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Article

Decreasing Access to Water and Coping Strategies to Shortage in Informal Settlements of Calabar, Nigeria

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Abstract: Calabar is a city where 65 per cent of people are living in poverty in informal settlements with low and decreasing access to improved water. In the low-income informal areas of the city, residents are being made responsible for securing their own water supply through several coping strategies. This paper explores the decreasing access to water and coping strategies to shortage in Calabar, Nigeria. It analyses two complementary pieces of data: (i) the households' coping strategies and (ii) satisfaction with improved water services. A mixed method was introduced and data was collected via fieldwork at three settlements in Calabar. A household survey of 360 respondents, 27 in-depth interviews and 2 focus groups were conducted. Findings show that households engaged in different coping strategies to access water, including conservation (changing routine/reusing), purchasing (spent a significant proportion of their income on buying water) and pumping as a coping strategy. The household's tenure, socioeconomic status and water accessibility determines their decision to move if services are not provided. A crucial differentiation exists between a larger population being granted less access to water versus certain individuals receiving access to a greater quantity of water.

Keywords: water; water accessibility; water system; resilient; coping strategies; households

1. Introduction

Among the world poly crises, the crisis of water is one of the most urgent [1]. Water is a critical civic service required by citizens. Its decreasing access and low resilience pose risks and stress in human society. A look at the availability of water supply across the globe presents a glaring image of shortages and unimproved sources [2–4]. There are persistent gaps in the general provision while the access rate is falling across the globe [2,5,6]. For example, about 780 million people lacked access to improved water in 2017 [7]. The burden of lack of access to improved water in Sub-Saharan Africa is high compared to other regions of the world [8–11]. More than 400 million (80%) of the under-served population live in Sub–Saharan Africa alone [12]. These numbers are projected to increase with population growth coupled with rising temperatures, longer and recurrent drought and diminished river flow [1].

In Nigeria, it was estimated that about 66% of the population had access to safe drinking water, while the rest of the 34% (75 million people) did not have access to improved sources of drinking water [13], third after China (119 million) and India (97 million) [14]. The burden of water access and low resilience to shortages is likely to worsen due to rapid growth in population and unsustainable urban processes [15].

Rapid urbanisation, demographic trends and unsustainable development pathways are projected to present significant challenges to domestic water supply [16]. Due to these challenges and many others, Calabar faces problem in providing clean water, without which the future of sustainable development can be difficult to attain. About 65% of Calabar's population live in poverty in informal

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settlements, exacerbated by overcrowding, with low resilient and decreasing water access. These settlements are concentrated and built outside the formal system of laws and regulations and are meant to ensure resilient structures, settlements and systems. These projections raise concerns about the future of water access, compounded by stress bundles.

In the context of decreasing access to improved water and low resilient to shortage of improved water, international agencies (UN, World Bank and WHO) and the government have struggled with ideas on how to solve the widespread problems associated with access to improved water [5]. The catalyst's role of providing improved water has also received significant recognition with the introduction of the Sustainable Development Goals (SDGs) in 2016. Specifically, SDG 6 which is an urgent call for action for all countries to ensure availability, sustainable management as well as the furtherance of cooperation and partnership at all levels in order to achieve the water-related goals and targets by 2030 [17–19].

In this regard, the Nigerian government have put in place measures to ensure access to water by taking up the cost of water while circumventing the bottleneck that constrained infrastructure provision. However, Calabar faces the challenge of meeting its immediate needs, increased deterioration of water supply infrastructure in their environmental and social conditions, and growing demands and making long-term plans to provide improved water for the increasing population. Improved water is classified based on the definition provided by the World Health Organisation/United Nations Children's Fund Joint Monitoring Programme (WHO/UNICEF JMP). The categories encompass piped water supplied to residential units, piped water supplied to yards or plots, public taps or standpipes, tube wells or boreholes, safeguarded dug wells, safeguarded springs, and rainwater [20]. Innovative ways of solving water shortages as well as large investments will be needed to provide water and maintain ageing infrastructure to serve this growing need at the forefront of envisioning the future of cities [21].

Studies have documented the inability of cities to provide improved water [10,22–25], and the importance of water as a critical good and questions of water supply [26], access and management both in quantitative and qualitative terms. Many of these studies propose guidance towards improving water operations or building infrastructure to increase water supply based on informed decision-making. Others, such as Mutune and Maingi [27], Molden, Khanal and Pradhan [28], Jepson, et al. [29] and Wutich, et al. [30], revealed considerable evidence of the need for pragmatic measures to improve access to improved water supply. Abubakar [31] and Achore, Bisung and Kuusaana [32] researched the approaches adopted by households in response to the inadequacy in domestic water supply and the various elements that influence the selection of coping strategies. However, there needs to be more empirical data on how water services are provided, coping strategies and satisfaction with improved water in Nigerian informal settlements.

Hutton and Haller [33] study suggests that most agencies responsible for providing water often discriminate against informal and marginalised groups [8,34]. Informal settlements and marginalised groups are more vulnerable because they have less access to financial and social assets to cope such as land tenure, political participation, livelihood opportunities, governance, and infrastructure [35]. This evidence reflects the need to effectively increase access to improved water for the urban poor. An unreliable water supply makes it difficult to reduce water-related diseases [36], increase water access [37] and cope with the challenges associated with water shortages [38].

Therefore, this study sought to explore the decreasing access to water and low resilience to shortage in Calabar. It analyses two complementary pieces of data: (i) households' coping strategies and (ii) satisfaction with services. The overreaching questions are: how water services are provided? what are the households coping strategies across the sampled settlements? how satisfied are residents with the quality of water services provided? These are alongside recommendations to provide improved water at both the city and household levels.

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2. Materials and Methods

2.1.1. The study area

This study was conducted in Calabar, the administrative capital of Cross River, in the Southern part of Nigeria. According to the data from the Nigerian Bureau of Statistics (2023), Calabar is estimated to have approximately 550,000 inhabitants, with a high poverty rate of over 50%. The local economy is heavily reliant on petty trading, urban agriculture, tourism, and fishing, with a large proportion of the population employed in the informal sector [39]. Water stress, inequitable access to water supply, inequalities and inadequate financing for established water sources, and lack of information about the state of water resources and their use still exist in the city. The increasing frequency and intensity of water shortage in the region has significantly impacted health and livelihood opportunities, with as many informal residents lacking access to water supply [40].

The Cross River Water Board Limited (CRWBL) still bears the responsibility for the water supply in Calabar. However, in reality, there is a gross shortage of water. This is evidenced by the provision of water reservoirs and water tankers by private enterprises and water vendors (Maruwa) to fill the demand. The CRWBL acknowledges there needs to be more adequate access to water supply and better services. This has led the public sector to implement water-saving measures and to shift responsibility through investing in systems to reduce shortages.

2.1.2. Research design

A mixed-method (triangulation) approach was used in this study. A mixed-method research approach allows the triangulation of different research data, provides a better understanding of the research problems and offsets the weakness in using either quantitative or qualitative methods alone [41]. This method is also advantageous because it utilises both methods to capture the responses of stakeholders and households and connect layers of frameworks used in data analysis to enhance the quality of the research outcomes. By leveraging the strengths of both approaches, results from mixed methods strengthen the robustness of the research and stimulate alternative understandings by illuminating the conditions associated with specific outcomes [42]. In terms of specific design, the research used a cross-sectional mixed-method design. The study began with a quantitative survey in the study locality. After analysing the survey result, the researcher proceeded with the collection of qualitative data, which were mainly interviews and focus groups with selected participants.

2.1.3. Data collection

Regarding the sample design, a multistage cluster sampling procedure from the existing enumeration of households from the Nigeria Population Commission [13] was used to select the respondents. The targeted population was the household. The choice of household was that they are in a better place to provide information on the coping strategies to shortage within the period of study. The first stage was a cluster of housing units called Enumeration Areas (EAs). Clusters were located using maps provided by the Cross River State Geographic Information Agency (CRSGIA).

The selected settlements featured here are the result of fieldwork conducted between December 2019 and November 2020 and subsequent trips to Calabar, Nigeria. The primary reason for choosing Calabar is its seemingly unremarkable profile as a medium-sized city in Nigeria that is affected by water stress due to the vulnerability of its coastal region. Thus, it has the potential to demonstrate the complexity and limitations of a region with water challenges compounded by the urgency of a growing informal population.

Three informal settlements, Mbukpa (squatter settlement and coastal community), Ekurinum (middle-income earners) and Ikot Ansa (unplanned buildings in informal settlements), were selected based on the peculiarity of the challenges, accessibility, income level and the structure of the study area. Mbukpa is an unplanned neighbourhood in the southern area of Calaber, 5km from the creek. Ekurinum is a sqautter settlement on the western coast 5km from the city centre. Ikot Ansa is an unplanned community located east of Calabar, 10km from the city centre.

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Systematic sampling and simple random sampling techniques were used to select the buildings and streets considered in this study to give each household an equal opportunity to be selected and to ensure a sample that truly represents the entire population. A sample size of 120 households was selected from each settlement making a total of 360 households. The sample populations were deemed sufficient to detect an outcome affecting 10% of the people using a power of 95%, with an error margin of 5%.

Computer-Assisted Personal Interviews (CAPI) were used to collect data from respondents aged 18 years and above. However, 317 (88%) of the household's questionnaires were retrieved. The high return rate was due to the ability to find the respondents included in the study. The questions were designed to elicit information on socioeconomic characteristics, the households' coping strategies and satisfaction with improved water. Respondents were asked about their perception of the quality of water supply, reliability of services and their related costs within the settlements, and monetary labour costs related to services received. A complaint procedure to the service providers and relocation plans in the three selected settlements was collected from households who have spent more than two years in the study area.

In terms of the qualitative data, in-depth interviews were conducted with key informants in the study area and two focus groups from stakeholders involved in service provision, some of whom were conveniently sampled and some purposely sampled. This includes stakeholders, most of whom were professionals or experts (water consultants, non-government organisation officers, the government official in CRWBL; 12 male and eight female), interviewed in their offices in Calabar. Seven informants were sampled in each settlement, bringing the total number to 27 participants.

In addition, four (4) household heads (three male and one female) were conveniently sampled in Ikot Ansa and Mbukpa for interviews. The two focus groups were conducted, one with technicians at the water pumping station and the other with community youth groups in Mbukpa. Data were collected using a structured interview guide and a tape recorder. Information solicited from the interviews and focus groups focused on water access and resilience to shortage, how households cope with unreliable services and challenges and how water access can be improved.

2.1.4. Data analysis and ethics

Quantitative data were analysed using Statistical Package for Social Science (IBM SPSS 24, 2016). This involved cross-tabulation, a chi-squire test of analysis and descriptive statistics, presented with tables and graphs. Qualitative data collected through in-depth interviews and focus groups were coded and analysed using Nvivo. Interview recordings were transcribed manually, checked, and thematically analysed and 'themes' were generated. These themes include water access, coping strategies and satisfaction. A convergent mixed-method procedure was introduced to merge the quantitative and qualitative data and triangulated it to provide comprehensive research findings.

Ethical consideration was very important in the inquiry and required the researcher to always protect the dignity of the research subject throughout the period of investigation. To maintain a climate of trust in conducting this research, the key ethical consideration before the fieldwork was maintaining transparency our identity as researchers and being on the purpose of the research and its attendant goal. Throughout this research, the legal requirements for research in the Data Protection Act of 1998 and the general research ethics of Newcastle University guided the entire study. We met all the international rules and regulations for academic and professional best practices.

3. Results

3.1.1. Households socioeconomic characteristics

Table 1 shows the mean household size of 6.5 persons in the three settlements, with a median of six people. There are variations in the distribution of household size across the settlements. Mean household sizes in Ekurinum and Ikot Ansa are 5.8 and 6, respectively (median is six), and in Mbukpa, the mean is 7.5 (median is eight). The interquartile range (IQR) of Mbukpa and Ikot Ansa

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at 25 quartiles and 75 quartiles are 7 and 8 and 5 and 7 individuals for each settlement, which demonstrates there is a concentration of large households in these settlements.

Table 1. Household size per settlement.

	Mbukpa n = 112	Ekurinum n = 95	Ikot Ansa n = 110	Total n = 317
Mean	7.47	5.76	6.00	6.5
Median (IQR)	8 (7,8)	6 (5, 7)	6 (5,7)	6 (5, 8)

Regarding the gender of household heads, Table 2 shows that about 65% were female and 35% were male. This is mainly because most of the respondents were housewives whose husbands were absent at the time of the survey. These figures differ from the earlier findings from the Nigerian Demographic and Health Survey, 2018, which show that the gender of household heads was 50% male and 50% female.

Table 2. The socioeconomic characteristic of household heads (percentage) by settlement.

	Mbukpa n = 112	Ekurinum n = 95	Ikot Ansa n = 110	Total n=317
Gender				
Female	63.4	69.5	63.6	65.4
Male	36.6	30.5	36.4	34.6
Educational status				
Formal education	42.7	60.0	55.9	54
No formal education	52.0	36.0	41.0	42
Don't want to say	5.4	4.2	4.5	4
Educational level				
Primary/elementary	62.5	44.2	40.9	50.8
Secondary	24.1	21.1	23.6	24.9
Tertiary/higher	13.4	34.7	35.5	24.2
Employment status				
Unemployed/laid off	42.0	31.6	35.5	37.0
Paid work (full time)	7.1	28.4	25.5	21.4
Self-employed	20.5	14.7	21.0	20.5
Paid work (part time)	10.7	13.7	7.3	8.5
Daily working	16.0	5.3	5.5	7.8
Taking care of family member	2.7	5.3	1.8	3.3
Retired/pensioner	0.9	1.1	3.6	1.6
Types of occupation				
Trading/sales worker	35.7	38.0	41.5	38.4
Artisan	23.3	19.8	15.6	19.6
Agriculture and allied sector workers	22.0	12.2	25.0	20.0
Civil service/technical related workers/administrative workers	12.7	16.0	10.0	13.0
Student/scholar	4.1	7.3	6.4	6.0
Skilled construction work	2.0	4.0	3.0	3.0
Others	0.2	2.7	1.5	1.4
Tenure				
Owner of the house	25.9	51.6	38.2	38.5
Rented	66.1	46.3	57.3	56.6

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Family owned	8.0	2.1	4.5	4.8

There are relatively significant proportions of older people, with 21% of household heads aged between 51–60 years that make up more than one-quarter of the population. About 7% of household heads are over 61 years of age (the official retirement age is 60 years for both men and women). Most household heads (27%) are aged between 31 and 40. This shows that the population is economically active and is within working age. Of these household heads, 45% have one or more dependent children. The numbers of those aged between 25 and 30 years are significantly higher than that of the household heads aged 61 years and above.

Results on the distribution of respondents' level of education show that 44% and 60% have completed primary school in Ekurinum and Mbukpa, respectively. Household heads in Ekurinum have comparable levels of education to the other three settlements, with 21% having had at least secondary education. 35% completed tertiary or higher education in Ekurinum. Household heads in Ikot Ansa have the highest level of education, as 36% have been educated to the tertiary level. Of the households surveyed, only 13% completed tertiary education in Mbukpa.

The most common occupation is trading (48%) and agriculture, all allied sectors. Artisan and skilled construction workers comprise only 12% and 7%, respectively, of the sample. A significant number (12%) of the total sample of households in all settlements are engaged in agriculture and allied sectors, most of whom are women. Other occupations include fishing, sellers of tobacco and scrap iron. There were variations regarding occupation between respondents across the sampled settlements. Trading was prevalent in Mbukpa (53% versus 38%). There is a predominance of artisans in Ekurinum (22%), but only 3% of workers in Ikot Ansa take artisanal jobs. Other occupations are well represented in all sample settlements, including charcoal burners, the food processing and beverage industry, welders, and painters.

Over half of the households are rent-paying tenants (57%). Rental tenure is characterised by the use of a tenement or single room house type. Owner-occupier households accommodated in multifamily housing constitute 38 per cent. Only 5 per cent of houses in the study were family-owned. A disaggregation of data shows that more of the households in Mbukpa (66%) are tenants than in Ekurinum and Ikot Ansa (46% and at 57%, respectively). Thus, there are more tenants in central than in peripheral settlements. Renting ranges across a continuum of forms, from tenants living in formal housing with legally binding contracts with the owner (which is beyond the scope of this study) to those in squatter settlements and slums with only verbal contracts with the owner. Other tenure forms have a more ambiguous legal status, somewhere in between these two extremes.

3.1.2. Source of water

Water sources and supply are important services for households in Calabar. The provision of improved water is a fundamental intervention. It is an essential requirement of people's livelihood security with a directly productive purpose and role in increasing labour productivity because of its impact on health or in combination with other capital assets. Table 3 shows that 42% of households obtain water from a shared tap/standpipe. This result is very much in line with the widespread belief that share tap/ standpipes are the main source of water for the urban poor and that the informal residents are likely to comprise a larger proportion of standpipe users [43].

Table 3. Source of water supply (%) by settlement.

	Mbukpa	**Ekurinum**	**Ikot Ansa**	**Total**
Shared tap/Standpipes	50.9	28.9	46.4	42.1
Borehole	21.4	28.9	16.4	22.2
Rainwater harvester	13.4	3.2	17.3	11.3
Private tap	1.8	30.5	3.6	11.9
Protected dug well	5.4	5.3	10.0	7.0
Stream	1.8	1.1	2.7	1.8

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Other	3.6	2.1	3.6	3.0
Don't want to say	1.8	-	-	0.6

About 22.2% obtain water from boreholes, and 11.3% from rainwater harvester. At the same time, 30% of households in Ekurinum have a private tap, compared with only 2% in Mbukpa and 3.4% in Ikot Ansa. The substantial differences in this situation may be due to improved housing environment and socioeconomic status. Only 3% of households own a well in Ikot Ansa. The sampled settlements in Calabar manifest have a combination of low- and middle-income dwellings. It appears that high-income settlements tend to exhibit a more secluded demeanour. So, residential areas frequently encompass households with diverse levels of water accessibility, primarily contingent upon their socioeconomic status and tenure of housing. For instance, out of the sampled households, 11% possess an indoor connection and are proprietors of their living quarters, while majority of the participants who use water from a shared tap/ standpipe are tenants.

The chi-square test shows no statistically significant difference between Ekurinum and Ikot Ansa regarding access to water sources (X2= 8.234 df=5 p-value-0.142. However, some households in Mbukpa obtained drinking water from shared taps, as its proportion was higher than in Ikot Ansa. The private water supply in Calabar was neither sufficient nor reliable. Most of the private tap connections in the settlements supplement the water they receive from piped distribution with water from other sources.

The other category of water sources in all sample settlements were tankers and water vendors. Vending is common practices in many parts of Nigeria where lack of infrastructure limits access to adequate quantities of improved water [44]. People pay a water vendor to fill their tanks and buckets. Sometimes, the water is supplied by a water system constructed by the residents. Households, mostly women and girls, have to queue for longer hours for water. A respondent in a focus group in Ekurinum said:

> *"Access to water is a problem for us, especially in the dry season. It is common to see people constructing drinking water sources like boreholes and wells themselves. Some of us who cannot afford our own boreholes employ the services of water vendors. Some people wait for hours for water vendors (maruwa) to bring them drinking water" (FG2, R19, Ekurinum, M, 29, 12/09/2019).*

Other households need a mains connection, leading to a reliance on expensive water vendors or the creation of illegal connections to mains water pipes. In addition to the occasional water shortage, a reduction in the quality and flow of water causes people to resort to unsafe sources (see Figure 1) that can almost erase the health benefits [45]. These also have significant health and livelihood consequences.

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Figure 1. Water pump installed by the water board.

In an interview, a householder stressed that the water accessibility was one of the top problems facing the community:

> *Every newspaper in Calabar metropolis runs at least one photograph and a new item each week condemning another breakdown of water supply. Despite numerous appeals to the government for assistance, we continue to struggle to get water from the water board. (Interviewee, R23, Mbukpa, M, 55, 11/10/2020)*

Respondents described water shortages as water cut, undesirable water quality and water rationing. Utility operations are less significant and it is not interested that it will serve more than the small fraction of the informal residents. An interviewee from the CRWBL commented that:

> *One significant factor contributing to water supply interruptions is the inadequacy of purification chemicals, this is usually compounded by delayed delivery. Distributing untreated water to the public would create a catastrophic situation, hence the only feasible recourse is to obstruct the water supply until the necessary chemicals are obtainable.*

An efficient and effective water supply infrastructure is necessary in order to alleviate the daily difficulties faced by water users. However, most people access their water sources by filling jerry cans from the trucks of small water vendors, packaged water, and emergency water trucks. This show the heady controversy that has surrounded private sector participation in the piped water systems.

In terms of distance to water sources, Table 4 shows that households access water at places between 150 m and 2 km from their home. Distance from water sources constrain people's productive capacity and, therefore, the human capital at their disposal. Consequently, more time and effort must be spent meeting the household's basic needs. Comparing distances to water sources on Mbukpa to that of Ekurinum, the latter is better off than the former. Distances to a water source in Ekurinum and Ikot Ansa were generally shorter than those in Mbukpa. This is because of the relatively small area covered and the proximity of a shared tap to almost every household in the settlement.

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Table 4. Distance to water source (%) per settlement.

Km	Mbukpa	Ekurinum	Ikot Ansa	Total
Less than 1	37.0	54.0	42.0	44.3
2–3	23.7	31.0	22.0	25.6
3–4	23.3	11.0	26.0	21.0
More than 5	16.0	4.0	9.0	9.6

Securing water resources for households in these localities has been transferred to the residents. Households may not own a well or borehole if they live in an area where the water level is too low if their well or borehole has dried up, or if they cannot drill within their settlements. In this case, private utilities play a vital role in the provision of water services. However, their coverage may not extend to the most marginalised individuals. For instance, a limited number of individuals residing in informal settlements have the opportunity to access in-house or plot connections. The most disadvantaged residents often depend on various water sources, including private vendors, packaged water, and storing water within their residences.

3.1.3. Cost of water

Different type of water sources varies in their price level and payment structure. About 40 such cans add up to a cubic metre, and the typical household of six members consumes about 1,000 such cans monthly. We found that buying water takes up considerable amount of household income for residents across the three settlements. Households consuming 50 litres per person per day according to WHO recommendation through direct piped supplies would have to allocate between 10-25% of their income for water.

In terms of the cost of water in the three settlements, there was no substantial difference in the cost of water in the sample settlements. We inquired about the amount respondents paid for water, to which the respondent stated the price of water varied with the income level of the settlement, starting from 50 jerry cans for US$2 according to official rates. In Mbukpa, water appears relatively affordable and was resold at between US$0.20 and US$0.50 per can. Some water vendors have their own private connections and the price depends on the conditions of water supply and the location of the consumers' premises. The households pay ten times more per litre to water vendors every month than they would if they had piped water. This is much more than they would pay if they were served by the public water supply. Thus, the water supply falls far below the levels required to satisfy minimum healthy living conditions, and the supplies are thus prone to contamination (see Figure 2).

Figure 2. Water supplied by truck (*mai ruwas*) in Atimbo.

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Respondents indicated that the price of water was generally lower in areas where piped water flowed more frequently (Interviewee, R11, Mbukpa, F, 35, 11/10/2020). We then asked the respondent why they believed the price was lower, suggesting that it was only because there was a pipe. The respondent confirmed this, stating that the lower price was due to where water was available. It is believed that when the water did not flow, the price would be higher. The respondent confirmed this, explaining that in Ekurinum, if the water did not flow for approximately three days, the price would increase.

Although vendors charged higher prices for water and the cost was subject to fluctuations, it appeared that the range of costs was relatively predictable and manageable. In fact, interviewees generally considered the prices charged by vendors to be reasonable and consistent. Some interviewees also mentioned that if the price was too high, they had the option to use less water or wait for the price to decrease before doing their washing or engaging in water-intensive activities to a certain extent (Interviewee, R7, Ekurinum, F, 45, 11/10/2020). In addition, the time spent searching for water was considered an important cost to consider.

3.1.4. Coping strategies with water

Table 5 shows that most respondents (32%) used water conservation (changing routine/reusing/storing) as a coping strategy. This coping strategy reduces the quantity of water used, reduces time spent getting water from street vendors and increases the time spent collecting water from public or community water supply. It was also seen that purchasing (27.5% spent a significant proportion of their income on buying water). It has additionally been found that the availability of water is progressively transforming into a pricey resource within the community. A female respondent in Mbukpa said that:

> *"In terms of the monetary expense of water, it looks like that we employ water in nearly every aspect of our activities here, specifically for consumption, personal hygiene, cleaning, labour and so on. Living in this locality has become problematic for us since we are required to pay for all these necessities, that is, potable water, bathing, and sanitation, thereby leaving a diminished amount of funds allocated for our sustenance".*

Only 1.9% of the respondents choose pumping as a coping strategy. This may be due to the limited number of water pumping points in the study area.

Disaggregation of data shows that 22% of respondents used rainwater harvesting (collecting) in Ikot Ansa compared with 4% in Ekurinum. The collection consists of walking to and from a water source of 10 minutes per trip with a different average waiting time of 20 minutes. About 83.5% of household heads were concerned about getting enough water to meet their daily requirement of 40 litres. In terms of improved services, households expressed worry about the quality of water supplied, and 9.6% of respondents reported that they were concerned about the quality of the water provided.

Table 5. Household coping strategies (%) per settlement.

	Mbukpa	**Ekurinum**	**Ikot Ansa**	**Total**
Water conservation (changing routine/reused)	35.0	28.5	32.0	32.0
Storing	20.7	34.0	19.6	24.6
Purchasing (alternative water)	27.0	32.5	23.0	27.5
Rainwater harvesting (collecting)	16.0	4.0	22.0	14.0
Pumping	1.3	1.0	3.4	1.9

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Respondents using public water supplies reported an average of 6 breakdowns in the supply system and two breakdowns from the shared water supply each year. One of the factors that contributed to the failure of the CRWBL policy implemented for direct-to-water homes was that many people needed to have in-dwelling pipe-borne water sources.

We asked respondents if utility networks provide intermittent piped water supply, respondents said to have been supplied with contaminated water due to storage and handling practices. They expressed different opinions on water supplied during supply periods, such as fluctuating pressure from the CRWL, the breakdown of pumping systems, and increased risk of contamination. The perception that exclusive reliance on private water provision would be disadvantageous arose partly from the failure of piped services. An interviewee, aged 35, living in Ekurinum explained that:

> *"depending on piped water could result in the inconvenience of having to wake up in the middle of the night to fill barrels* (Interviewee, R23, Mbukpa, F, 35, 11/10/2020).

Even individuals with higher or more regular incomes faced challenges in planning their water usage around piped services. Another interviewee, a retired lecturer living in the Ikot Ansa area, where he owns his home and a fish farm, recalled that he was unable to access water when he attempted to bathe on the same morning (Interviewee, R6, Ikot Ansa, M, 67, 11/10/2020). However, he had the means to purchase sachet water or store large quantities to supplement his water security. As he stated, "*We have water storing facilities which are helping a lot of us too. If you don't like this (share tap) water you buy large storage or a sachet water and put it in your room"*. Likewise, a woman who sold beverages by the roadside in the Mbukpa stated, "

> *"We have a pipe but there is no water in it, we have become used to the practice of reusing/storing water, as it is possible for taps to cease flowing at any given moment, and it is important that we remain prepared for any circumstances. In order to avoid facing hardships during periods of scarcity, we ensure that water is stored in large quantities. We bought a number of drums that is of great assistance during times when water is scarce. Occasionally, my children and I dedicate an entire day to the task of collecting water from one standpipe to another, filling up as many jerry cans as possible. We persevere through the passing days, conserving this water until it is completely consumed*" (Interviewee, R3, Mbukpa, M, 39, 11/10/2020).

During this period, she supplemented her water source by collecting rainwater for washing and cooking, strategically placing large metal pans around the courtyard of her compound. In a focus group discussion, another respondent added "

> *I fetch water and store, this reduce the need to waste time waiting in line each day. Unfortunately, we do not have sufficient storage drum, which necessitates my daily wait in the queue and subsequently causes me to be late for work. In the event that there is no water at the standpipes, I can spare the expense of purchasing water from vendors, which can be exorbitant in price.*

We observed that the daily consultations surrounding how household cope with water scarcity involve various forms of conflict and negotiation in order to gain access to water institutions.

3.1.5. Satisfaction with improved water decision to move

Table 6 shows the pattern of satisfaction with improved water sources in the three settlements. Most respondents (66.2%) were not satisfied with water provided in the study area. Disaggregation of data in the three survey settlements indicates that 76% of households in Ekurinum were not satisfied with the water provided compared to 52.8% in Ikot Ansa settlement.

We asked households if they planned to move if sufficient water services were not provided; about 77% of households in Ekurinum were dissatisfied with the services, but only 24% of households were planning to move. About 69% of households were dissatisfied with service in Mbukpa, and a record low of 30% planned to move if improved services were not provided. Interview also shows

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that households who complained to the utility agency lived in owned housing compared to those who lived in rented housing in the three settlements.

Of the households surveyed, about 69% of households in Ekurinum planned to move, compared to less than 30% in Mbukpa. Households dissatisfied with water supplied were more likely to complain and planned to move to another location. However, the income level of households, tenure status and locations were determinants of the extent of the household plans to move. The analysis of this study revealed some important outcomes. The chronic shortage of water was recorded as one of the complaints of 60% of the households planning to move. About 68.8% of the Ekurinum residents have water facilities connected to their homes compared to Mbukpa, with 39% lacking adequate water supply to their homes. Most households only receive water from the CRWBL once or twice a week and sometimes stay for an average of 3-6 weeks without water supply from the service providers.

Table 6. Satisfaction with service and decision to move (percentage).

	Settlements			
Satisfaction	**Mbukpa**	**Ekurinum**	**Ikot Ansa**	**Total**
Yes	47.2	24.1	30.0	33.8
No	52.8	75.9	70.0	66.2
Dissatisfaction with service and planning to move				
Planning to move	37.0	68.8	30.0	45.3
Not planning to move	48.0	24.2	62.0	44.7
Don't want to say	15.0	7.0	8.0	10.0

Correlation analysis was used to test the extent of the relationship between water supply and households' level of satisfaction. It can be seen in Table 7 that a positive relationship exists between water supply and occupants' level of satisfaction (rho=-0.017, n=424, $p<0.05$), indicating that occupants' level of satisfaction was attributed to the level of water provided. The data shows that improved water supply is unreliable, and households are generally dissatisfied with the quality of water provided and have often resorted to self-help or private water vendors to advance the level of water supply on an individual and household' level.

Table 6. The relationship between water and level of dissatisfaction with service.

Correlations		**Water supply**	**Satisfaction**
Water	Pearson Correlation	1	.017
	Sig. (2-tailed)		.724
	N	424	424
Satisfaction	Pearson Correlation	.017	1
	Sig. (2-tailed)	.724	
	N	424	425

These enforces a system of rationing whereby the flow of water is directed to specific settlements on specific days. According to a senior representative of CRWBL, the rationing schedule was implemented in order to ensure an equitable distribution water resources across densely populated settlements (Interviewee, R9, M, 45, 12/10/2020). However, despite the complexity of this system, it does not result in an equal distribution of water to all areas. Certain settlements receive continuous service (their mains are always connected to the municipal water supply), but they may still experience issues with water pressure and overall shortages that affect the entire system. On the contrary, the three survey settlements receive water only once a week or not at all. Although the rationing schedule has reportedly been in operation for more than 10 years, it has not been made publicly available and most people do not receive advance notice of water flows.

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Households may rely on occasional newspaper publications to find out where water will be available on a given day, but when respondents described their experiences with water services, it became clear that the distribution of water was highly inconsistent. Despite the water utility's control over water flows in the urban areas of Calabar through the pipeline and rationing schedule, these infrastructures can be difficult to access, understand, and predict. The lack of water lead residents to seek out other means and services. In this way, residents make decision to move or rely on their sources to access water services on a daily basis, with a particular emphasis on their ability to adapt and navigate a system of sporadic water distribution.

4. Discussion

The socioeconomic data evidences the intricate and interconnected impacts of the water access in Calabar. It underscores the pressing need for efficacious and sustained action to tackle the fundamental causes of the problem and to enhance accessibility to water for the inhabitants. The findings reveal a mean household size of 6.5 persons with a median of six individuals. The mean dependency rate is 3.5 persons, with over half of the households having two or more dependents. Most respondents (65%) were female compared to males who provided data for the study. There was a significant proportion of male-headed households of working age in Mbukpa. The household heads had a mean age of 43 with a standard deviation of 8.568 and were mainly married.

Approximately 54% of respondents had formal education. Half completed primary and secondary school, while 22% only completed primary education. About 37% of respondents were unemployed or laid off, which surpasses the national average of 33.3%. Over four-fifths of employment is in the informal sector. About half of the households walk between 2 km and 4 km (30 minutes' walk) to obtain water. Ekurinum has the highest number of household heads living less than 2 km from their water source. Around 39% of households obtain water from a shared tap, while 29% use a borehole. 30% of households in Ekurinum have a private tap, compared to only 2% in Mbukpa.

Over half of the households are rent-paying tenants (57%). Owner-occupier households accommodated in multifamily housing constitute 38 per cent. Only 5 per cent of houses in the study were family-owned. Renting ranges across a continuum of forms, from tenants living in formal housing with legally binding contracts with the owner to those in squatter settlements and slums with only verbal contracts with the owner.

Women and girls are responsible for making daily decisions on accessing water. Household water collection has been conceptualised to segment gender norms into objects, activities, and roles. Sarkar [46] study in Kenya founds that the strategies of women and men vary significantly in the same household where women resort to practices that are even compromising on their health, hygiene as well as well-being leading to emotional and physical distress. Water accessibility and collection have been and continue to be culturally stereotyped into biological sex roles, with women in the study region and Africa as a whole responsible for its collection and usage [47,48].

The results from this study demonstrate that approximately 72.5% of households in Ekurinum and 65.8% of households in Ikot Ansa have access to a source of water, specifically share tap/ standpipe water. This development is noteworthy, particularly when considering the average municipal percentage of individuals with access to improved water. Mitlin and Walnycki [49] argued that water utilities and other public agencies supplying water are experimenting. They emphasised that while this experimentation appears to be extending access, prices prevent low-income households from being able to purchase sufficient quantities of water from public suppliers. This is similar to the findings of this study. For example, the primary source of water in urban settlements in Calabar was public tap/standpipe, which 42% of households obtain water from. Approximately 26.8% of households in informal settlements of the municipality had access to pipe-borne water that was not within their homes. Studies by Rhoderick [50] also suggests that households experience greater advantages when water is directly piped to their premises, compared to the use of shared taps. Howard, Bartram, Water and Organization [36] insist that the amount of water consumed by households is influenced by the level of accessibility, which is primarily determined by the factors of

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distance and time. It is observed that the quantities of water used in situations where residents have to carry the water may not be adequate to effectively mitigate risks [45]. This is congruent with our study, which shows that respondents have access to water that is not within their homes. The issue of in-house water facilities has become a prominent topic in the discussion of access to improved water [51]. This is similar to the findings by Armah, *et al.* [52] that accessibility to water on premises improves water access, and thus, more effort should be made to extend in-house water facilities.

As demonstrated in the study, one of the factors that contributed to the failure of the CRWBL implemented for direct-water to homes was that many people needed to have in-dwelling pipe-borne water sources. Gbedemah, *et al.* [53] studies on the challenges and coping strategies shows that about 68.5% of households have access to pipe-borne water during COVID-19 compared to 8% who use unhygienic sources. Most households (54.5%) depended on pipe-borne water sources outside their dwellings. The main water accessibility challenge was the increased cost of water (41%) even though water provision was supposed to be free during the pandemic. This study found that most households faced accessibility problem and adapted to the lack of water access by storing water using small-sized storage facilities, using emergency trucks, and also had to buy from other vendors at an expensive rate.

It is found in this study that the process of accessing water services entails an intricate combination of connections and disconnections, which are negotiated on a daily basis through practices embodied in the pursuit for water supply. Respondents in the study utilised a range of water sources (shared tap/standpipes, borehole, rainwater harvester, private tap, protected dug well) as well as networks (including vendors, neighbours, and the CRWBL). Both individuals who had a direct connection to the piped water network and those who did not reported dissatisfaction water flows. However, while the participants expressed the uncertainties in the water flow, they also emphasised the limited opportunities in which they could improve these deficiencies. In this respect, the concept of reliability is established through what Simone [54] refers to conjunctions - the creation of multiple infrastructures involving people and objects, which together authorise life in the urban setting. In this particular case, the conjunctions of water access necessitate the residents of Calabar to develop various coping strategies with majority of the respondents (32%) using water conservation (changing routine/reusing), purchasing (27.5% spent a significant proportion of their income on buying water) and pumping as a coping strategy. The ability to act in resourceful and innovative ways, and to exert some level of control over these social relationships, are critical for the urban informal poor who are unlikely to have storage tanks, and are unable to afford the purchase of water for their household needs [46,55].

Regarding the decision to move, the extent to which they have continual access to water was constrained, not just by the housing tenure status but the household's income and the location of settlement. This is similar to the study by Amankwaa [56] that different social perceptions of the settlements, such as accessibility of services, tenure status and socioeconomic status were clear determinants of the household's decision to move and determinant of use of coping strategies. A crucial differentiation exists between a larger population being granted access to water versus certain individuals receiving access to a greater quantity of water [57,58].

The practice of water supplies to some settlements and others not having access to water has given rise to informal residents progressively more resistant to water scarcity. This shift transfers the responsibility for governing water resources to the inhabitants, thereby redefining their role to cover both consumers and suppliers. It is argued that households have to sacrifice essential needs to purchase water from vendors or acquire products that improve water quality. This situation is particularly arduous for people who are primarily responsible for water collection. These could further impede the household's capacity to cope with water scarcity.

5. Conclusions

The paper explored the decreasing access to water and low resilience to shortages in Calabar, Nigeria. A household survey was carried out using a CAPI to collect data from 325 respondents, in-depth interviews with 25 stakeholders and two focus groups of respondents in charge of service

provision. Findings show no disparities in access to improved water among different groups in Calabar. However, majority of households obtain water from a shared tap/standpipe. In terms of the cost of water in the three settlements, there was no substantial difference in the cost of water in the sample settlements. However, coping strategies are developed to deal with short-term water stresses. The impending crisis of poor access partly leads to the larger-term impact [59]. Most households were not satisfied with water provided and those dissatisfied with water supplied were more likely to complain and planned to move to another location. However, the income level of households, tenure status and locations were determinants of the extent of the household plans to move. Bridging this gap is a crucial policy intervention to achieve the water related target for all residents.

Currently, the government focus solely on providing piped water services as the solution to providing domestic water in urban areas, which neglects informal settlements since they are often considered illegal and unrecognised by governments. As a result, these areas are excluded from resource distributions, which creates institutional barriers and necessitates the use of the coping strategies. As informal residents collect and supply their water, they form a new type of localised privatisation that feeds into power governance and changes the relationship with the city. The finding of this study provides valuable insights into water-related challenges in Calabar and informs ongoing efforts to improve water security by drawing policy attention to the lack of improving water access in the region.

Therefore, there is an urgent need to increase innovative efficiency of use by implementing strategies to improve ways households access improved water [21]. This includes the construction of new water sources and distribution points through water bending and intermittent water supply [2]. Productive economic activities in providing accessible water resources to urban households are needed [60], and not just physical service is required, but constructive strategies in the allocation and distribution. Upgrading water point installation and maintenance of extending trunk infrastructure in informal settlements can significantly reduce exposure and vulnerability to water related stress especially those who are most at risk or vulnerable. This includes funding infrastructure projects and redevelopment of shared water points for water storage [20], informal areas, including peri-urban areas, outgrowths, and urban corridors. In conclusion, the incentivising and/or regulation of water supplied and deployment of new infrastructure services with more focus on the informal and marginalised groups will alleviate the current challenges for sustainable utilisation of resources.

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