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PERCEPTIONS OF THE PROBLEMS OF DRINKING WATER SUPPLY IN ZIGUINCHOR (SENEGAL): CASE OF THE PERIPHERAL DISTRICT NEMA 2

Abstract: Good water quality is important for the human health, energy and development. However, it is not available to millions of people throughout the world. In the Casamance region, the climatic situation has been characterised for the last thirty years by a drop in rainfall, combined with a demographic explosion which has led to an intensive exploitation of available water resources. Ziguinchor, the main city of Casamance, although located in a humid region rich in rainwater, does not guarantee continuous access to drinking water for all its inhabitants, especially those living in the outlying districts. The aim of this article is to show that the difficulties of access to drinking water in the outskirts of Ziguinchor are closely related to the inadequacy of the infrastructure for water supply. The methodology adopted revolves around three main axes: documentary research, data collection and data processing. The results of this study reveal that the water production capacity in Ziguinchor, of 9,500 m^3 per day (i.e. 400 m^3/h), in fact presents a production deficit in relation to demand from population estimated at 583,528 inhabitants, mainly noted in the peripheral zone such as Néma 2. The causes of this mismatch between supply and demand are due to inadequate infrastructure, but also to the pollution and salinity of water resources, in addition to poor governance of the supply sector. Faced with this situation, there is an imperative to mobilise water resources in the commune in a properly rational manner and to ensure more sustainable management.

Key words: water resources, supply, drinking water, periphery, Ziguinchor

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Introduction

Water is a main key for the sustainable development achievement. Today, water supply has become a great challenge for mankind (Kettab & Djaffar, 2016). Africa, the world's poorest continent, has significant water resources. On the other hand, it lacks the distribution and sanitation infrastructure that would allow population to have access to drinking water. One third of Africa's population, 330 million people, has no access to drinking water and almost half of Africans suffer from health problems due to the lack of drinking water. Africa is indeed the continent where access to quality water is the most limited in the world. Barely 60% of sub-Saharan Africa is supplied with drinking water. In relation to the progressive decrease in these resources and the increase in consumption, the proportion of the African population at risk of water deficiency will increase from 38% in 2013 to 74% in 2040, affecting 28 countries (Sakho, 2018).

Water is a commodity that is essential for life and access to it has always been a constant concern for humanity. Freshwater constitutes only 2.5% of the planet's water and is mainly found in frozen form in glaciers and ice caps. The rest of the freshwater is mainly stored in groundwater and only a small part is found on the surface and in the atmosphere (Green Facts, undated). Thus, pressures on water resources are increasing, mainly due to human activities including urbanization, population growth, rising living standards, increasing competition for water resources and pollution (UNESCO, 2011).

The issue of water has become one of the main themes in the debate on the future of human living conditions (Bouguerra, 2003). Water, an indispensable element for life and health, is now enshrined in fundamental human rights (Yao, 2020). Senegal as a whole does not lack water. It has a fairly dense hydrographic network consisting of three rivers that have their source in Guinea (Senegal, Gambia and Kayanga rivers) and which drain a large part of the country. Thus, in Senegal, the largest surface water reserves are located in the basins of the Senegal and Gambia rivers (Sané, 2015). The other smaller rivers with intermittent flows are the Casamance, the Kayanga, the Sine, the Saloum and the coastal backwaters. Finally, a number of lakes and ponds (such as Lac de Guers) complete this hydrographic network (Faye et al., 2019).

Overall, Senegal therefore has sufficient water resources to feed its population (Faye & Dieye, 2018; Faye et al., 2019). The diversity of water resources makes it possible to exploit surface water or groundwater (CONGAD, 2009). However, the country experienced a period of drought during the 1970s which led to a drop in the water table and thus disrupted water resources in the north, the Sahel and in the south, Casamance (Faye & Dieye, 2018). According to the 2003 World Food Programme report in Senegal, only 38% of villages have boreholes for drinking water, 27% have cemented wells and 21% have traditional wells (CONGAD, 2009).

Senegal is one of the countries on the African continent where the population connection rate between 1990 and 2015 is 33% (UNICEF and WHO, 2015). As of December 31, 2015, total water production was 172.27 million m^3, comparing with an annual forecast of 173 million m^3.

According to the Ministry of Hydraulics and Sanitation (2016), there is an improvement in the quality and safety of water access has progressed significantly over the period 2005-2015, with the increase in the rate of access by water supply and the

decrease in water supply access rate per well. However, in recent years, worrying signals have been raised in the water supply with an often-interrupted service and extensions of the afterimage agreement between SONES (public structure in charge of water) and SEN'EAU (private structure) in sometimes unclear conditions, etc. (Pezon, 2018). Although the water crisis is most often linked to the absolute scarcity of physical availability, it is also rooted in poverty, inequality and inequitable power relations, as well as in inadequate water management policies that exacerbate water scarcity (Bohbot, 2008). It became apparent that only a new form of water management can guarantee sustainability between supply and demand or between available resources and needs (Diouf, 2013). This water scarcity also has its origins in conflicts such as that in Casamance.

The issues related to access to water have therefore recently taken on great importance in the major global debates on water. Disparities in the daily water supply between social groups within a defined space have been mentioned by the United Nations on several occasions, although their eradication has been the subject of chapter 18 of Agenda 21, which focuses on the major orientations of sustainable development (Seghiri & Bellal, 2020). Despite being located in an area rich in rainwater, the outskirts of Ziguinchor face several water problems, especially after the urban dynamics it has experienced in recent years. This dynamic is the result of several factors linked essentially to urban population growth and the spatial fragmentation of the population into different types of land use, which have ended up generating different social groupings. All of this has increasingly strained the demand for water in this environment characterised by a more or less humid climate, but the excess of salt water threatens the availability of fresh water in quantity and quality. Faced with this deficit, the authorities have mobilised financial resources to set up hydraulic equipment to meet the demand for water.

There are several reasons for assessing the difficulties of access to drinking water in the outskirts of Ziguinchor. The periphery is considered to be a space with two particularities, geographical in terms of its position in relation to the city, and sociological according to the social groups that occupy it. In addition, climatic and other natural conditions affect the quality and quantity of local water resources (Seghiri & Bellal, 2020). The perimeter of the Néma 2 outlying studied district contains both an urban and natural landscape. The challenge of water in this space has become important, especially after the demographic growth and the urban changes characterised by irregularity and limitation of this resource. The outskirts of Ziguinchor were then confronted with "water stress", and were therefore no longer able to provide the water resources necessary for a sprawling, growing and anarchic urbanity (Sadio, 2020; Gomis & Thior, 2020).

In the face of growing water needs, overexploitation and degradation of resources, steps must be taken to restore the good quantitative and qualitative status of water bodies. Also, the implementation of new resources must be carried out within the framework of a reasoned and environmentally friendly approach. Whether it is drinking, thermal, industrial or agricultural water, the reinforcement or development of its use must be part of a global and expert approach. It includes a relevant assessment of the resource, efficient and safe means of exploitation, and a management and protection policy that is part of a global territorial vision (Sadio, 2020; Gomis & Thior, 2020). For this reason, the present study examines the difficulties of access to drinking water in Ziguinchor,

particularly in its peripheral district of Néma 2, in close connection with the inadequacy of the infrastructures for supplying this resource.

Study area

The town of Ziguinchor is located in southwestern Senegal, 60 km from the mouth of the Casamance River. It is built on a river side, made up of flood zones and continental shelves which are surrounded by forests with the plant species typical for South Sudanese climate (Ndiaye, 2014). While the site of the town is occupied by urban forms and agricultural land with strong agricultural potential, its extension along the Casamance River is blocked by two backwaters: the backwaters of Boutoute and that of Djibélor. The rainwater from this area therefore flows towards the Casamance River and its tributaries or stagnates in its depressions. The commune of Ziguinchor, capital of the region of the same name, is located on the left bank of the Casamance River, 65 km from its mouth on the Atlantic Ocean and 15 km from the border with Guinea Bissau. The surface area of the Commune is estimated at 4,533 hectares (PDC, 2018). The Commune is bordered to the north by Tobor (Commune de Niamone), to the south, east and west by the Commune of Niaguis. To the south of the town of Ziguinchor is the Néma 2 sub-district, which was selected for this study. It is important to specify that the Nema 2 sub-district is attached to the Néma district, hence the name "Néma 2". As a result, it is not one of the 26 officially recognised neighborhoods in the municipality of Ziguinchor. The Néma 2 sub-district is located to the east by Kandialang-Ouest, to the west by Kansahoudy and Castor, which is also a sub-district of Néma, to the north by the water tower sub-district included in Néma and which constitutes its boundary, and to the south by Kénia (Sadio, 2020; Gomis & Thior, 2020). Néma 2 is a sub-district covering an area of 62 ha (cadastre) (Fig. 1). The sub-district of Néma 2 suffers from a problem of accessibility due to the fact that it is not subdivided, which explains all the difficulty in getting the water and electricity supply network into it.

In the town of Ziguinchor, the population obtains its water supply from underground water resources. The drinking water supply infrastructure consists of a SEN'EAU water supply network covering part of the town and numerous private wells. However, during the rainy season, the use of rainwater as drinking water is not negligible in many parts of the city. Moreover, the percentage of subscribed concessions in peripheral or restructured districts is very low (for example 4% in Kenia and 2% in Kandialang). This situation is caused by the inaccessibility of the network for part of the population and, on the other hand by the lack of financial means for some people despite the reduction in subscription costs as part of the social connection policy (PACTE, 2006). In addition, since 2002, the city of Ziguinchor has experienced an increase in losses in the network, ranging from 13% to 21% of production, due to the dilapidated state of the network in the older districts (Sadio, 2020; Gomis & Thior, 2020). The city of Ziguinchor (especially the outlying districts) is therefore faced with water management problems for which the decentralised services of the state, local authorities and NGOs are trying to find solutions to improve the living conditions of the population.

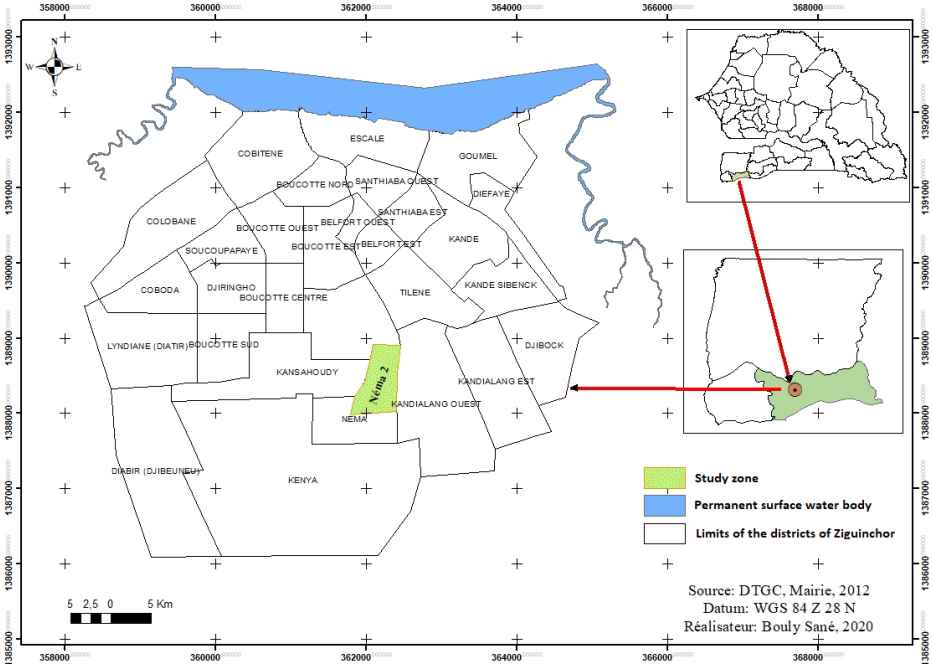

Fig. 1. Location of the town of Ziguinchor and the sub-district of Néma 2 (Source: DTGC, Municipality of Ziguinchor, 2012)

Over the last few decades, this geographical area has undergone a very important demographic evolution influenced by a significant influx of people from the rural areas of the region and from Guinea Bissau. The increase in the number of buildings has been particularly spectacular in Ziguinchor from independence to the present day, combining the densification of buildings in agricultural areas and buildings built in new urban areas (Diallo, 2015). Between 1976 and 2013, the population increased threefold, representing an annual rate of change of 4.4% (Diédhiou et al., 2019). Migration is essential (Sakho *et al.* 2016): while the number of city dwellers born outside the city was over 53% in 1973 (Bruneau, 1979), they still represented 43.7% of the population in 2007 (Sy and Sakho, 2013). At the same time, in 30 years, the municipal perimeter has increased by only 25%, from 3,400 ha in 1972 to 4,450 ha in 2002 (Sakho *et al.,* 2016).

This rapid change in the population of the city has led to an unprecedented urban sprawl which has resulted in an anarchic and uncontrolled occupation of certain areas on the periphery of the city. Indeed, neighborhoods such as Kénia and Kandialang-Est are located in these depressions or on sites which were reserved for agricultural activities (Sadio, 2020; Gomis & Thior, 2020). This would be explained by many socio-economic factors that have caused the rural exodus as well as the development of the standard of living in the big cities. The analysis of Fig. 2 has shown the spatial evolution of the city of Ziguinchor between 1914 and 2017, an evolution which has gone through several phases since the colonial era, according to the different housing policies. This spatial spread took all directions from the initial core of the town of Ziguinchor.

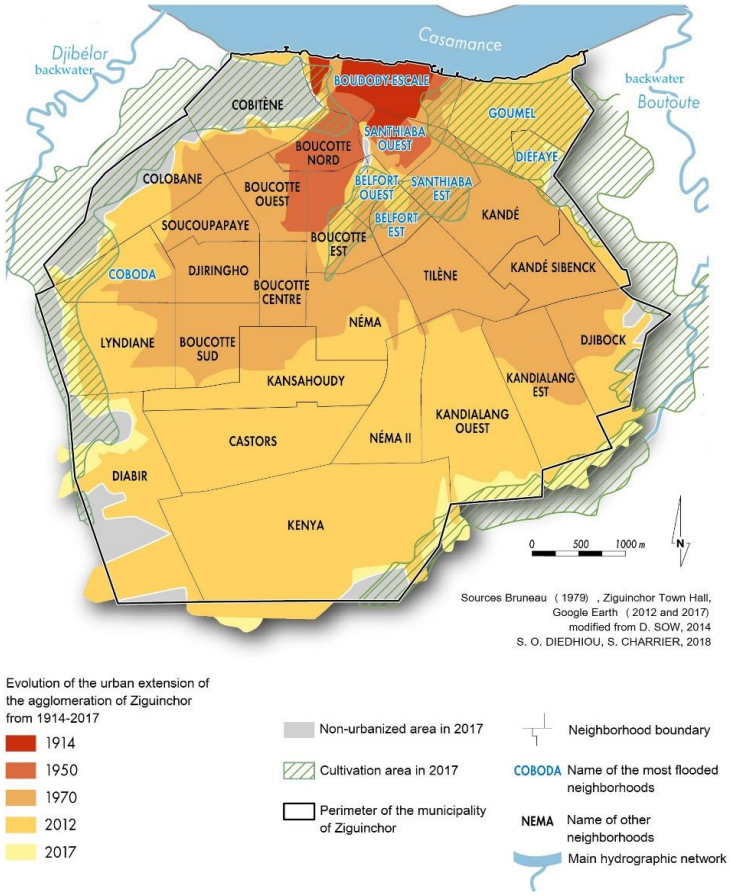

Fig. 2. Evolution of the urban extension of Ziguinchor between 1914 and 2017 (Source: Diedhiou et al., 2019)

The urbanisation of the town of Ziguinchor took place in four phases. The first took place during the colonial period, the second came after independence, more particularly during the rural crisis, the third around the 1980s following the beginning of the politico-armed crisis in Casamance, and the fourth in the 2000s after the creation of basic infrastructures in the commune. Its geographical position being favorable during the colonial period, the city welcomed thousands of people. After independence, the town of Ziguinchor saw the influx of an ever-increasing number of peasants discouraged by the constraints of a poorly oriented and technically underdeveloped agriculture. Besides these factors, climatic consequences, especially droughts also contributed to the rural exodus and expansion of Senegal's cities (Diallo, 2015).

Due to demographic growth and mass arrivals of the population displaced by the crisis, the population density in new sub-districts of the Ziguinchor city has also increased. The settlement process in the Nema 2 district has been carried out in several stages. In 1940, the authorities decided to create the Néma district in the south of the

Ziguinchor municipality with a view to achieving a harmonious and orderly development of the urban space. This meant that the Néma district was officially subdivided and provided with all the basic infrastructure. A few years later, the Mandingues who had settled in Néma, no longer being able to pay the rent, decided to isolate themselves by moving to a village in 1957 called "Banco-wouling", which today has become the sub-district of Néma 2. The purchase of land was done by a simple request to the village chief in the presence of two witnesses. (Gomis, 2014). From 1982-1990, following the Casamance conflict which led to a large flow of rural people to the town of Ziguinchor, population growth and the spatial spread of the town increased. Faced with this situation, the Mandingo people and certain authorities thirsting for money began to engage in land speculation, with plots of land being obtained at prices ranging from 70,000 F to 95,000 F CFA (Sadio, 2020). Today, there is almost no empty land left.

In short, Néma 2 has settled in an area that is not serviced with a total lack of basic equipment and infrastructure. (Gomis, 2014). Unlike other districts in city of Ziguinchor, Nema 2 is settled by single ethnic group. The space is therefore always shared between several social categories with, however, a majority ethnic group. In any case, each ethnic group has its own specificities which may determine its relationship with its environment and the knowledge it conveys with regard to the water aspect. The Néma 2 district, the subject of this study, has an estimated population of 3,167 inhabitants, i.e. 1,412 men and 1,755 women. It should be noted that Néma 2 is a sub-district included informally in the Néma neighborhood (ANSD, 2013).

The geographical area around Ziguinchor has undergone significant demographic change accompanied by a very strong spatial expansion. Can this alone explain why this area has a "high demand for water"?

Material and methods

The consultation of specialized scientific work on the water process in the Ziguinchor periphery, particularly in terms of quantity and distribution, is a significant contribution to this research. Primary data collection was mainly based on field surveys. The study is based on quantitative and qualitative data provided by the documentary analysis of statistics from the National Agency for Demographic Statistics and SEN'EAU. Interviews were also conducted with the actors of the two structures (the Hydraulics Directorate and SEN'EAU). These interviews focused on the water service in Ziguinchor, particularly in the outlying districts, production capacity, water shortages and management methods. Surveys were carried out to locate infrastructure and to obtain the opinion of households on drinking water consumption and the quality of the service. This survey took place in Néma 2 where a total of 160 households were interviewed.

Results and discussion

Water supply for the sub-district around Néma 2 in Ziguinchor

The water source is one of the most considered elements in access to water. According to the JMP (Joint Monitoring Programme) method, the water source is said to be improved if it is protected from contamination (run-off water and bird droppings in particular). Water supply points such as household connections (taps in the dwelling or concession),

public taps, pumped wells, boreholes, protected wells, protected springs, rainwater, tanker trucks and bottled or bagged water are considered improved sources. Unprotected wells and springs correspond to unimproved water sources. In Senegal, the majority of households have access to drinking water from an improved source. The Nema 2 sub-district is supplied with drinking water from the SEN'EAU, which is currently in charge of urban water production and distribution in Senegal, and also from well water (Tab. 1).

Tab. 1. Population perceptions of water sources used for drinking, cooking and other domestic tasks in the Néma 2 neighborhood

Water sources	For drinking		For Cooking		For other household uses	
	R	%	R	%	R	%
Fountain bollards	2	1.25	3	1.875	4	2.50
Individual connections	20	12.5	39	24.375	24	15
Well	138	86.25	118	73.75	132	82.5
Total observation	160	100	160	100	160	100

Note: R - respondents

The water supply in this district is mainly provided by wells or standpipes. Indeed, according to the interviewees, well water is mainly used for drinking (86.3%), cooking (73.8%) and other domestic tasks or uses (82.5%). Water from taps from standpipes (1.3% for drinking, 1.9% for cooking and 2.6% for other domestic uses) and from individual or collective connections (12.5% for drinking, 24.4% for cooking and 14.9% for other domestic uses). In the Néma 2 district, the presence of standpipes and the low level of individual or collective connections (taps) can be explained by the absence of a housing estate in the district.

Part of the population obtains water from standpipes when the wells are dry or if the wells have a massive influx of users, water generally used for drinking and cooking. This preference for well water is also justified by the fact that this water, once boiled, does not deteriorate the pot, unlike tap water which, once boiled, causes a black colour on the pot. However, it is particularly difficult to quantify water consumption, especially for households using water from standpipes (as noted by 64.4% of respondents). This is explained by the undetermined level of this consumption, which most often varies according to the daily financial availability of households and their expressed needs. However, consumption can increase in some situations by up to 25 basins per day.

Tab. 2. Perceptions of the population's preference for well and tap water in the Néma 2 neighborhood

Preference of well water	R	%	Preference of tap water	R	%
No available	75	46.87	Reliability, cleanliness, accessibility	22	13.75
Lack of other water supply options	1	0.62	Difficulties in accessing the wells	2	1.25
Best taste	20	12.5	Less tiring	15	9.37
More accessible	42	26.25	Well tapping and depth	2	1.25
No answer	22	13.75	No answer	119	74.37
Total observation	160	100	Total observation	160	100

Note: R - respondents

All in all, in the Néma 2 district, well water is the main source of supply, on the one hand because of preference and on the other hand because of the lack of means of the population. Some users (12.5% of the respondents) claim that well water tastes better than tap water (Tab. 2). Some of the households have taps in their concession, but prefer to use well water for drinking, because in their opinion it is still better than tap water, which is too bleached and sometimes bitter. In addition, other users (46.88% of households surveyed) say that this high use of well water is linked to its availability. It should also be noted that 0.63% use well water to manage the water bill in their concessions and 26.25% of the households surveyed use well water because it is more accessible. The use of tap water is linked with its reliability, cleanliness and accessibility (according to 13.75% of respondents), energy saving (9.38%), difficulties of access to wells (1.25%), drying up and depth of wells (1.25%).

For those who use tap water from individual or collective connections (Tab. 3), the price of water is considered affordable (10.6% of households surveyed), high (7.50%) and very high (4.4%). In the case of water from standpipes in the Néma 2 district, 56.3% of the population surveyed say that the price of the basin is high, 2.5% say the price is very high and only 20% say the price is affordable (Tab. 3). However, it should be pointed out that the households that consider the price of water to be affordable have taps in their concession and the opposite is true of those who get their water from standpipes. In addition to the distance of the standpipes from the houses and the difficulties of some users to get there, the price of the basin has doubled to 50 CFA francs and the bucket to 25 CFA francs. However, previously, the basin sold for 25 CFA francs and the bucket for 15 CFA francs. This is also the reason why some women use water from wells and use the money for drawing water from standpipes to cover other expenses at home. Others prefer to pay a boy to draw water, and each basin drawn is paid 25 CFA francs. For example, instead of paying 400 Francs CFA for 8 basins at 50 F CFA at the standpipes, women prefer to pay 200 F CFA for 8 basins at 25 F CFA at the wells (Sadio, 2020).

Tab. 3. Perceptions of the population on the price of water in individual connections and at the standpipe in the Néma 2 neighborhood

Water prices in individual connections	R	%	Price of water at the standpipe	R	%
Affordable	17	10.6	Affordable	32	20.0
High	12	7.5	High	90	56.25
Very high	7	4.4	Very high	4	2.50
No answer	124	77.5	No answer	34	21.25
Total observation	160	100	Total observation	160	100

Note: R - respondents

For those who have individual or collective connections, the normal price of the fortnightly consumption bracket varies between 2,500 and 45,000 FCFA depending on the size of the household and the uses made of the water. With regard to the taste of tap water used for drinking, 13.13% of the population interviewed believe that the water is bleached, 5.63% think it is too bleached, 0.63% say it is bitter and 3.13% say it is good (Fig. 3). The high percentage of respondents who do not give an answer regarding the taste and quality of drinking water (77.5%) is justified by the fact that this population is getting more water from wells. This preference for well water is linked to the taste of the water, with tap water being considered bleached to bitter. Despite the often-undesirable

taste of tap water, 21.9% of the households surveyed say that the quality of this water is acceptable, compared to 0.6% who think it is turbid (Fig. 4). In the Néma 2 district, the task of fetching water is exclusively the responsibility of women and sometimes children, who sometimes have to travel long distances (as noted by 14.4% of respondents) to collect this water for the household.

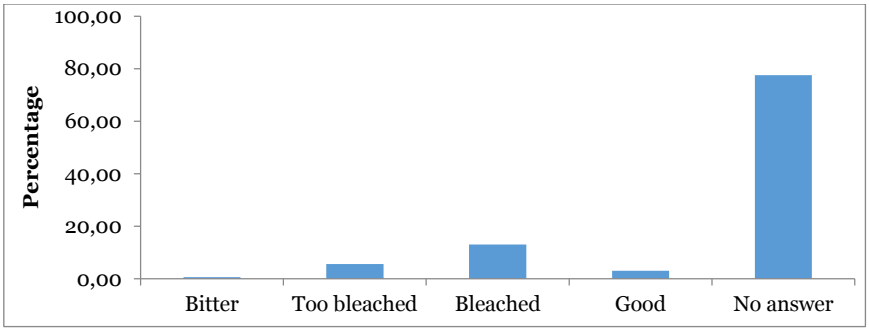

Fig. 3. Public perception of the taste of tap water in the Néma 2 neighborhood

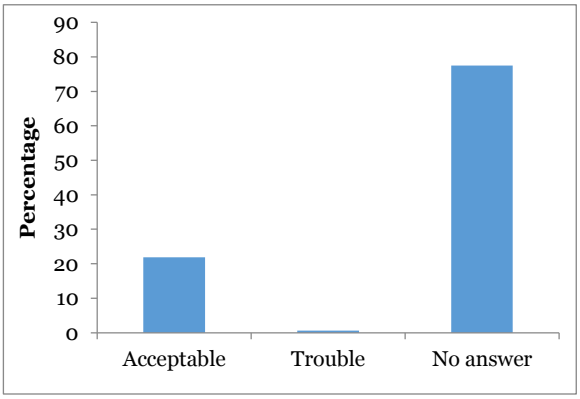

Fig. 4. Public perception of the quality of tap water in the Néma 2 neighborhood

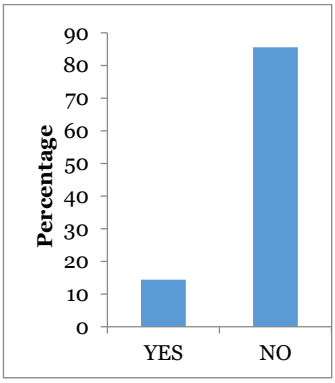

Fig. 5. Are the distances travelled for water fetching long?

Water supply problems in the sub-district around Néma 2 in Ziguinchor

Analysis of the results of the surveys at Néma 2 shows that the population is facing enormous difficulties in accessing water, as 76.3% of the population surveyed attest (Tab. 4). The problems of access to drinking water in the Néma 2 district have always been noted by 75.6% of the people interviewed, with only one respondent (0.6%) stating that they have only recently noted this problem. Today, the populations of the Néma 2 district are experiencing enormous difficulties in accessing drinking water because the district is not well developed. Water connections cannot be made indoors, and only households that are on the road benefit from them. Moreover, the Sénégalaise des Eaux (replaced by SEN'EAU) systematically refuses to deal with people's demand for tap water connections at house level, which leads some households to use the money to dig wells at their concession.

The main problems of access to drinking water in the Néma 2 district are the lack of means (according to 36.86% of respondents), the fact that the district is not subdivided (35.63%), the lack of skills (1.88%) and the long distances to be covered (1.88%). Such problems of access to drinking water in the Néma 2 neighbourhood are manifested by the impossibility of getting water inside the neighbourhood (according to 39.38% of respondents), the dry, remote or deep wells (25%), the turbidity or even coloured water (6.25%), the long queues to be observed to draw water (2.5%) and sometimes problems with the manager of the standpipes, especially when opening and closing them.

Tab. 4. Perceptions of the population on the problems of access to drinking water in the Néma 2 neighborhood

Do you have problems with access to drinking water?	R	%	Since when have you been experiencing problems with access to drinking water?	R	%
Yes	122	76.25	Always	121	75.6
No	38	23.75	A few years ago	1	0.6
			No answer	38	23.8
Total observation	160	100	Total observation	160	100
Causes of the problems of access to drinking water	R	%	Manifestations of the problems of access to drinking water	R	%
Long distances	3	1.88	Turbid or coloured water	10	6.25
Lack of competence	3	1.875	Impossible to get water inside	63	39.37
Lack of resources	59	36.87	Long drawing tails	4	2.5
Undeveloped area	57	35.62	Problems with the tap manager	2	1.25
No answer	38	23.75	Dry, deep or remote wells	40	25
			No answer	41	25.62
Total observation	160	100	Total observation	160	100

Note: R - respondents

At the neighbourhood level, the wells are too deep, with a depth varying between 16 m and 18 m. This makes it very difficult for the women to get water from them every time. In addition, there is the problem that the water table at the wells temporarily drops from

11 a.m. onwards, and in this case, it is not until around 1 p.m. that they can be tapped again. At a certain point, the well water turns red (turbid), causing households to get up as early as possible to fetch water, especially during the school year. Other constraints are related to the rubbish thrown by children into the wells, especially those that are not in good condition (i.e. wells that do not have a cover). In addition, some toilets are too close to some wells and can lead to water pollution with health impacts on the population that can result if they are used. According to the surveys, 25.6% of the households surveyed reported health impacts linked to problems of access to drinking water (Tab. 5).

Water is an indispensable resource for life and the development of our societies, but it can also be a source of disease because it can be contaminated by harmful elements, leading to illnesses such as diarrhea diseases. These health impacts linked to the problems of access to drinking water in households are manifested at the level of the most vulnerable children (i.e. from 0 to 5-year-old age group). In fact, 25.6% of households claim that their children suffer from the diarrhea disease as a result of poor management of wells (Tab. 5). As a result, this water is often contaminated and its consumption affects the health of the children. In addition, during the rainy season, rainwater runoff often mixed with pit water can cause pollution of well water.

Tab. 5. Perceptions of the population on the health impacts of the problems of access to drinking water and the water distribution service in the Néma 2 neighborhood

Are there health impacts related to problems of access to drinking water?	R	%	If yes, which ones?	R	%
Yes	41	25.6	Diarrhea	41	25.6
No	79	49.4	No answer	119	74.4
No answer	40	25			
Total observation	160	100	Total observation	160	100
SDE water distribution service (SEN'EAU)	R	%	Are there any water cuts	R	%
Satisfactory	31	19.4	Yes	36	22.5
Not satisfactory	129	80.6	No answer	124	77.5
Total observation	160	100	Total observation	160	100

Note: R - respondents

All these constraints make it difficult for people to see the positive side of the water distribution service of SDE (replaced by SEN'EAU). Only 19.4% of the households surveyed said that the SDE water distribution service (replaced by SEN'EAU) is satisfactory in the district. For these people, SDE distributes water of good quality and whose consumption hardly causes diseases related to poor water quality. The dissatisfaction of some respondents with the service offered by SDE is explained by the lack of competence, the high cost of their service, the failure to deal with requests for water conveyance and the problem of water accessibility.

Monthly water cuts in the Néma 2 district are becoming more and more frequent. In fact, 22.5% of the people surveyed said that they experience water cuts at their concession (Tab. 5). The importance of the non-respondents (77.5% of the population surveyed) is explained by the fact that in this neighborhood, households use much more well water. Frequent water cuts are caused by water leaks, or by insufficient water being collected from boreholes for distribution in the Ziguinchor area. These water cuts recorded on the water distribution service do not prevent people from carrying out their other domestic

chores, as they have the possibility of obtaining water from wells next to or even within their concessions.

Strategies for a better water supply in the sub-district around Néma 2 in Ziguinchor

In general, there are no strategies put in place by private actors at the level of the Néma 2 neighbourhood for water availability. The strategy of the SDE (replaced by SEN'EAU) for water availability at the level of the subscribers is to carry out preventive maintenance, to ensure the monitoring of boreholes, plants and structures, but also to see to the end of their validity, if there is deterioration of this equipment (Sadio, 2020). As far as subscribers are concerned, to be able to have tap water in their concessions, with the existence of an extension it becomes easier because the applicant only pays for the connection. Water conservation differs from household to household in the Néma 2 district. According to the surveys, 82.5% of the households surveyed conserve well water in containers or barrels and 3.1% in ponds (Tab. 6). Finally, the 14.4% of respondents who did not provide an answer consist of households which tend to use tap water and which do not need to store well water at home. The treatment of well water at home is done in several ways depending on the households surveyed: by filtering and bleaching (according to 56.9% of the respondents), by filtering only (25%), or by bleaching (1.9%) or by decanting (1.9%). However, 14.4% of respondents do not use the well water treatment method at home (Tab. 6).

Tab. 6. Perceptions of the population on the different methods of water conservation and treatment in the Néma 2 neighborhood

Well water conservation methods	R	%	Methods of treating preserved water	R	%
Ponds	5	3.1	Decanting	3	1.9
Containers	132	82.5	Filtering	40	25
No answer	23	14.4	Bleaching	3	1.9
			Filtering and Bleaching	91	56.9
			No answer	23	14.4
Total observation	160	100	Total observation	160	100

Note: R - respondents

In urban areas, local communities intervene in the water sector in order to meet growing demand for water. This mainly involves setting up the hydraulic infrastructures or, in some cases, taking over subscriptions. These actions include cooperation with partners resulting in concluding the contracts (e.g. the contract of leasing). Thus, they contributed 2.6% to the mobilisation of overall funding for the water sector between 2005 and 2009 (PEPAM, 2010). In the Néma 2 district, water management is a problem and 98.1% of the respondents say they are not satisfied with water management (Fig. 6). This can be explained by the fact that there are standpipes that are no longer functional (three fountain terminals are no longer functional in the neighborhood, lack of management, payment and monitoring) in addition to their distance from some houses. Most of the standpipes are on the road, as the interior of the district is not served. Only 1.9% of households surveyed say they are satisfied with water management in the neighborhood. These are in a few of households with fountain terminals, despite the price of water a little high.

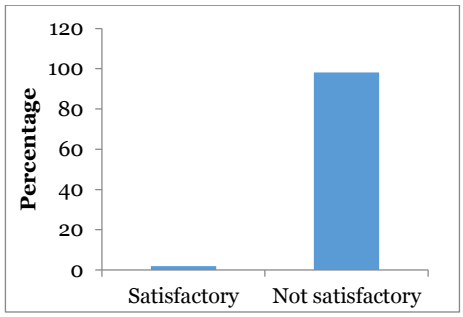

Fig. 6. Household perceptions of water management at Néma 2

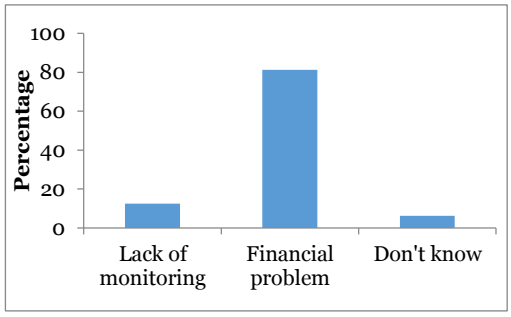

Fig. 7. Cause of water management at Néma 2

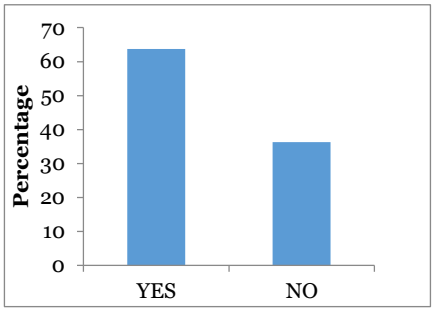

Fig. 8. Involvement of Néma 2 households in water management

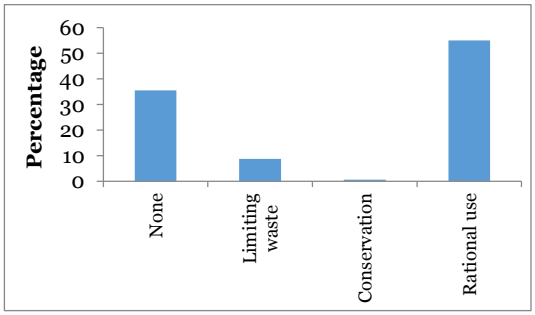

Fig. 9. Water management method at Néma 2

According to the households interviewed (Fig. 7), the constraints related to water management at the level of the fountain terminals in Nema 2 include parties: the lack of financial means (according to 81.25% of respondents) and the lack of monitoring (12.5%). In addition, the level of state participation is too limited for water management in the district, hence the problem of monitoring. As a result, some standpipes are no longer functional and others are in poor condition. However, despite the problems related to water management and the non-satisfaction of water needs in their neighborhood, the involvement of the populations in the management of this water is felt. In fact, 63.7% of the households surveyed claim that they are involved in the management of water in their neighborhood (Fig. 8). This proves that households, despite the fact that they often do not have the financial means to pay for water, think that water is well managed at these standpipes. However, 36.3% of the households surveyed said that they are not involved in water management because they are too far away from the standpipes.

In the Néma 2 district, there is therefore a public water service with standpipes. Knowing the difficulty of access to this resource, households have developed a method of water management in their concessions. Indeed, 55.6% of households have opted for the rational water use. Others advocate a way of managing water well by limiting waste (8.8%). In the same way, 0.6% of the households surveyed proposed rainwater conservation as a management method. However, 35.6% of households have no water management method in their concessions, despite the fact that they have difficulty in finding water to supply themselves properly (Fig. 9).

Another aspect of water management is related to how water is billed and paid for. In fact, 10.60% of households surveyed say that the price of the bimonthly SDE bill suits them (i.e. affordable) as opposed to 7.50% who say the price is high and 4.4% who say the price is very high (Tab. 3). Those who emphasize the high cost of water bills, like electricity bills, can benefit from the payment facilities. In fact, the payment can, in this case, be made in two installments. In the Néma 2 district, several strategies are proposed by the households surveyed for sustainable water resource management (Figure 10). In fact, 1.3% of the households surveyed have as a strategy the alignment of roads to get an overview of the water supply within the district. In addition, 10.7% of the households surveyed suggested alternating the two water sources as a strategy for sustainable water resource management. For sustainable water management in the district, 26.4% of the households surveyed opted to increase the number of standpipes as a strategy. In order to have easy access to individual connections (taps), 59.7% of the households surveyed proposed the subdivision of the neighborhood as a strategy. Finally, 1.9% of the households surveyed opted for the protection of wells as a strategy to provide cleaner water without waste or rubbish inside.

Optimal water management means using water more efficiently. More efficient use of water basically means increasing the productivity of water use, i.e. increasing the capacity to create wealth for the amount of water used. This can be done by limiting leakage and percolation losses in the transport of water through urban networks, or by reducing wastage due to inappropriate use of the resource in agricultural or industrial processes. The most promising way in this regard seems to be increasing agricultural productivity by making better use of water through changes in irrigation techniques, minimising the evapotranspiration that accompanies plant growth, and creating varieties that are more resistant to water scarcity (Baechler, 2012).

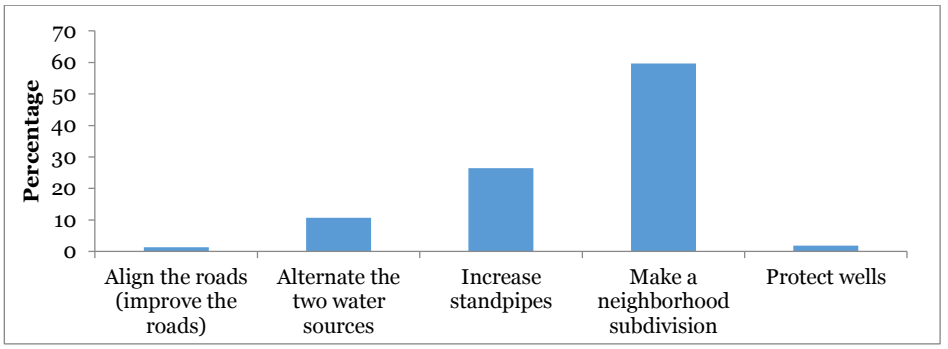

Fig. 10. Households' perception of the strategies proposed by the population in the Néma 2 neighborhood

The possibilities for improving demand-side water management are based on an overall principle: directing water towards optimal use, which on a strictly theoretical level should lead to equalizing the value of a marginal unit of water for all potential users. Equalizing the marginal values of all potential uses of water is obviously a perfectly utopian goal. However, the principle which ensues from it and according to which the actors concerned should be encouraged to make the most "productive" use possible of the resource when it becomes scarce stems from common sense. There are mainly two ways to do this: to encourage users to make more efficient use of water; encourage transfers of the resource from the least beneficial uses to those with higher "returns" (Baechler, 2012).

The authorities' action must consist of increasing production by building new units, reinforcing existing installations and interconnecting all the infrastructures of the public water network in Ziguinchor for a better distribution of production. These projects should make it possible to increase the supply of drinking water, improve the flow of pressure at the tap, strengthen the public water network and reduce the discontent of the population. Also, SEN'EAU must carry out several standpipe projects in precarious neighborhoods of Ziguinchor. However, in order to make up the deficit in drinking water production and ensure a sustainable supply, projects must be studied, such as mobilising water resources from the deep-water table and collecting water from the Casamance River. Such projects should make it possible not only to diversify supply but also to increase the production of drinking water. Today, the high demand for drinking water in this city, increasing with the accelerated growth of the population, requires the implementation of these projects.

Conclusion

This study is being carried out in order to show that the difficulties of access to drinking water in the outskirts of Ziguinchor are closely linked to the inadequacy of the infrastructure for supplying this resource. The availability of water is evaluated according to the results obtained during the surveys and interviews conducted in the Néma 2 neighborhood, and the results show that water is not effectively available and in sufficient quantity. Although the city of Ziguinchor is provided with water resources, the difficulties in drinking water supply in this locality remain real. A great deal of effort has been made in the sector in question of water in Ziguinchor. Today, the deficit in drinking water become more and more acute. This deficit is caused by inadequacy of water infrastructure, pollution and the salinity of water resources. These factors originate from the

abandonment of several drinking water supply infrastructures. In turn, poor governance of the water sector does not allow for the expansion of drinking water infrastructures and networks. Ultimately, the populations will only be satisfied if new investments are made and better governance is put in place in the drinking water and sanitation sector.

In the town of Ziguinchor, the problems identified in the peripheral neighborhoods, such as Néma 2, revolve around the difficulties of access to water services (low density or absence of a water supply network in the neighborhood, lack of access roads, lack of financial means for the population, wells in poor condition, etc.). In addition, in the Néma 2 district, the population suffers from the depth of the water table. Sometimes the water in this area changes colour in red, and there is a drying up of the wells in the month of May until the end of the winter. This district also suffers from the absence of the actors who are active in the water sector, in addition to the participation of the state, which is very limited with regard to the water supply infrastructures. Indeed, the infrastructures in Néma 2 are insufficient and are too far from the concessions. As a result, the city must have many actors to find solutions to water problems. Their involvement will certainly give a better solution to be adopted. In addition, it would be important to make, in a future study, a diagnosis of water governance at the municipal level.

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ПЕРЦЕПЦИЈЕ ПРОБЛЕМА СНАБДЕВАЊА ПИЈАЋОМ ВОДОМ У ЗИГИНШОРУ (СЕНЕГАЛ): СЛУЧАЈ ПЕРИФЕРНОГ ОКРУГА НЕМА 2

Резиме: Добар квалитет воде је важан за здравље, енергију и развој, али није доступан милионима људи широм света. У региону Казамансе, климатску ситуацију последњих тридесет година карактерише опадање количине падавина у комбинацији са демографском експлозијом која је довела до интензивне експлоатације расположивих водних ресурса. Иако се налази у влажном делу државе, Зигиншор, главни град региона Казаманса, нема непрекидан приступ води за пиће за све своје становнике, посебно оне који живе у околним областима. Циљ рада је да покаже да су тешкоће у приступу пијаћој води на периферији Зигиншора уско повезане са неадекватношћу инфраструктуре за водоснабдевање. Усвојена методологија је конципирана око три главне осе: документарног истраживања, прикупљања података и обраде података. Резултати ове студије откривају да капацитет производње воде у Зигиншору, од 9.500 m^3 дневно (тј. 400 m^3/h), заправо представља производни дефицит у односу на потражњу (јер мора да покрије потребе за водом процењене популације становништва од 583.528 становника). Узроци ове неусклађености између понуде и потражње су неадекватна инфраструктура, загађење, заслањеност водних ресурса и лоше управљање системом за водоснабдевање. Због овакве ситуације неопходно је користити водне ресурсе на одговарајући рационалан начин и обезбедити одрживо управљање.