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Urban Governance and Access to Water in Abéché, Chad

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Abstract: *The city of Abéché, located on a bedrock site, is characterized by the absence of a permanent hydrographic network and poor hydraulic development, making the living conditions of its 170,000 inhabitants problematic. Against this backdrop, the aim of this study is to analyze water governance in order to understand the conditions of access to drinking water in this city. To achieve this objective, three is approaches were mobilized. Documentary analysis of the regulatory framework for water governance in Chad and of reference works on the subject helped to circumscribe the subject. A random survey of a sample of 555 households was used to assess the water access situation in the city. Field observations and interviews with resource persons in the water sector were also carried out. The results show that the city is mainly supplied by a water tower built in 1994 for a population of less than 50,000. The capacity of this water tower has now been exceeded, due to the growth of the city, with a population of over 170,000 and a land area of 3,600 hectares. As a result, the company's water supply network is limited to the central districts. The ten standpipes installed to complement the official network operate intermittently, compromising the proper irrigation of this urbanization. As a result, parallel access strategies are emerging and gaining strength in the city. These consist of private boreholes and traditional wells.*

Keywords: *Governance, urban growth, access, water, Abeche, Chad*

1. INTRODUCTION

Access to water still poses enormous difficulties in many parts of the world. In 2003, some 1.4 billion people worldwide had no access to drinking water, 450 million of them in Africa (Gauthier, 2004). Today, 780 million people do not have access to an improved water source . In Africa, around 85% of the urban population has access to drinking water, while 55% of the rural population still does not (Enterprise Works World Wide, 2003).

According to Briand and Lemaître (2004), there is a direct link between lack of access to water and the illnesses suffered by the world's poor, particularly in developing countries. Access to drinking water is a recurring issue in developing countries, due to demographic growth and urbanization (Bied-Charreton et *al.*, 2004). Water scarcity threatens public health and economic growth in developing countries. Water is a limited and vulnerable resource, indispensable to life, development and the environment, and its scarcity and critical deficits make it impossible to cover and satisfy needs equitably. As a result, for several decades now, water has been a priority issue for sustainable development policies, both nationally and internationally.

In recent years, access to water has increased, and the progress indicators used until now do not guarantee the potability or reasonable price of this water without taking into account issues such as the sustainability of the service and equity.

In Chad, the rate of access to drinking water in urban centers varies from 40% to 50%, and in rural centers from 25% to 30% (PADUR, 2015, p 47). The access rate in Ouaddaï province was 27% in 2015. However, we shouldn't overlook the singularity of certain urban centers like Abéché, located in a sub-Saharan environment on the granite bedrock of the Ouaddaï massifs covering an area of 3,600 ha (fig.1).

The sedentarization of mankind is accompanied by the need for access to the resources essential to survival. Of these resources, water represents a major challenge, as it determines the health of

populations. In urban areas, access to water is the responsibility of a multitude of players, including public authorities, companies/corporations (usually public or semi-public) and operators, each working at their own level to produce drinking water and supply it to a customer base of subscribers.

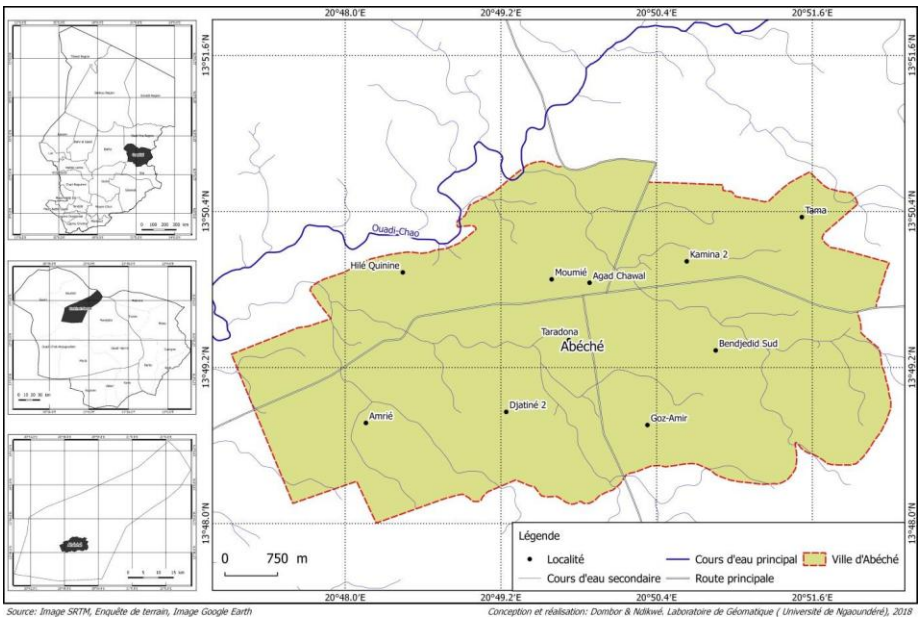

Figure1. *The city of Abéché in Chad*

This governance of water, perceived as a board game, brings together players (stakeholders) with different strategies and rules , with a view to achieving objectives aimed at correcting a situation characterized by constraints (ACFI, 2016). It refers to the functioning of the economic system, and raises the issue of the need for organization. It is the process by which human organizations, whether private or public, take the helm to govern themselves (Tob-Ro, 2015 p. 108). Water governance systems determine who is entitled, when and how, to water and related services. This includes the arrangements through which decisions are made and implemented, stakeholders express their interests and these are taken into account, and decision-makers are held accountable for the management of water resources and public water services.

While this water governance system works effectively in developed countries, providing city dwellers with permanent access to water, it struggles to deliver satisfactory results in the cities of developing countries. This situation can be observed in Abéché, a city in eastern Chad that covers 3,600 hectares and has a population of 150,000. The average annual temperature in Abéché is 32°C. Its population increased from 138,684 in 2009, to around 178,896 in 2016 (commune d'Abéché 2016). Faced with this deplorable situation, we ask the following question: how is water produced and supplied to the people of Abéché?

2. METHODOLOGICAL APPROACH

Three approaches were used to carry out this study. The first, a documentary analysis, analyzed the legislative and regulatory framework for water governance in Chad, administrative documents (reports and accounts of work) of the departments in charge of water management, and reference works on the subject. The conditions of water production and access in the city were assessed through observations and interviews with resource persons in the sector, and a field survey of a sample of 555 households. The sample size was estimated using Epi-Info software, with a 95% confidence interval, on the basis of data supplied by the Commune of Abéché. The mapping of a certain number of indicators was a prerequisite for locating factors likely to influence access to water.

3. RESULTS AND DISCUSSION

3.1. Abéché: a Physical Environment Reducing Access to Water

The town of Abéché, located in the semi-arid region on the eastern edge of the Chadian basin, on the Ouaddaï mountain range, is situated on a massif whose altitude varies between 500 and 1,000 meters. This massif is made up of various elements with a crystalline structure, compromising the availability of water.

3.2. Low and Declining Rainfall

The city of Abéché has a Sahelian climate, with a rainy season from July to September. Rainfall is very low, varying between 300 and 600 mm per year. However, there are peaks, especially in August, sometimes reaching 800 mm. Precipitation analysis shows a dry anomaly associated with the great droughts of the 1970s and 1980s, due to the lack of precipitation (see figure 2). During this dry period, rainfall was lower than usual, and the geographical limits of the wet zone shifted considerably southwards, particularly in 1984, resulting in a shift in isohyets. The regression line, derived from statistical analysis of rainfall data, shows a decrease in rainfall with a negative slope (-0.681).

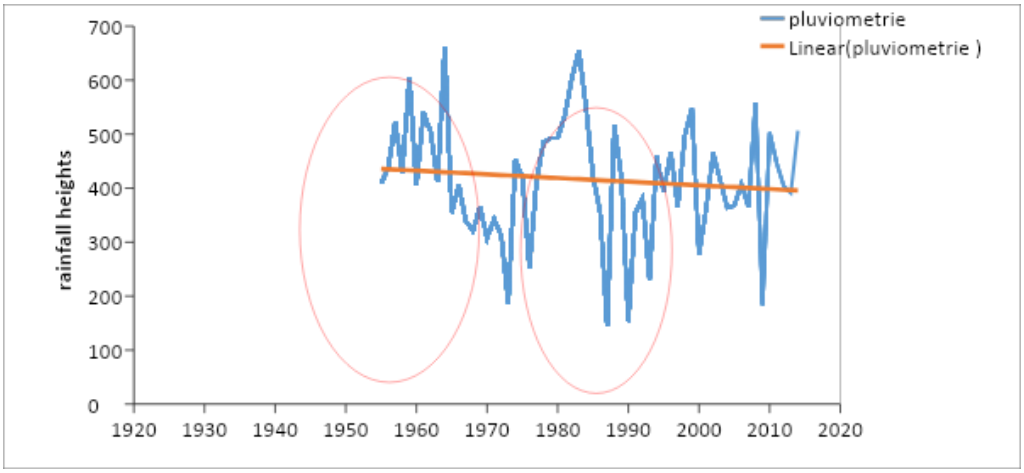

Figure2. *Rainfall trends in Abéché from 1950-2018*

Rainfall over the last six (06) years has shown a rollercoaster pattern. In 2014, 507 mm of rain was recorded over 32 days, compared with 392 mm over 33 days in 2013, a difference of 115 mm that could be explained by the adverse effects of climate change. In fact, over the last six (06) years, the average cumulative rainfall is 412 mm, spread over 37 days, for a difference of 94 mm compared to the 2014 results, with a differential of minus five (- 05) days. These statistics show that the city of Abéché is strongly affected by climate change, which is reflected in a profound change in rainfall patterns, both in terms of periodicity and rainfall levels. This drop in average rainfall is causing many water supply problems.

3.3. An oro-Hydrographic Framework Restricting Access to Water

The town of Abéché lies on a Precambrian bedrock, at the foothills of the Ouaddaï massif on the border with Sudan. This is the largest crystalline massif in Chad, covering more than 500 km from north to south. The rocks found in this massif are granites, gneisses and migmatites, particularly in the northern part of the region. The southern part is made up of ridge-forming quartzites, micaschists, graphite schists, amphibolites, marbles and "arkosic schists". These rocks are widespread, and are surmounted by rocks with very little metamorphism, dominated by slightly sericite schists and hematite schists with 20-25% iron content, which outcrop at the southern end of the massif, near Ankarouba, the locality whose name the series bears (kusnir, 1995). The town of Abéché is characterized by two orographic zones: the first below 560 meters and the second above 560 meters (Figure 3). The first set represents sandy and rocky plains, while the second set represents massifs.

There are three main watercourses called ouadis in the Abéché region (figure 3): the "Chao" ouadi, the "Amsoudourieh" ouadi and the "Djiline" ouadi. These watercourses are generally only formed during the rainy season. They dry up completely at the start of the dry season in November. The beds and banks of these Ouadis are a source of water for the local population. The town of Abéché is located in the Ouadi Chao watershed, to the north of the town, which rises between Abéché and Am Zoer, in the northern Ouaddaï region. The city of Abéché is criss-crossed by three main ouadis, which extend over a length of 3,350 linear meters (see table), a length that continues to evolve each year.

Table1. *Ouadis in the town of Abéché*

N°	Denomination of ouadis	Length (in linear meters)
1	Am Soudourieh	1 450
2	Am Kamal	1 200
3	Hayal Matar	700
	Total	3 350

Source: *URBAPLAN, 2010; p 49.*

Ouadis are temporary watercourses in the endoreic regions of Asia and Africa, originating in the mountains and disappearing immediately after flooding. The Ouadis of Abéché have their source in the Ouaddaï mountains. They dry up in the dry season, but return to their beds as soon as the rains arrive. Given the nature of the soil and climatic factors, there is no surface water from December to June, with the exception of certain ponds which hold water until February. This temporary water regime means that for much of the year, they remain dry, creating the illusion among the population that they do not constitute a danger.

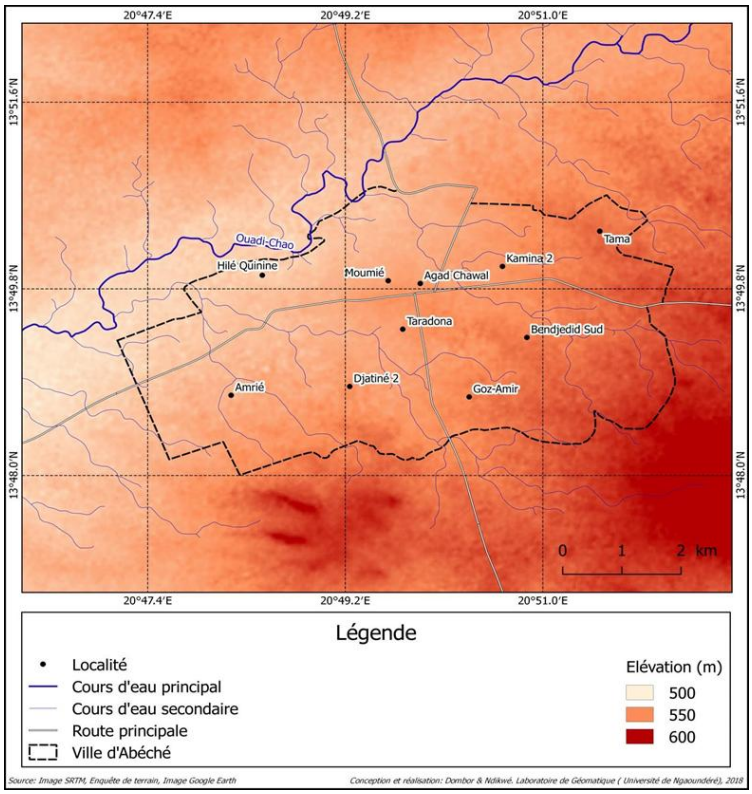

Figure3. *Oro-hydrographic map of the town of Abéché*

Plotting the linear stream segments reveals a distribution rosette showing the stream flow directions: the main direction is SE-NW and two secondary directions, respectively ENE-WSW and NE-SW (Djimramadji, 2016. P. 53). Fracture measurements made in comparison with the directions of these segments show two main fracture directions oriented ESE-WNW and SSE- NNW, followed by a secondary direction NE-SW. The major stream flow direction is close to one of the major fracture directions. This shows that the flow of water in the city of Abéché is largely imposed by the fracturing of the basement rocks. Water tables are located around these fracture zones, but their volume is small.

4. LIMITED HYDRAULIC DEVELOPMENT

The problem of access to water is closely linked to the history of the town of Abéché. It is the cause of its relocation from its original site of Ouara to the current site, which however, does not differ significantly in terms of oro-hydrography. In order to maintain the population on this site, hydraulic developments had to be carried out.

4.1. Water Production in Abéché

Water for household needs is produced in three ways in Abéché: the STE, boreholes and wells.

4.2. Drinking Water Production and City Supply: the role of Société Tchadienne des Eaux (STE)

The city of Abéché is supplied with water by Société Tchadienne d'Eau (STE) from a production zone located 40 km south of the city, in the locality of Bithéa. STE has three boreholes with a capacity of 181 m^3 /h, coupled with a treatment plant and a 527 m reservoir[3] . The production capacity of these boreholes varies from 120,000 m^3 (low demand period) to 200,000 m^3 (hot period, therefore high demand).

The Société Tchadienne des Eaux (STE) network, established in 1960, is currently limited to the central and pericentral districts and is characterized by its obsolescence. As a result, particle deposits are observed in the water served to households, with a proven impact on the population's state of health (Dombor et *al.*, 2019).

The volume of water produced by STE rose from 1,680,350 m^3 in 2005 to 1,942,200 m^3 in 2009[6] . This growth reflects an increase in drinking water requirements of 3.7% on average per year, fuelled by an increase in population during this period caused by the Darfur crisis. Bithéa's STE equipment was installed in 1994 to serve a population of around 50,000, but the population has now increased fivefold (table 2). This shows the inadequacy of water production resources. To this we can add the capacity of the reservoir storage tank at the drinking water treatment plant, which is insufficient. The main cast-iron pipe carrying water from Bithéa to Abéché is old and needs to be doubled.

Table2. *Demographic situation of Chad's main cities*

N°	*Cities*	Years of creation	Population in 1993	Population in 2009	Intercensal growth rate *1993-2009 (in %)*	Population in 2019		Population in 2020	
						Workforce	*%*	*Workforce*	*%*
1	N'Djaména	1900	530,965	951,418	3.7	1,368,229	56.8	1,418,854	56.1
2	Moundou	1923	99,530	137,251	2	167,308	6.9	170,654	6.8
3	Abéché	1909	54,628	97,963	3.7	140,880	5.8	146,093	5.8
4	Sarh	1899	75,496	97,224	1.6	113,949	4.7	115,772	4.6
5	Kélo	1916	31,319	57,859	3.9	84,825	3.5	88,134	3.5
6	Am-Timan	1910	21,269	52,270	5.7	90,992	3.8	96,178	3.8
7	Doba	1911	17,920	49,647	6.5	93,194	3.9	99,252	3.9
8	Pala	1920	26,115	49,461	4	73,214	3.0	76,143	3.0
9	Bongor	1904	20,448	44,578	4.9	71,924	3.0	75,449	3.0
10	Goz-Beida	1912	3,083	41,248	17.4	205,156	8.5	240,853	9.5
	Total		6,000,000	11,175,915	4.0	2,409,673	100.0	2,527,382	100.0

Water storage is provided by two water towers. The first, with a capacity of 800 m^3 , is located 5 km south of the town of Abéché, on the road leading to Goz Beida and Am Timan. The second, with a capacity of 500 m^3 , is located inside the military camp in the town center. The supply network, which covers the majority of the city, totals 42 km in 2018, made up of PVC, asbestos, cement and cast-iron pipes with diameters ranging from 63 to 350 mm. According to technical studies[7] carried out by STE in 2018, the network is mostly in good condition. However, the efficiency of the distribution network, at around 55%, is low. Part of the consumption is not accounted for due to meter blocking and non-paying connections, common practices observed among subscribers. In the city of Abéché, SNE and STE are struggling to collect bills for consumption of their products. Bills are rarely issued and sent to subscribers. Nor do customers hurry to the head office to pay their bills.

A drop in water pressure/flow has been observed, especially in hot weather, due to an increase in the number of connections to pipes not designed for this purpose. Neighborhoods at the ends of the network suffer most from this situation, with water not flowing until very late at night. The population is supplied by 1,617 individual connections and 55 standpipes, only 10 of which were operational in 2018.

The apparent inadequacy of STE's production has contributed to the emergence of community initiatives that have led to the installation of wells and boreholes within the town and especially in areas far from the water supply network.

4.3. Drilling

Some deeper boreholes (photos 1 and 2) (around 50 m) provide a continuous supply, enabling most households and water carriers to draw water from them. Borehole borehole is considered adequate for drinking. However, it is expensive to install (between 8 and 15 million FCFA). This is due not only to the city's physical setting but also because of the scarcity of the resource underground. These boreholes are done with a view to marketing. Borehole water costs less than tap water.

Board1. *Water drilling at Amrié (Dombor, September 2016)*

4.4. Well Construction

Numerous wells, some twenty meters deep, have been dug by hand on the edges of the main ouadis (figure 4). These wells only operate for part of the year (from July to November) and often run dry during the dry season. Equipped wells on the outskirts provide water all year round. However, due to the considerable physical effort and filling time they require, their use is compromised.

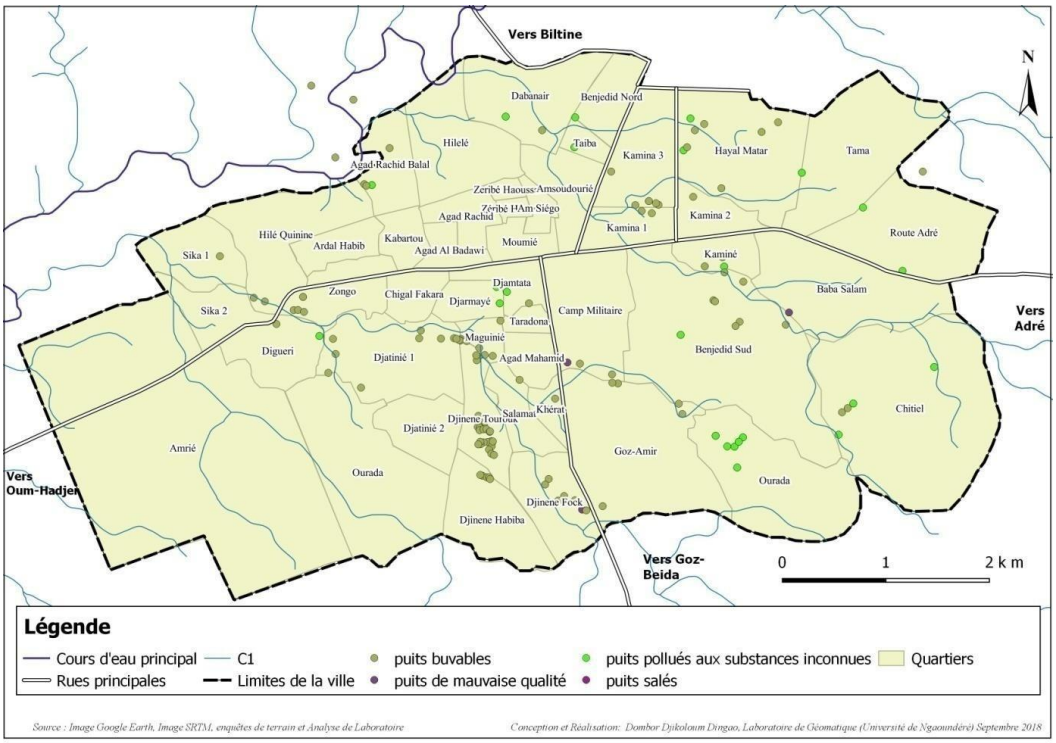

Figure4. *Distribution of wells in the town of Abéché*

4.5. Spatial distribution and access to water in Abéché

4.5.1. Spatial Distribution of Water Access Points

Population Water Supply Mode

There are three main water supply methods in Abéché (figure 5). These are piped water from the STE (19%), borehole water (3.7%) and well water (44%). Stream water (1.2%) and rainwater (1.1%) are used during the rainy season. STE piped water supply is the predominant mode in residential neighborhoods, which benefit from an almost permanent supply. In the central and outlying districts, which do not benefit from the same treatment, wells and their combination with the STE take over. Access to boreholes is not widely available, due to the high cost of construction (around 3,000,000 CFA francs). Given the precariousness of access to water, several methods are used at the same time: well water combined with the retail purchase of running water from the STE, well water combined with the retail purchase of borehole water, borehole water with STE water and/or well water combined with borehole water and running water from the STE.

Water supply methods depend on the population's purchasing power. Thus, the STE's piped water supply is more prevalent in residential areas (64%), while wells and boreholes are used in central and outlying areas.

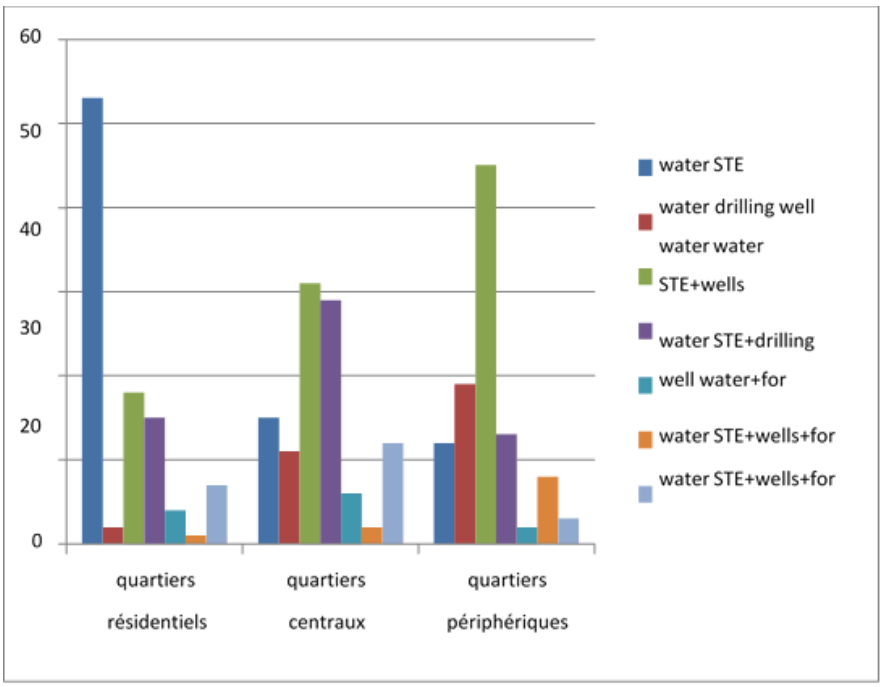

Figure5. *Distribution of water supply methods by neighborhood type*

Source: *household survey*

5. URBAN POVERTY COMPROMISES ACCESS TO WATER

Households in the neighborhoods tend to use a method that corresponds to their social level, as having water sources at home requires financial means. In outlying areas, however, the resident population is poor, and the use of well water and the retail purchase of water from boreholes and the STE are envisaged. There is a significant dependency between purchasing power and household water supply. Purchasing power also influences the means of transporting water. Depending on the proximity of water retail outlets, several means of transport are used: animals (such as donkeys and horses), pushcarts and wheelbarrows.

6. GOVERNANCE OUT OF TOUCH WITH WATER

6.1. Institutional and Regulatory Framework for the Water Sector

The water sector is governed by Law n° 016/PR/99, of August 18, 1999, on the Water Code. This document confers the monopoly of the public water service on the State. However, independent operators, legal entities under Chadian law, acting on behalf of the State under contracts (in the form

of concessions, leasing, management, etc.) are allowed to operate, provided they can deliver quality services. Article 41 of the Code allows the State, through the implementation of its decentralization policy, to delegate to decentralized local authorities (CTDs) its powers to manage, maintain, operate and develop the drinking water distribution network within its territory. The CTDs may in turn (article 48 of the Water Code) delegate their powers to the private sector (private operators, individuals, groups or associations) to ensure the maintenance, operation and development of the supply system. Numerous structures exist to ensure concerted action in the management and monitoring of the water sector[9] .

The water sector in Abéché is overseen by the Délégation de l'Environnement, de l'Eau et de la Pèche, which is responsible for implementing policies to protect the environment, combat desertification and manage natural resources, as well as policies on urban, village, agricultural, pastoral and sanitation hydraulics, meteorology and hydrology. Within this framework, it initiates, leads, coordinates and regulates water resource activities.

6.2. A Multitude of Players for Difficult Access to Water

6.3. The Town of Abéché

The Municipality of Abéché manages the hydrants. It has its own Technical Services Department, which is responsible for water services in the town. The Environmental Hygiene and Sanitation Division of the Ouaddaï Regional Public Health Delegation provides water treatment for the population. It works with the STE and populations in outlying areas with little or no access to appropriate water service structures and equipment.

6.4. Société Tchadienne des Eaux (STE)

Drinking water supply in Abéché is provided by the Société Tchadienne d'Eau (STE), under the supervision of the MEEP. STE is responsible for water collection, treatment and distribution.

Other players in the WATSAN sub-sector are: donors - including AFD, the European Union and KFW, which are currently the main donors to the WATSAN sector.

6.5. NGOs

Four non-governmental organizations and associations are more active: UNICEF, FAC, AFD and UNDP. We also note the presence of religious associations

NGOs and charities; and the private sector.

6.6. Other Players in the Water Sector

Individual water operators in Abéché are of three types: fountain operators, private individuals and water vendors. The fountains are managed by the fountain operators, who also which also involves the STE and the Commune of Abéché. To become a fountain attendant, interested parties apply to the Commune and lodge a deposit with the said institution. STE then bills the water in their name. Water fountains sell water to street vendors and to households not served by STE. Approximately 43% of the population of Abéché obtains its drinking water from fountain operators.

Individuals are involved in the management of wastewater of wastewater, runoff and drinking water. water. They build dry pits, septic tanks, traditional latrines or pit latrines to evacuate wastewater. Individuals also dig small canals in front of their homes to collect and drain run-off water. It's true that most of these channels are makeshift ditches dug in the ground, but sometimes individuals build masonry channels. Finally, they acquired individual connections to the STEwater supply network, installing human-powered pumps in the courtyard or in front of their homes. They also build wells with or without coping stones. Some households get their water free of charge, while others pay for it, as do peddlers. Those who come for free are either relatives of the owner, acquaintances and/or neighbors.

Peddlers, the third type of individual operator, are generally male, aged between 20 and 50. They are mainly involved in drinking water distribution. water. These vendors buy water from standpipes, human-powered pumps or individual connections and resell it to consumers.

7. CONCLUSION

The aim is to understand the logics and strategies of water stakeholders in Abéché. It shows that water scarcity and the polarization of social classes in Abéché reinforce inequalities in the city, particularly socio-spatial inequalities linked to water supply. The STE water supply networks are discontinuous and uneven. As a result, Abéché's inhabitants are served by a highly variable water supply: connected STE connection, wells, water vendors, borehole water, etc. This socio-spatial inequality linked to water supply influences representations of the water resource, modes of water supply and differentiated consumption practices. Discontinuous and uneven water supply networks encourage different water supply methods in different neighborhoods of Abéché. The different preferences for water supply modes to meet specific needs such as showering, drinking, washing, toilets, are generally determined by income level. However, there are specific water consumption practices (washing using a water bucket, etc.) within the Abéché population: consumption practices that lead to excessive water consumption.

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Dr DOMBOR DJIKOLOUM DINGAO, born September 13, 1985 in Moundou, southern Chad, specializes in Environmental Geography, with an emphasis on Health Risks. He studied at the University of Douala in Cameroon, where he obtained his Bachelor's degree in 2009 and Master's degree in 2012. He continued his studies at the University of Ngaoundéré, where he obtained his PhD in 2020. He was promoted to the rank of Maitre-Assistant CAMES in 2021. From 2013 to 2021 he was Enseignant Chercheur in the Geography Department at the Ecole Normale Supérieure d'Abéché, and since November 2021 he has been at the Ecole Normale Supérieure de Bongor. He is a member of the Geomatics Laboratory (University of Ngaoundéré) and the Geography and Environment Laboratory (University of Douala). Since 2023, he has been appointed Director of Studies at the Ecole Normale Supérieure d'Abéché.

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