequencies of public standpipes. Quadrant four had 36.56% of the sampled population, observing public standpipes in their localities, quadrant three had 32.25% of households having public standpipes, 23.92% in quadrant one and quadrant two have the least.

The use of a borehole is also predominant in the study area. The sampled population of quadrant three observed more boreholes in their localities than the rest of the community. That is, 36.56% of the sampled population in quadrant three believe boreholes are common. Quadrant one had 31.23% while quadrant two had 2.18%. Finally, quadrant four had the least number of households that depend on boreholes for domestic activities. The distribution of protected dug wells that serve the communities as a source of water for domestic activities was equally examined in Bonaberi. The results showed that 35.61% of the sampled population acknowledge

Table 5. Spatial distribution of access to water in the four quadrants under examination

Variable	Options	Location (%)							
		Quadrant One		Quadrant Two		Quadrant Three		Quadrant Four	
		Ngwele	Bojongo	Mambanda	Grand Hangar	Bonandale	Rai	Quatre Etages	Sodiko
Pipe water connection to house or plot	Yes	5.24	16.08	5.59	4.20	3.15	26.40	26.92	12.41
	No	4.00	30.00	24.00	2.20	0.60	31.80	1.60	5.80
	NA	0.00	0.00	65.12	16.28	0.00	11.63	0.00	6.98
Public standpipe	Yes	2.15	21.77	2.42	4.84	1.34	30.91	29.57	6.99
	No	3.98	24.52	24.52	7.32	1.91	28.50	3.98	5.25
	NA	14.78	6.09	33.04	14.78	3.48	18.26	5.22	4.35
Borehole	Yes	3.79	27.44	20.82	5.36	2.52	33.75	3.79	2.52
	No	3.67	24.00	27.00	7.00	0.50	29.33	2.67	5.83
	NA	8.08	5.56	37.37	15.15	5.05	16.16	6.06	6.57
Protected dug well	Yes	5.17	17.71	22.14	11.07	2.95	32.66	3.87	4.43
	No	3.10	28.93	30.79	3.51	0.21	25.41	2.07	5.99
	NA	7.87	6.74	37.08	13.48	4.49	16.85	10.11	3.37
Protected spring water	Yes	4.99	21.04	26.25	5.64	2.39	31.24	4.34	4.12
	No	3.44	24.59	27.49	8.32	0.72	27.31	2.71	5.42
	NA	7.92	8.91	28.71	16.83	5.94	19.80	4.95	6.93
Rainwater collection	Yes	2.53	25.54	22.03	7.41	2.92	32.94	2.92	3.70
	No	4.22	19.19	33.40	6.14	1.15	25.72	3.84	6.33
	NA	18.52	13.58	18.52	23.46	0.00	14.81	6.17	4.94

NA: Not Applicable. Source: Fieldwork, November 2020

that quadrant three had the highest number of households who use protected dug well. Furthermore, quadrant two had 33.21% of the households depending on protected dug well while quadrant one had 22.88% depending on protected dug wells. Quadrant four have just 8.3% of the household depending on protected dug wells for domestic usage.

A spatial analysis of this in the different quadrants reveal that quadrant three had 33.63% of the population depending on springs and streams. This is followed by quadrant two, with 31.89% of the population depending on this source of water for their day-to-day activities. Quadrant one showed 28.07% depending on this source of water. Finally, quadrant four had 8.46% of the population who depend on springs and streams. Rainwater collection is equally another source of water used by inhabitants in the area for domestic activities as it is one of the cheapest and most available sources of water during the rainy season. 35.86% of the sampled population acknowledge rainwater collection as a source of water in quadrant three, 29.44% in quadrant two, and 28.07% of quadrant one. Finally, 6.62% of the sampled population were from quadrant four.

The results revealed that though there is pipe water connection in all the localities, the intensity and availability varies from quarter to quarter. The analysis presents quadrant four having a high connection to pipe-borne water and public standpipes than all other quadrants in the study area. From the results and observations, the more the number of homes connected to pipe-borne water, and public standpipes, the less the dependency of the population on alternative sources of water.

4. DISCUSSION

4.1 Access to Water in Bonaberi

Based on field findings, it is evident that water inaccessibility is a common and pertinent feature in the Bonaberi slum environment. This slum environment is a host to over 3000000 inhabitants, and for all these persons there are a few public taps that support the community. In the Bonaberi slum, there are wells, springs and CAMWATER that supports people. The Bonaberi slum is separated into various quarters, and in some quarters there is no arrangement of water for the houses in quarters like Ngoune and Dakeng which are fishing communities in the Mambanda area. These wells are shallow and

contains dirty and unhygienic water. Additionally, springs are contaminated with industrial waste that flows from urban areas into the ocean. The population also depend on rain harvesting from buildings around which the slum-houses are situated. These wells and springs are used for cooking, cleaning and drinking. Elsewhere in the Bonaberi slums where there exists CAMWATER, inhabitants have to pay money for the repair of broken pipes and taps or they have to buy water from other neighbourhoods. Another striking observation was the fact that broken pipes that supply water in the communities lie in springs. This means that water could still be contaminated even before it reaches the population. Where there is a tap, the women in the slums have to wait for long to collect water.

Quality of water is also very much dependent on the source that suppliers use. If they are dependent on public network water is more likely to be of a reasonable quality and uncontaminated than if sourced independently from private wells or boreholes reliant on potentially contaminated groundwater. The quality of water which reaches the consumer is of course dependent on the quality of construction or working methods. For example, mobile distributors, who transfer water between multiple containers, run a much higher risk of contamination [11]. They are less likely to be subject to complaints or lost custom due to poor quality as they do not always have repeated interaction with the same consumer base.

4.2 Distance Covered to the Nearest Water Point

Distance covered by the households to obtain potable water was also a concern, as the longer the distance covered, the lesser the effectiveness and efficiency to which people can comfortably use pipe borne. The least distances covered by the participants were less than 50 meters and 29.6% of research participants were within this range, whereas 23% of the respondents cover more than 200meters to get potable. Those who cover such long distances to get potable water are those who depend on other sources of water for domestic activities and only go for potable water as a source for their drinkable water.

4.3 Regularity of Water Flow

The population of Bonaberi have resorted to sinking wells in their homes to solve the problem

of water scarcity. This has been due to inconsistency in the management of the water system, as damaged water pipelines stay longer than expected before they can be maintained. The absence of electricity in some localities equally contributes to the absence of potable water, as machines which are used to power water supply depends on electricity. All these has only made the population of Bonaberi to suffer from the lack of potable water. This phenomenon was common in most of the quarters under investigation. Urbanization is one of the major social changes sweeping all over the world, especially in developing countries, where urban growth rates are rapidly increasing. Urbanization brings changes in the way of people's life- in the number of people they see in the places they were, and often in the quality of water they drink. Such changes have profound impacts- both positive and negative on the health of city residents [12]. Urban poverty is a multidimensional phenomenon. The urban poor lives with deprivation and their daily challenges include limited access to employment opportunities and income, inadequate and insecure housing, lack of access to safe drinking water, violent and unhealthy environments, little or no social protection mechanisms and limited access to adequate health and educational opportunities.

5. CONCLUSION

All communities in slum environments pay largely for the water they use and the amount of payment is proportionate to water consumption. Based on the analysis, the following conclusions are plausible: Firstly, that water accessibility is a major problem which is caused by weak institutional policy governing the provision of basic services to lagging communities in the Bonaberi slum environment. Secondly, the regularity of water flow has been largely poor (once a week), principally due to the lack of maintenance and poor quality pipes. Owing to this rule, water which is largely available as a natural resource that is to be made available for all has become the possession of only those who can afford to pay for the best quality. Obtaining water through regular payment is unquestionably difficult for slum people, most of whom are day labourers. Consequently, it is almost impossible for them to arrange for a water source for their financial inability to pay for it. Water inaccessibility has become a crucial part of the people living in the Bonaberi slums. Many slum inhabitants cover several distances to fetch water

and the failure to bring in water has led to torture and quarrel. In Bonaberi, slum inhabitants who do not have access to potable water end up buying water or have to pay for the overhaul of the water. It is therefore recommended that the government should integrate all the sectors saddled with the task of providing safe drinking. A control committee should be set aside independent of these bodies to check the quality of water supplied to the communities. This will reduce the incidence of contamination of potable water.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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