

Neighbours' Mini Water Networks in Saguia, Arrangements, Solidarity and Innovation in Urban Water Services in Niamey, Niger

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Abstract: Niamey, the capital of Niger, like other cities in sub-Saharan Africa, is experiencing water insecurity due to the mismatch between rapid urban growth and substantial investment in water services. On the outskirts of the city, where the water distribution network is almost non-existent or inconsistent, private water points are increasingly being built, particularly private boreholes, as an alternative solution. This article based on a methodology combining qualitative and quantitative data collected from 20 beneficiaries, 3 suppliers and 5 carters, focuses on the mini water networks of neighbours. A new form of solidarity around water in Saguia, an outlying district of the city of Niamey, through the 'co-production' of water services and the mutualisation of water installations between neighbours-providers and neighbours-beneficiaries. This new 'social' service offer, built around arrangements between neighbours, deserves to be studied by analysing it as both an innovation and a social response adapted to the absence of a formal water network and to the uncontrolled and planned urban sprawl in Niamey. The neighbours' mini water networks thus contribute to the universalization of access to water and to urban sprawl by allowing the construction and occupation of new formal and informal neighbourhoods not covered by the official water network.

Keywords: Niger, Niamey, Arrangements, Water Solidarity, Mini Water Networks of Neighbours

1. Introduction

Sub-Saharan Africa lags far behind other regions of the world in terms of access to safe water and sanitation, with 400 million people lacking minimal access to water (out of 693 million worldwide), or 42% of the total population of the region [1]. In the water sector, more than 40 years after the 1977 United Nations Water Conference in Mar del Plata, and more than 20 years after the 1992 Dublin International Conference on Water and the Environment, what had been presented as 'the global water management model' has shown its limits [1]. Its three pillars, namely integrated water resources management, public-private partnerships and the commodification of water, have all shown their shortcomings in Africa. The decentralisation initiated in the 1990s, which in many African countries devolved responsibility for the provision of basic services, such as drinking water, to their citizens, has not significantly improved the situation [2].

Today, more than half of the urban population of the African continent lives in precarious neighbourhoods. In a context where public resources are limited and users cannot bear the cost of basic services alone [3]. The water service is the most emblematic sector of this gap between urban growth and water supply [3].

In Niger, after more than 50 years of implementation of water policies, the challenges of water resource management are becoming increasingly important [4-6]. Problems of access to domestic water are acute in both rural and urban areas, despite the difference in supply modalities. Niamey, like other African cities, is experiencing rapid and uncontrolled growth, characterised by the production of new formal and informal neighbourhoods with a lack of essential urban services, including water. The absence of planning policies complicates interventions in terms of accompanying public actions to improve the situation [4, 7, 8]. In Niamey, as in several African cities, beyond the pooling of water

points between neighbourhoods with different water situations, the inability to connect to the network (household poverty), and the inexistence or inconsistency of water distribution networks have favoured the emergence of compensatory initiatives on the outskirts of cities. The explosion of water challenges resulting from urban growth and the lack of investment in the water sector favours the emergence of new, diversified forms of access to the resource through solidarity around water [1]. The initiatives are diverse, both individual and collective; small private water operators [3, 9-11], micro-grids [1], have become parallel water services in several African cities. Solidarity around water in the Sahel, both in urban and rural areas [4-6, 8, 12-19], is an appropriate social response to the shortage of water resources. It corrects the major imbalances in terms of spatiotemporal availability of the resource and hydraulic infrastructures in villages and between towns and villages.

Created in 2014, Saguia recasement is a peripheral district illustrating the absence of public water services. The particularity of the site, a plateau area with a beautiful view of the city of Niamey, makes it one of the most coveted peripheral neighbourhoods where the price of land is more expensive. A 400 square metre plot costs between 7 and 8,000,000 FCFA (€10,671 and €12,195). Its population is growing rapidly and exceeds 1000 inhabitants. The strong demographic and territorial growth through relocations and house building has been made possible by the so-called mini water networks of the neighbours. A system of water sharing between neighbours-suppliers (water tower owners) and neighbours-beneficiaries (connected), which appears to be an important innovation and a new form of solidarity in the water sector, in contrast to the systems of small private water operators or micro-grids, which are the result of a market initiative from the start. By making up for the absence of the

SEEN network, the mini-water networks contribute to the universalisation of access to water in urban territories still on the fringes of the official water service offer. The objective of this article is to study the functioning of this system by identifying the actors, analysing the arrangements between neighbours for the “co-production” of water services and evaluating the robustness of this hydraulic solidarity.

2. Materials and Methods

Saguia recasement or Saguia plateau is a peripheral district of the 5th district of the city of Niamey (figure 1), the result of urban sprawl, and is not covered by the distribution network of the Société d'Exploitation des Eaux du Niger (SEEN) like most of the districts on the periphery (figure 1). However, Saguia stands out due to the effect of the topography with an average elevation of 216 meters, which limits the functioning of the network even if it exists. The Société des Patrimoines des Eaux du Niger (SPEN) intends to build a water treatment basin to solve the problem of water supply in the district and a large part of the town. By installing a basin on the plateau, the effect of the slope makes it easy to distribute water to the lower parts of the city without much pressure in the network.

The sinking of boreholes equipped with water towers in the outlying districts, as is the case in Saguia, is the main response of residents with the financial means (wealthy families) to produce water services themselves and allow neighbours who request it to be connected. The self-production of water services becomes a co-production between neighbours-providers and neighbours-beneficiaries. This initiative, which is an innovation built on neighbourhood solidarity, deserves to be studied (Figure 2).

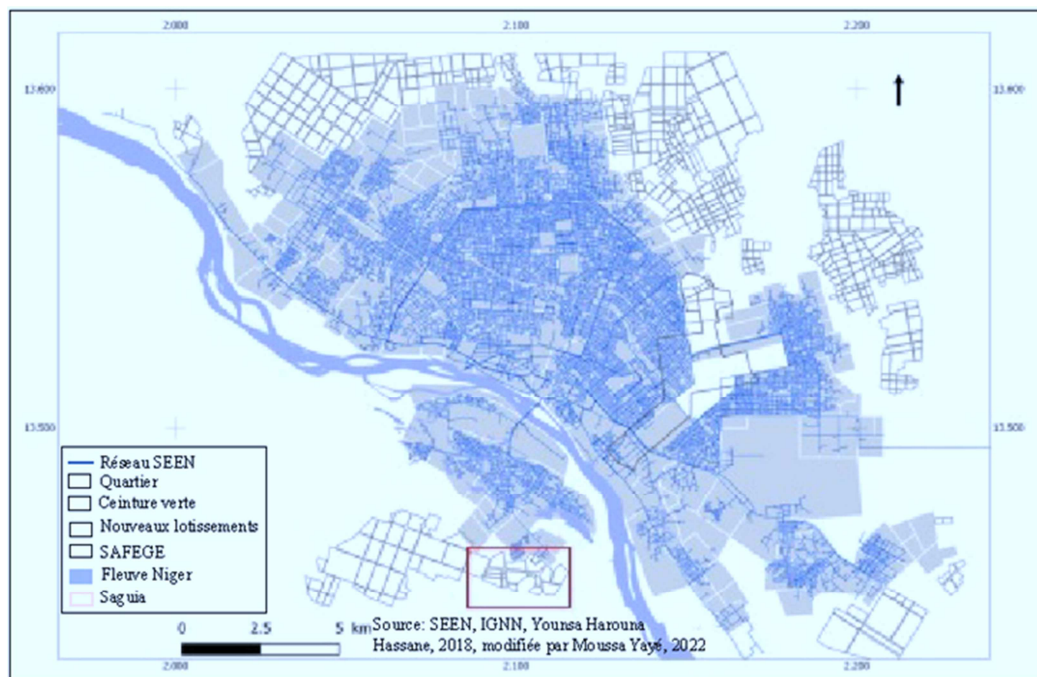


Figure 1. Niamey's water distribution network in 2016.

The methodology adopted in this work combines the mobilization of quantitative and qualitative data collected from 3 main suppliers (private water operators) with water towers, 20 beneficiaries (connected neighbours), 5 carters (water resellers) using a questionnaire and 2 borehole builders using a semi-direct interview guide. The initiative to share water, the operation and management of the shared infrastructure, the availability and use of the neighbours' mini-water systems, the social relations built around water, the role of the mini-water systems and the carters (water resellers) in the construction and occupation of the neighbourhood were the main questions asked of the three categories of actors interviewed. After collection, the data was coded to construct the modalities and the tabulation (response capture and data processing) was done in the survey software Sphinx Plus. The raw data were

exported to Microsoft Excel and Xlstat for statistical processing and analysis (graphing). The survey data was also used in the text of the article as a life story after transcription. Sphinx Plus and Microsoft Excel and Arc Gis and Adobe Illustrator were used to produce the maps and graphic models. The fieldwork, i.e. the in situ observation and the survey, enabled a better understanding of the functioning of the social-solidarity service, to evaluate its robustness and its contribution to universal access to water and to the construction and occupation of the neighbourhood. In view of the aspects it deals with, this article makes an interesting contribution to the social sciences of water and enriches knowledge on the water challenges in growing African cities and the diversity of coping strategies developed by city dwellers “forgotten” by public services.

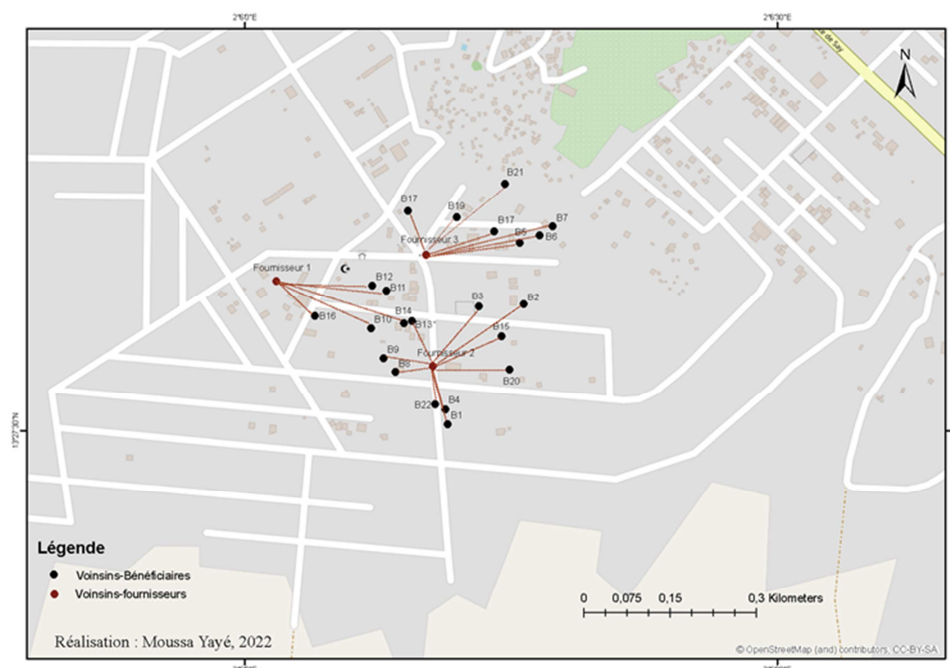


Figure 2. The hydraulic solidarity model mini water network of neighbours in Saguia.

Table 1. The actors interviewed.

Stakeholders interviewed	Nb. quotations ¹	Frequency ² %
Suppliers	3	10.7
Beneficiary	20	74
Charretier	5	17,9
Total	28	100

3. Results

3.1. The City of Niamey: Between Urban Growth and the Challenge of Water Supply

The cities of West Africa have been experiencing strong

urbanisation for several decades, mainly due to the rural exodus and internal growth. Niamey, a small village in the 1900s, is now a city with more than one million inhabitants. In the 1930s, the city had only 1642 inhabitants [20]. It then experienced a slow growth, which is probably linked to the Second World War. The city started to grow again in the 1950s. In 1952, Niamey had a population of 11,790 inhabitants and became the first urban centre of the country [21]. At independence, the population reached 33,816 with an annual growth rate of 12% [22]. The population multiplied 17 years later by 7.1, and rose to 242,973 inhabitants according to the results of the general census of population and housing (RGP/H) carried out in 1977. In 1988, 2001 and 2012, the population increased to 392,165, 707,951 and 1,026,848 inhabitants respectively. In fifty years, the population of Niamey increased from 1% to 8% of the total population of Niger [23]. This rapid population growth is

¹ Is the number of times a modality was cited in a survey.

² Is the number of quotations, of occurrence of a modality in terms of proportion, of share in a survey.

accompanied by an equally rapid expansion of the city. The surface area of the city has increased from 860 ha in 1960 to 10,000 ha in 2000 to about 30,000 ha in 2020. Urbanisation has not fundamentally led to a change in demographic behaviour. Also, unlike that experienced by developed countries, this urbanisation is not accompanied by urban policies [3], and it is not too much to speak of urbanisation without real urbanism. Thus, the various infrastructures necessary for urban life do not follow and thus expose city dwellers to numerous urban development problems. Public service infrastructures are degraded or inoperative [10]. This is the case for water distribution systems, which often only cover part of the city. The lack of governance and the failure of municipalities to control sprawl, which have not been structured to cope with strong population growth, make it difficult, if not impossible, to meet the needs of urban services, including water supply. The water service is the most emblematic sector of this discrepancy between urban growth and the provision of essential services, as it is so much affected by economic, technical and environmental logics (extent of infrastructure, technical equipment, cost of service) that it clashes with the strong health, social and political expectations concerning access to water [3]. The privatisation of the urban water sub-sector, although it has led to an improvement in the quality of services and financial governance, has had difficulty in accompanying the urban explosion, which is reflected in the spatial extension of the city, which became anarchic as early as the end of the 1980s and 1990s, as [24] pointed out in 2005: "The reforms do not in themselves provide a general response to the ambition of universal service. In the absence of adequate public subsidy schemes, private companies, like their public counterparts, are unable to meet the rapidly increasing demand for water from low-income urbanised populations with unevenly consolidated land tenure". Public-private partnerships (PPPs), which have been a model since the 1990s, are now being challenged on a variety of grounds, including equity in access to services, increasing spatial inequalities, and economic efficiency [25]. A variety of initiatives and strategies are being implemented in the outskirts of the city of Niamey as well as in small and medium-sized towns and even in rural areas. The notions of diversification and bricolage with the combination of complementary responses and strategies [4-6, 8] are part of the resilience of communities to water challenges.

3.2. A Diversity of Alternative Strategies for Universal Access to Water on the Outskirts of Niamey

Urban sprawl is leading to the construction of peripheral territories that are "forgotten" in the supply of urban services (figure 3). In addition to standpipes and water resellers (garoua), there is an increasing explosion of private boreholes, the main reason being the self-production of water services in the absence of formal services. There are three main types of boreholes in Niamey which are external signs of water insecurity and the absence of urban planning. Firstly, there are many boreholes dug in precarious or

peripheral neighbourhoods by foundations, non-governmental organisations and associations (national and international), which are collective and community water points. The second category is that of private promoters (individuals) attracted by the manna of water [11], they are generally located in front of the housing plot. But often for a question of social prestige and building a good social image, the owner makes access free of charge, as was observed during the fieldwork for this study. In the town of Mbouda in Cameroon [26], water from boreholes is also given free of charge by certain owners to create sympathy and hope for the support of the population during elections. Finally, we have private boreholes installed inside houses to be autonomous either because of the lack of the Société d'Exploitation des Eaux du Niger (SEEN) network or because of the inconsistency of the distribution in the peripheral neighbourhoods. In Saguia, the drilling of boreholes is due to the non-operationality of the network because of the topography of the district. On average, they are 30 to 50 metres deep, but can go beyond 60 metres, storing water in tanks of varying shapes and capacities [11]. The populations, depending on their income, produce their own water services (self-production and co-production) through the installation of boreholes equipped with a tower running on energy from the Société Nigérienne d'Électricité (Nigelec) and or solar energy. All concession facilities (shower, kitchen, tap for gardening) are connected to it. This self-production of water services is a highly developed practice in Saguia recasement, the pilot district of this article. It is the main source of water supply in the neighbourhood built around neighbourhood solidarity.

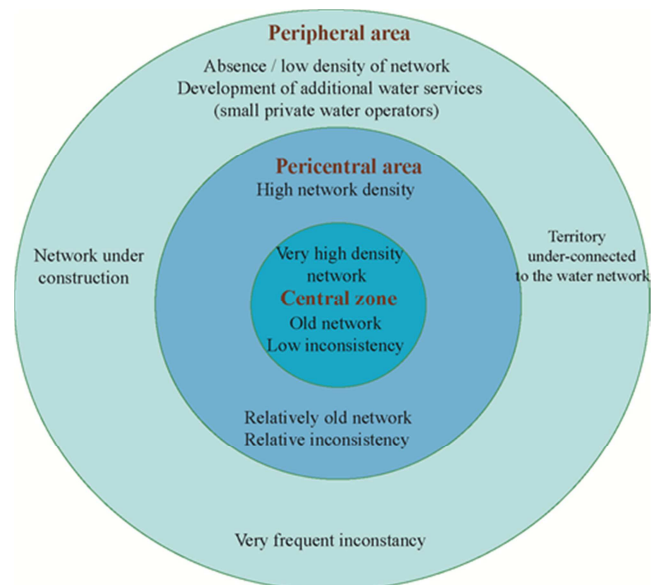


Figure 3. Model of the hydraulic territories of African cities.

3.3. Neighbours' Mini Water Networks: Water Solidarity as an Innovation in Urban Water Services

Mini-networks or small-scale automatic networks have emerged all over the periphery of African cities in recent

decades. As the official water supply network has never been able to meet the needs of the entire population, the inhabitants of the periphery mobilise different types of informal suppliers [27, 28]. Since the late 1990s, small autonomous piped water systems have sprung up and proliferated in the neighbourhoods of the cidade de caniço in Maputo [27, 28], as in a number of large African cities, in contrast to the Indians, small-scale private water operators develop mainly in small and medium-sized cities where the drinking water supply network does not meet the needs of the entire population. Faced with this situation, a number of small local private operators producing and selling water are investing in the urban environment and coexisting with rural practices of direct access to private and public sources [29]. In Africa over the past 20 years, small private operators have continued to develop and expand their activities to other cities and neighbourhoods [10]. The use of small private operators (POPs), operating according to entrepreneurial,

associative or community logics, particularly in neighbourhoods where the connection of populations to the conventional network is now unlikely, appear to be 'unconventional offers', an alternative or 'endogenous ways of reforming networks' [30]. In this way, they are responding to a growing household demand for water. In several African countries (Mozambique, Mauritania, Burkina Faso, Somalia, etc.), small-scale private water providers are becoming large-scale operators in view of the large number of subscribers. In Niger, in contrast to the model of private operators known in the literature on water services in African cities, a new model is emerging which is referred to in this paper as the Neighbourhood Mini-Water System (Figure 4). This system is being developed on the outskirts of the city of Niamey, particularly in the Saguia Recasement district, where it began in the first half of the 2010 decade. It is helping to make access to water universal in 'urban' areas on the fringes of the supply of essential urban services (Figure 5).

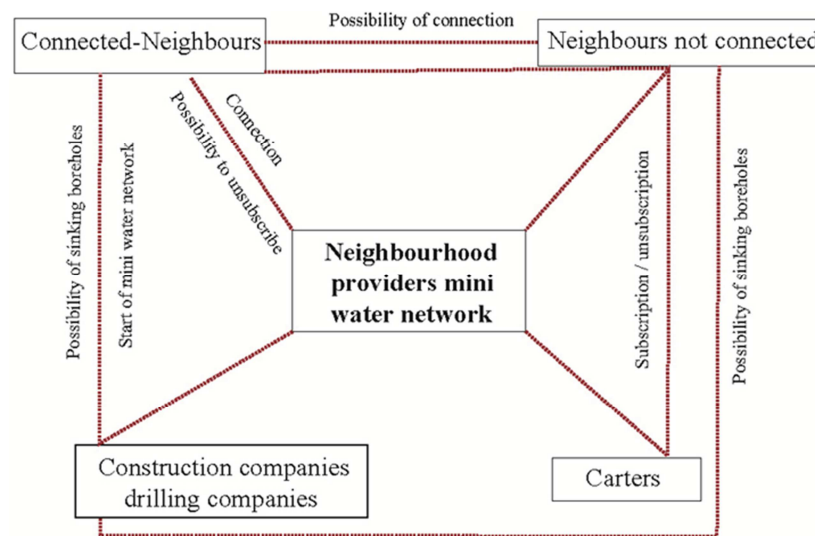


Figure 4. Model of mini water networks of neighbours.

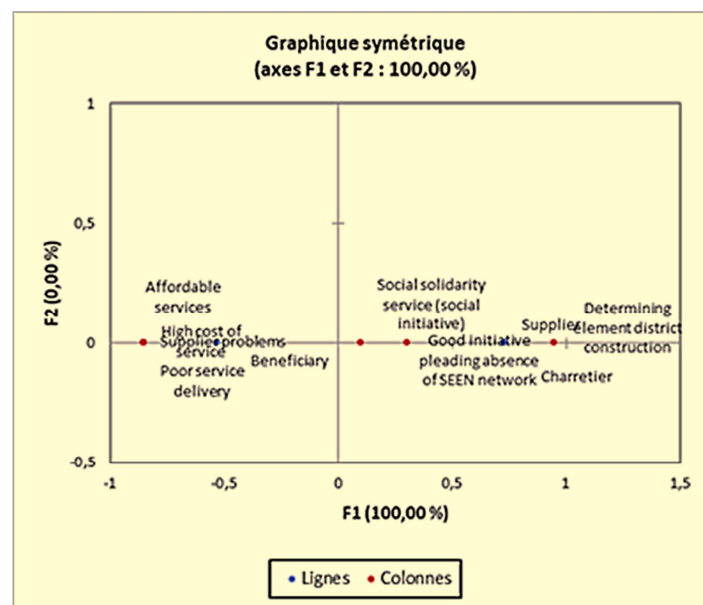


Figure 5. Stakeholders' reading of the contribution of neighbours' mini-water systems.

3.4. Water Tower Owners or Water Service Providers «in Solidarity»

The texts governing the exploitation of underground water resources³ allow and supervise private exploitation. Article 14 bis of law N°98-041 of 7 December 1998 stipulates that the creation of any modern water point for the benefit of a private individual with a flow rate of less than 40m³/day must be declared to the administrative authority and the prefectural authority if the flow rate is greater than or equal to 40m³/day (new article 14). But in reality these texts are not respected because of the lack of control and the often cumbersome administrative procedures. Boreholes are built with the prior agreement of a competent authority. This partly explains their explosion on the outskirts of the city of Niamey. The mini water network system of the neighbours in Saguia dates back to the creation of the district (2013-2014). From self-production, the trend is towards the co-production of water services by allowing neighbours to connect and contribute to the operation of the facilities through the payment of the bill. According to a solidarity water service provider interviewed in January 2022, the idea of sharing water is a combination of two factors, namely the importance of water production (average water flow is 10 cubic metres per hour) and the water needs of neighbours. *“We realised that we can't consume water while the neighbours need it, the developers need it. We have to give them water to build their houses”* (interview with Mr Boureima, the first to share water with his neighbours, January 2022). There is no written contract to connect, you just have to submit your request, and once it is accepted by the neighbour-supplier, the neighbour-beneficiary finds a plumber to do the installations. The contract is therefore moral. The mini water network system of neighbours is developing more and more because of the cost, which is more or less accessible to the civil servants who are in the majority in the neighbourhood.

The cost of drilling depends on the company and the depth of the borehole. Up to 36 metres, a borehole can be drilled for 1,000,000 (€1,524) at 1,200,000 FCFA (€1,829) or 800,000 FCFA (€1,220). Those who use manual equipment (Figure 7), can do so at 300,000 FCFA (457 €). But it all depends on the type of crew. Crewing is done in 110, 120, 140 and 160. For deep drilling, you have to go to 40 or even 50 metres (Figure 6), at this level the flow is good. For this type of drilling, you have to pay between 1,500,000 FCFA (2,286 €) and 2,000,000 (3,049 €). The overall cost depends on the type of borehole. A simple borehole in a concession does not exceed 1,200,000 FCFA (1,829 €) including pump, metal, black sheet or rubber tank. The rubber tank of one cubic meter is sold at 100,000 FCFA (152 €), the support on which it will be placed at 200,000 FCFA (304 €) and the piping, all at 1,500,000 FCFA (2,286 €), 1,700,000 FCFA (2,591 €) to 1,800,000 FCFA (2,744 €) if the tank is made of black sheet metal, and 2,300,000 FCFA (3,506 €) for the

metal tank (Interview with Mr. Mohamed, contractor and drilling constructor, August 21, 2022).

There has been an explosion of private drilling on the outskirts of Niamey. This is due to the absence of a network and its inconsistency when it exists. The importance of the demand explains the decrease in the cost of drilling. Drilling is making peripheral areas habitable and is becoming a factor in urban sprawl (Interview with Mr. Djibril, drilling constructor, 20 August 2022).

In the field survey results, the minimum cost for a private borehole is 3,500,000 FCFA (5,335 €) with an average of 4,000,000 FCFA (6,098 €). Due to the demand for private urban boreholes and the operation of drilling companies, the cost of construction is falling considerably. This explains the difference between the estimated costs of the contractor and the owners of the boreholes. The maintenance of hydraulic installations costs on average 32,000 CFA francs (49 €) and rarely exceeds 40,000 CFA francs (61 €). This is mainly the amount of the electricity bill. Changing the pump is rare and can cost up to 60,000 FCFA (91 €).



Figure 6. A borehole under construction in Saguia, January 2021.



Figure 7. Manual drilling of a borehole in Saguia, March 2022.

3.5. Neighbours Benefiting from Solidarity Water Services

Neighbour's mini-water systems allow people to have water as if they were connected to the SEEN network. After the neighbour-supplier authorises the connection, the neighbour-beneficiary seeks a plumber for the connection. The cost of the connection depends on the distance between the castle and the concession of the connection applicant. It can range from 50,000 to 200,000 FCFA (76 to 305 €), 60,000 (91.47 €) to 75,000 FCFA (114.33 €) in the Airport district of Niamey [11]. A sub-meter is installed to monitor

³ Law N°98-041 on the water regime, 12p. And the ordinance N°2101-09 of 1st April 2010 on the water code in Niger, 22p.

and collect monthly consumption. The cubic metre is sold at 500 FCFA (€0.80) compared to 350 FCFA (€0.50) at Aéroport (ibid.), which is well above the SEEN tariff of 127 FCFA (€0.19) from 0 to 10 cubic metres for individuals and social connections (social bracket). Although consumers find the price of water very expensive compared to the official offer, for the suppliers it is rather a participation in the production of a collective service, a co-production of a local service. This contributes to strengthening the social relations built around water. With some suppliers, a flat rate of 10,000 FCFA per month is instituted for unlimited consumption. Neighbours who are not connected pay directly after taking the water (21%). The average bill is FCFA 9,900 (€15) (Table 2) compared to FCFA 7,300 (€11) before connection to the neighbours' mini-water systems (Tables 3 and 4). There is one supplier whose "solidarity" service is evolving into a real market activity, like the small private water operators found in large African cities (Mozambique, Mauritania, Burkina Faso, Somalia). The "subscribers" are registered in a database, which makes it possible to integrate monthly consumption, to draw up invoices and to control the situation of unpaid bills. A monthly invoice is thus issued to consumers (Figure 8) and after two months of unpaid bills, the supply is interrupted as with SEEN. At the start of the fieldwork in January 2021, 106 households, i.e. at least 742 people, were counted as being connected to the neighbours' mini-water networks. On average, 35 households are connected to a mini-water system compared to a maximum of 70. And about 20 applications are registered with suppliers during the fieldwork in January 2022. Today, the number of households connected to the mini-water systems is very high in view of the rapid occupation of the area (Figure 8). Households without private boreholes are connected to the mini-water system either by connection or through carters. Some households draw water directly from the supplier.

Table 2. Monthly consumption mini-grid.

Monthly consumption in FCFA	Nb. quotations	Frequency %
No response	8	29
Less than 5,000	1	4
5000 to 6000	3	11
7000 to 8000	1	4
8000 to 9000	2	7
9000 to 10000	1	4
10000 and more	12	43
Total	28	100

Minimum bill: 4000, Maximum: 15000, Average: 9900 FCFA

Table 3. Monthly bill before connection to the mini-grid.

Monthly consumption in FCFA	Nb. quotations	Frequency %
No response	7	25
Less than 3000	5	18
3000 to 6000	5	18
6000 to 9000	4	14
9000 to 12000	4	14
15000 to 18000	1	4
18000 and more	2	7
Total	28	100

Average bill: 7300 FCFA (11 €)

Table 4. Water sources before connection to the water network.

Water sources before	Nb. quotations	Frequency %
No response	8	27
Carters- retailers	5	18
Drilling	3	11
Bollard fountain	1	4
Private water tower	3	11
Free neighbour	3	11
SEEN Network	6	21
Total	28	

N°	Nom et prénom	Téléphone	M3 au début du mois	Index à la date du relevé	M3 Consommé	Montant à payer (500 F/M3)	A payer avant le
5		96482480		262	285	23	11 500 05/12/2020

Figure 8. Example of a water bill from a neighbour's mini-water system subscriber.



Figure 9. A plumber installing a tap for a house construction site.

3.6. Carters: The Other Major Player in the Functioning and Dynamism of the Territory on the Outskirts of Niamey

In African cities, vendors play an important role in providing access to water for people, whether they are connected or not, whether they live in the city centre or on the outskirts, the inconsistency of water distribution leads city dwellers to resort to the services of water vendors. They provide an essential service and participate in the universalization of access to water in African cities. In Saguia recasement, carters (water resellers) (Figure 10) ensure the supply of water to households not connected to the mini water networks of neighbours and construction sites. The water reselling activity is as old as water sharing in the district, dating back to 2014. The high demand for water with the relocation of families and the explosion of house building sites has boosted the emergence and development of the activity. There are more than a hundred carters in the district and each supplier registers at least ten carters on average at the same time. The average number of trips between the water point and the customers is 8. A cart driver makes up to 15 trips per day. The carts have a load of 12 to 16 25-litre cans of water. The two 25-litre cans sell for 25 CFA francs (€0.03), the 200-litre barrel sells for 750 CFA francs (€1.1) and costs 100 CFA francs (€0.15) from the supplier. There is a monthly subscription contract between the carters and their clients

(households and construction site managers). The average daily income is 6,500 CFA francs (€10), i.e. a monthly income of 195,000 CFA francs (€297), well above the minimum monthly wage in Niger, which is 30,047 CFA francs (€46).



Figure 10. Carters filling their jerry cans at a neighbour's mini-water system.

3.7. Mini-Networks of Neighbours: a Factor of Urban Sprawl in Niamey

Neighbours' mini water networks and small private operators help to meet the water needs of the inhabitants of the peripheral districts and contribute considerably to the occupation and densification of the housing. In Saguia, the

actors interviewed are unanimous on the important role of water sharing between neighbours in the development of the neighbourhood's territoriality. *"The construction of the water towers led to the construction of houses and the presence of the mini-networks facilitated the installation of people in the district"* said a neighbour of the mini-network water system interviewed in January 2021. *"There has been a big change in construction compared to previous years. The carters are busy because of the importance of the construction sites and the settlement of the neighbourhood with the continuous arrival of newcomers. There is a lot of demand although people are connecting to water towers. Some people stop their construction work to wait for water from the carters. The interest in the district is linked to its topographical situation"*, said a cart driver interviewed in January 2021. The people interviewed spoke of a considerable transformation of the district, of the building boom (100%) (Table 5), of the settlement of the district and of the connection to the mini-water networks. On the link between the sharing of water between neighbours and the sprawl of the district, a mini-water network "promoter" said: *"I built my house with the neighbour's mini-water network system and many other people"*.

Table 5. Correlation between neighbouring mini-water systems and peripheral spatial growth.

Status/neighbourhood construction	Castle construction pushed house building	Presence of mini-grids has made it easier for people to settle in the area	TOTAL
suppliers	3	3	6
beneficiaries	20	20	40
carters	5	5	10
TOTAL	28	28	48

3.8. How Robust Are the Saguia Resettlement Mini-Networks of Neighbours

The mini water network system of neighbours is a social response to the absence of a formal network. It is built on hydraulic solidarity through the sharing of water between neighbour-provider and neighbour-beneficiary. For 32% of the beneficiary-neighbours interviewed, it is a social-solidarity service that makes up for the absence of the SEEN network (21%), a determining element in the construction of the neighbourhood (32%). The service is affordable for some (25%) and expensive for others (25%). The good "partnership" relationship, both social and economic, between the actors in the system (neighbour-provider and neighbour-beneficiary) and the carters ensures that the system works well. However, 57% of neighbour-beneficiaries surveyed prefer SEEN services to the mini-water system because of the reliability of the meter (32%), the guarantee of water quality (18%) although the water is regularly analysed according to the suppliers, the reduction in consumption (21%) and the interruption of water distribution with power cuts (29%). Low water flow (57%) due to large numbers of users and power cuts (50%) are presented by respondents as the main problems facing the neighbouring

mini-water system in Saguia. The dependence of water services on electricity services contributes to water insecurity in African cities [4, 11, 31].

4. Discussion

In all African cities, there is a coupling of the primary network (managed by a main operator, in a monopoly position) and a great diversity of independent operators who resell water downstream, either by delivering it to the home (rickshaws, carters, trucks) or in fixed sales points (standpipes, cisterns) [9]. Innumerable small-scale artisans who provide the main basic public services, and in particular the water supply [9]. In Khartoum, microgrids are a sign of the return of state investment and new private entrepreneurs [32]. Neighbours' mini-water networks in Saguia (Niamey), like the small private water operators in African cities, are an alternative to the absence of the formal water network in the peripheral neighbourhoods. They contribute to the universalisation of access to water in territories 'forgotten' by municipal intervention and contribute to the occupation, densification and sprawl of neighbourhoods. [3] speak of a local market service in relation to the action of small private operators to serve peri-urban neighbourhoods in Africa. In

Sagua, the mini water networks of neighbours is an innovation in the water sector that results from neighbourhood solidarity, from the “co-production” of an essential and collective service. Far from being an obstacle to the development of the public service, small private operators are a very interesting option for organising the supply of informal settlements and shantytowns [10] and in new neighbourhoods not yet covered by the water network. We are witnessing the emergence of new, diversified conditions of access to the resource, based on old or emerging forms of solidarity, and which integrate local hydro-social configurations in Africa [1]. In the department of Téra (Liptako Niger), water insecurity has led to the implementation of social responses to correct the water deficit. Water solidarity [4-6, 8], through the pooling of water points between neighbourhoods, between villages and between town and villages, appears to be an appropriate response to the level of water insecurity and makes it possible to correct a deficit and a geographical injustice by sharing water. [33] also spoke of correcting a geographical injustice in relation to the use of the waters of the Èbre through the sharing of water between the mountains and the plain. Studies conducted in Khartoum have shown the contribution of 'water donations' between neighbours in correcting very unequal situations [34]. Faced with the failings of the centralised water manager, forms of solidarity have developed, such as the use of tap water or traditional wells from the neighbour [35]. Unlike the small private water operators that have developed in Africa in an insecure context: without contracts, they are on the fringes of the law [10], the initial objective of the neighbours' mini-water networks in Sagua was social, to encourage the arrival of people in a new neighbourhood. And the price per cubic metre dropped from 1,000 to 500 FCFA (from 1.5 to 0.70 €) with the increase in connections. [3, 11], referring to informal mini-networks, speaks of demands for water. In some areas of the Airport district of Niamey, after at least three decades of supply from boreholes and wells and unsuccessful projects to connect to the SEEN network, the idea of allowing neighbours to have access to water without having to travel, through a connection, has finally emerged [2, 14]. The social objective is being supplemented by a market activity in Sagua.

5. Conclusion

The system of mini water networks of neighbours appears to be an adequate social response to the absence of the SEEN network in Sagua. It is an innovation, 'innovative solutions' [3] in the water sector, built around hydraulic solidarity between neighbour-providers and neighbour-beneficiaries. By making access to water universal in the peripheral areas of the city, mini-water networks accelerate spatial growth through the diffusion of social practice and reproduction (water sharing). If the water micro-networks in Khartoum are redrawing urban territories and modifying their functioning [32], Sagua is a good example of this model of a territory that develops thanks to the mini water networks of its

neighbours. The neighbourhood is now coveted because of its high position, which gives a good view of the city of Niamey. This makes land ownership more and more expensive and the neighbourhood is spreading rapidly. Neighbours' mini-water systems have played a big role. Niamey is registering its first small private water operators.

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