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Article

Unequal access to drinking water in the city of Doba (Chad): An urban political ecology perspective

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Abstract: Within the context of climate change and other environmental stressors, water scarcity has become a major concern in urban areas of the Sahel region of Africa. Water is an important resource and its scarcity which is exacerbated by socio-economic inequalities has created unequal power relations and conflicts. From this guiding premise, this work seeks to examine challenges in ensuring effective drinking water supply and how they have reshaped relations in urban areas using the case of Doba. A mixed methods approach was employed and includes documentary research, a questionnaire survey with 120 purposively selected households, 11 in-depth interviews and a collection of water samples for quality analysis. Data collected was analyzed qualitatively and quantitatively while water quality analyses were conducted at the Sarh laboratory. Under the lens of the Urban Political Ecology (UPE) approach, results revealed that households drink water from boreholes (31%), open wells (48%), springs (8%) and pipe born water (20%). The physicochemical analysis showed an iron level of 0.24 mg/L in tap water and the turbidity rate of 48.20 Nephelometric Turbidity Units (NTU) in well water while bacteriological analysis gives a total aerobic chlorine level of 100 CFU/100 ml in all the waters sources analyzed. These inequalities results from poor state of infrastructure, climate change and socio-economic differences at the level of households. This has resulted to conflicts between the state water supplying institutions and dwellers and between dwellers themselves over water sources. This work has a policy implication as the provision of drinking water requires concerted efforts between all stakeholders.

Keywords: drinking water; unequal access; conflicts; urban political ecology; Doba; Chad

1. Introduction

Dryland areas in Sub-Saharan Africa are highly vulnerable to water scarcity and insecurity which has been exacerbated by unequal distribution [1,2], climate change and rapid population growth [3]. Three major regions in Africa; the Sahel, the Horn of Africa and South East Africa are hit by severe droughts once every thirty years on average [4]. These droughts have tripled the number of people exposed to acute scarcity of water resources, leading to major food and health crises. According to the World Health Organization and the United Nation's Children Emergency Fund [5], 700 million people, or 9% of the world's population do not have access to drinking water and the situation is worse in Sub Saharan Africa although there has been a steady improvement since the year 2000. Among the 700 million people who do not have access to drinking water, the WHO identifies 300 million people (4% of the world's population) who must walk for more than 30 minutes to access a drinking water point [5]. For a long time, there has been a strong International and sub-regional mobilization to provide solutions to the difficulties of access to water and

especially to drinking water. This is why, since the 1980s, under the impetus of the International Drinking Water Supply and Sanitation Decade (IDWSD, 1981 to 1990), efforts have been made to promote access to drinking water for the world's rapidly growing population, particularly in developing countries. Despite this high level of vulnerability these areas are often overlooked in urban studies literature and therefore this paper is contributing to filling an empirical knowledge gap

Water scarcity in urban areas of the South is fueled by the interaction between physical and human factors. Unequal water distribution caused by inadequate infrastructure, weak policies and the brunt of climate change have reshaped the urban waterscape [2]. Nowadays, many people, especially the majorly urban poor experience acute water scarcity due to affordability problems [6]. Many dwellers in populous African towns do not have the financial means to connect to the water distribution networks nor buy mineral water. This commodification of drinking water has pushed the urban poor to drink water from streams, rivers and ponds, which are not of good quality [7]. Another major constraint is the restriction of the drinking water supply network to some parts of the urban center thus limiting access to water to a very small proportion of the population [8]. According to the World Health Organization-United Nations International Children Emergency Fund [5], there has been a drop in home water connections within the urban areas of Chad from 43% to 33% since the year 2012. This drop is explained by problems such as inadequate finances, infrastructural and technological barriers as well as policy limitations [9]. However, understanding the situation of water scarcity requires a multidisciplinary approach. The Urban Political Ecology approach provides a suitable framework for the analysis these inequalities. The combination of scientific (physico-chemical and bacteriological analysis) for quality with the socio-economic and political dimensions to explain inequalities in drinking water supply and how they have affected social and power relations in cities is the strong hold of this work.

Chad, a landlocked Sahelian country, is among the poorest in the world. It has a surface area of 1,284,000 km^2 and an estimated population of 15,162,000 inhabitants, with an annual growth rate of 3.6% (United Nations Population Fund) [10]. However, according to the African Development Bank [11], the rate of access to drinking water for its population is 63.5% and 19% for sanitation. In the Southern Logone region where Doba is the capital, the rate of access to drinking water is 27% as reported by the Ministry of Urban and Rural Water Supply in 2017. The city has serious problems supplying its population with drinking water. In addition to the fact that the infrastructure and equipment in place are dilapidated, network extensions have not been carried out for a long time and the city's population continues to grow at a rapid rate. Equally, the non-payment of water bills by local administrative officials, and the exorbitant price of household connections to the Chadian Water network are some of the obstacles hindering access to drinking water by the population [10]. Drinking water supply in Chad is not provided only by the state. Multiple actors have joined the water supply sector for diverse reasons. As individuals invest in water supply to make money, Non-Governmental Organizations (NGOs) intervene to perform a social role and reduce inequalities.

Politically, the water code which was promulgated by law n ° 016/PR/99 of 18 August 1999, stipulates that, the public water supply may be provided by the State or

by one or more independent operators (legal entities under Chadian law) acting on the delegation of the State by contracts, provided that they can provide quality services. Article 41 of the code gives the State the possibility, through the implementation of its decentralization policy, to delegate to decentralized territorial collectivities, its powers of management, maintenance, operation and development of the drinking water distribution network. The decentralized authorities (article 48 of the water code) in turn delegate power to private operators, individuals, groups or associations) to ensure the maintenance, operation and development of the supply system (Rural Drinking Water Supply and Sanitation Program [12]. Never the less, decentralization has not been accompanied with the transfer of financial resources and the multiplication of state actors have led to ambiguity and conflict of competence. Despite the objectives set by the country, Chad is ranked among the sixth countries in the world where the need for drinking water is the greatest [13]. In 2015, during the World Water Day festivities, the Minister of Livestock and Hydraulics declared that out of a total of 12.3 million inhabitants in Chad, only approximately 6.8 million inhabitants were served by drinking water. This number has been reducing over the years as climate change has added significantly to the existing water crisis [2].

This article therefore analyzes issues of unequal access to drinking water by city dwellers using the UPE approach. It enlightens on the interconnection between environmental and societal challenges and how they have affected the quality of services in urban centers, particularly water. The interdependence between the effects of climate change, politics, socio-economic challenges, poor infrastructures and technical limitations with the physiochemical and bacteriological analysis is crucial in understanding the unequal distribution of drinking water in urban areas. Using the case of Doba (Chad), that falls within the Sahel zone of Africa, this work provides an evidence base that will inform policies and shape practices relating to the provision of basic services to the rapid growing urban populations.

Theoretical framing: Urban political ecology of water

Urban Political Ecological is an interdisciplinary theoretical approach that examines the political, economic, socio-cultural, behavioral and material factors that shape environmental governance, resource distribution and decision making in urban areas [14,15]. It emerged in the 1980s following research in rural contexts in the Global South [16,17]. This approach seeks to make visible the political, socio-economic and power relations that produce the current forms of differentiated access to water resources and more particularly to drinking water in cities [18]. It emphasizes that environmental change and resource management are intertwined and will affect political-economic structures as well as socio-political objectives [16]. The reflection on urban socio-environmental processes as political and power relations finds its origins within the discipline of urban geography with a Marxist framework [18].

UPE is interested in conflicts, inequalities and power relations around the management of the environment and natural resources [19]. To do this, researchers analyze the various actors and their interests, the discourses and representations. For

these analysis purposes, the discipline uses both natural parameters and social parameters. Indeed, UPE studies start from the postulate that in all technical problems lie with social questions. Generally speaking, invoking the principle of justice, this approach takes the side of marginalized and oppressed groups [19]. In terms of scale (socially and naturally constructed), it focuses on the local, but especially how the latter is influenced by the global [20]. Drinking water in Doba is not only provided by the state. Individuals and private institutions equally venture into this domain for financial gains. This is gradually leading to a shift in practices. According to Mendy [21], social practices are reproduced in time and space. This allows individuals to develop models of social relations, but also highlights a mechanism that leads to the stabilization of practices in social structures. This dimension of sedimentation of practices is at the heart of the theory of consumption practices that is widely critiqued in UPE literature [7,9,22]. Daily efforts and movements to fetch drinking water in most homes, water storage methods and efforts to reduce wastage have shaped practices in urban waterscape. Issues of conflicts can also arise especially in the Sahel regions where only women and children are responsible for water supply to homes [10]. This is an important dimension of UPE that looks at power relations at a micro scale.

UPE is applicable as it helps to comprehend the behaviors and conflicts between users and stakeholders, the strategies for distributing drinking water, the means available to the latter and the physical conditions that impact on drinking water. Water supply is influenced by environmental factors such as climate change, materials (infrastructures and equipment) and socio-economic limitations but UPE goes further to include the role of institutions and governance in the management of the precious resource [15]. Issues of poor infrastructure and water quality are equally responsible for inequalities [9]. As such, the interdependence between water qualities, infrastructure, politic, power and how they affect access to drinking water are enshrined within the scope of the UPE approach. This will help unravel the increasing inequalities observed in the urban waterscape.

2. Materials and methods

2.1. The study area

Located between latitudes 8° and 9° North of the equator and between longitudes 16° and 17° East of the Green Wich Meridian, the city of Doba is the head quarter of the South Logone province and it is approximately 500 km South of the capital N'Djamena (**Figure 1**). Climatic conditions rely on two air masses: the harmattan (hot and dry continental air mass that brings winds from the East and North-East of the Sahara) and (the unstable monsoon maritime that carries moisture from the South-West). Between these two air masses is the inter-tropical front, an important element in the alternation between dry season (6 to 7 months) and rainy season (3 to 4 months) and in the determination of rainfall amounts [13]. Rainfall varies from 800 mm to 1200 mm per year and an average temperature are 28.9 ℃. The thermal regime is marked by a relatively cold period from December to February (11 ℃ to 22 ℃ and a hot period from March to June (40 ℃ to 43 ℃) [13]. These conditions make the area favorable for agro-pastoral activities. According to

local edaphic conditions and micro climates, three types of vegetation can be distinguished: the grass savannah, wooded savannah and gallery forest [23].

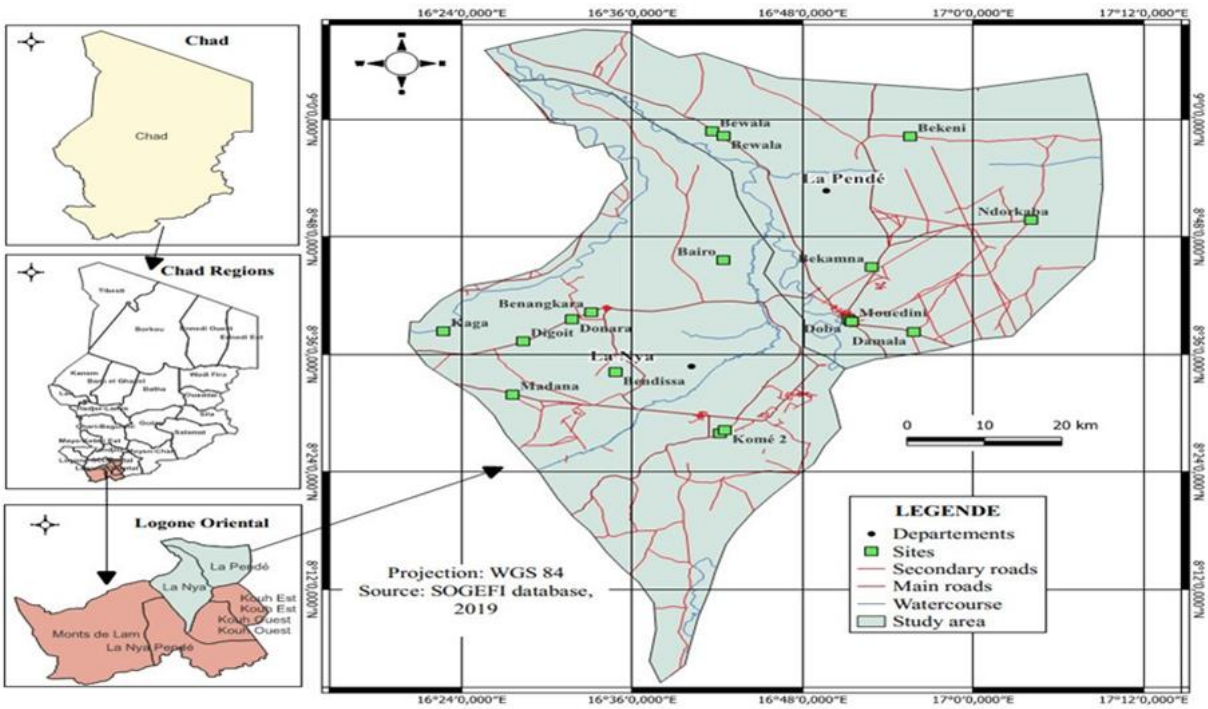


Figure 1. Localization map of Doba within the southern Logone province.

Doba is the 3rd largest city in Chad and has experienced significant population growth in recent years. It has an estimated population of 18,052 inhabitants, according to the General Census of Population and Inhabitants [24]. With the discovery of crude oil between the year 2000 and 2001, the population of Doba increased to 25,650 inhabitants in 2008 and to 702,885 in 2009 [25]. Doba covers a surface area of 130,000 km^2 with a population density of 33 inhabitants/km^2 [25].

Environmental conditions have made access to drinking water extremely difficult for a majority of the population. In Doba, extreme rainfall variability characterized by frequent droughts in recent decades has reduced its potential in water resources. Equally, poor infrastructure and policy limitations have exacerbated the water crisis. In 1973, the city benefited from a 600 m^3 water tower located on the Western bank of the river Logone. This tower supplied the population through standpipes but only served 2692 subscribers in a population of 218,000 inhabitants. However, the tower was intended to supply 10,000 inhabitants for cities like Doba [12,13]. Politically, law No. 016/PR/99 on the Water Code, which is Chad's first reference text on water, proposes legislative and regulatory measures in the water sector. It considers water resources located within the national territory as a collective good whose protection and management is ensured by the state. The supply of drinking water is placed as a priority above agro-pastoral, reforestation, industrial complexes, agro-industrial and road development needs (Chad Article 149). Through the process of decentralization, the state has transferred competences to local authorities, including the management and expansion of water supply networks. However, challenges led to the creation in 2010, of the Chadian Water

Company (STE) following the dissolution of the Chadian Water and Electricity Company (STEE). Since then, it has become the national operator for the production and distribution of drinking water in large urban centers.

2.2. Data collection and treatment

This study employed a mixed methods approach in the collection of both qualitative and quantitative data. Secondary data was collected from online sources, libraries and archives in Institutions such as the Chadian water utility company and the meteorological center for rainfall data. Primary data collection was carried out during field visits organized from the month of April to July 2024. During this phase, field observations of water infrastructure, key informant interviews, house hold questionnaire surveys and collection of water samples were the main data collected methods used. A questionnaire survey was conducted with 120 households purposively selected from both residential and low class quarters of the town. The purposive sampling technique was adopted in the identification and selection of participants. It consisted of two steps, expert sampling and snow ball sampling. Expert sampling was used to identify knowledgeable persons with valuable insights on water management in Doba. The Chadian Water Company, which is the main institution in charge of drinking water supply, was used as the starting point for the identification of interviewees and quarters within the town. From the company's connection network, three neighborhoods or quarters were sampled based on their primary drinking water sources (those drinking water from taps, wells and boreholes). While in the quarters, snow ball sampling was used to select households for the questionnaire survey. In each quarter, the first household head was selected and then he/she provided multiple referrals. Each new referral then provided more participants until the number was enough for the sample. The sample size of 120 (40 per quarter) marked a data saturation point. At this point, enough data had been collected to draw necessary conclusions, and any further data collection could not produce value-added insights. With both open and closed ended questions, questionnaire administration was done with the help of kobo-collect toolbox built in smartphones. Also, 16 key informant interviews were conducted with 2 District delegates, the city mayor, 2 agents of the water supply company, delegate of environment, head of the meteorological station, 6 quarter heads and 3 water sellers. During discussions, voice notes were recorded using Dictaphones.

To study water quality, 3 water samples (Borehole, Tap and Well) were collected in 3 neighborhoods. To better monitor the evolution of pollution over time, the water samples were taken on the same day. However, due to the non-functioning of water points or taps in the neighborhoods, and the closure of the water tower, tap water was sampled directly at the source (where water is treated before pumping to the different neighborhoods). During this phase, factors such as the rate of attendance at water points, the presence or absence of a potential source of water contamination, the level of development of the structure and waterborne diseases reported in the households surveyed were taken into consideration. Water samples collected were conditioned in 1.5 liter plastic containers previously rinsed with distilled water. These containers were filled and hermetically sealed to prevent gas

exchange. An ice bar was broken and placed in a cooler to keep the temperature of the water samples at 4 °C as recommended by [25].

Data collected was treated quantitatively and qualitatively. Questionnaires were coded and treated in SPSS version 20 while voice notes from interviews were transcribed, coded and treated with the help of Atlas.ti software. Qualitative analyses were done based on content and themes corresponding to the study objectives. Water samples were taken to the laboratory in Sarh for physic-chemical and bacteriological analysis.

3. Results and discussion

3.1. Accessibility to drinking water sources and factors of inequality in Doba

The Chadian Water Company (STE) is the main organ responsible for the provision of drinking water to the population in the main urban centers. However, findings from the household survey have revealed that there are 4 main sources of drinking water in Doba (**Figure 2**).

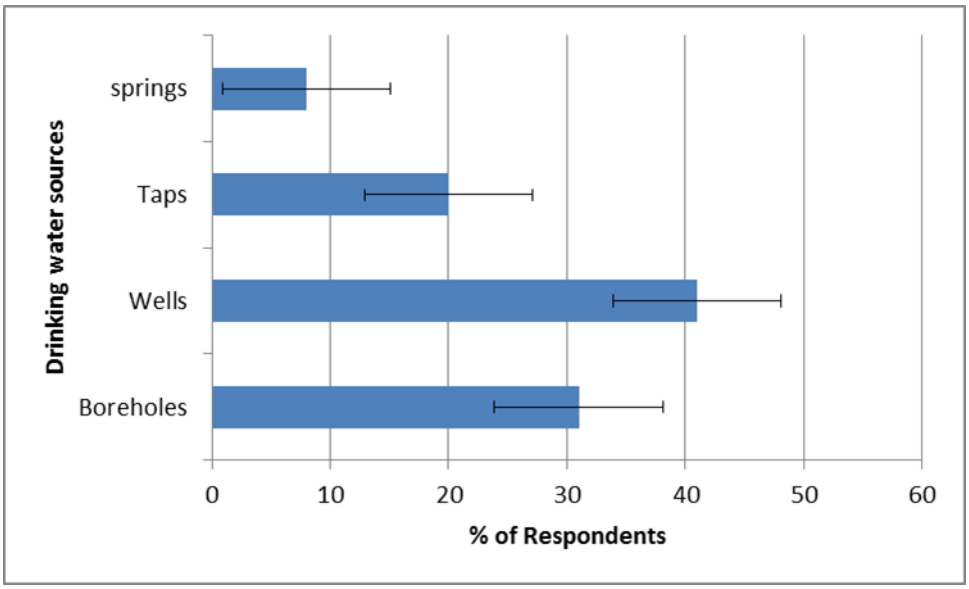


Figure 2. Drinking water sources in the town of Doba.

Figure 2 shows that 31% of the population drinks water from boreholes, 41% from wells, 20% from taps and 8% from natural springs. This implies that a greater proportion of the population (80%) is not connected to the National water network. In the last few decades efforts have been made to improve the water and sanitation situation of the population in urban areas but inequalities exist. From the survey, 45% of the population said their situation have deteriorated over time, 23% affirm that their situation has not changed, 17% confirm that their situation has worsened and 15% believe that their situation has improved. Indeed, the 45% of the population who said their situation is deteriorating decry their experiences with STE. This category of households were connected to systems before abandoning due to challenges such as flow irregularities (**Figure 3**).

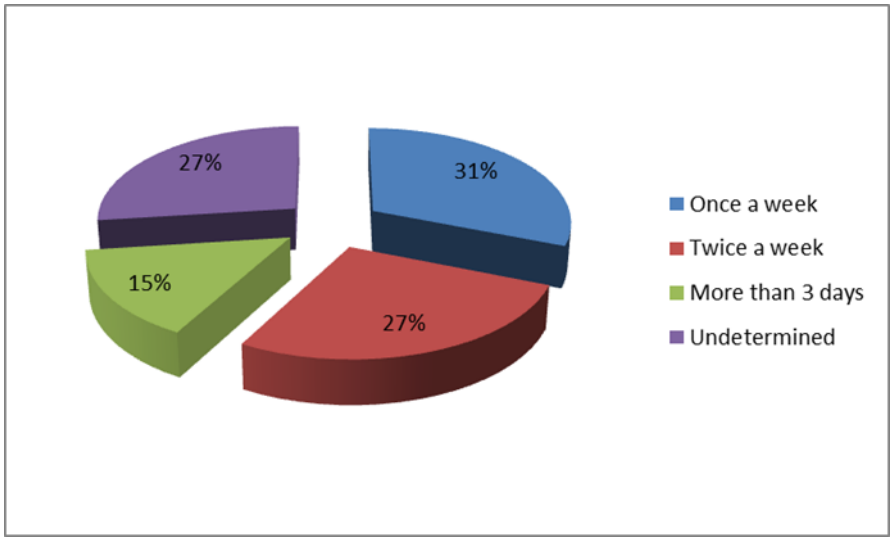


Figure 3. Water flow frequency from STE taps in households.

Figure 3 demonstrate that water from the STE taps do not run regularly. Surveys have shown that 31% of those connected to their network get water only once a week on average and only 15% get water three days in a week. Worse still, 27% cannot say with certainty nor remember when last their taps had water. During interviews, a quarter head in Doba said;

> "….. *taps do not run regularly in some neighborhoods due to low pressure in the pipes and dwellers tend to use suppressors and boosters to increase flow...*" (Interview, 2024).

Suppressors are devices that allow water to be sucked from the networks in order to increase the flow in users' taps. This allows households to have regular flow. They are also used by most households that have transformed their taps into standpipes (construction of standpipes). Results of the survey reveal that among the households officially connect to the STE networks, 4.5% use boosters, especially in the neighborhoods of the 2nd District of the city. This practice deprives households located downstream of the drinking water distribution networks of regular water flow. Due to this practice, many households can go for months without tap water. This has generated conflicts between upstream and downstream users. This explains the rise in the number of households drinking water from boreholes and wells which in most cases are of doubtful quality. The inequalities and irregularities in the water supply system are caused by both natural and human factors. As such, examining the interactions between these factors and how they have affected resource provision in towns is crucial in understanding inequalities.

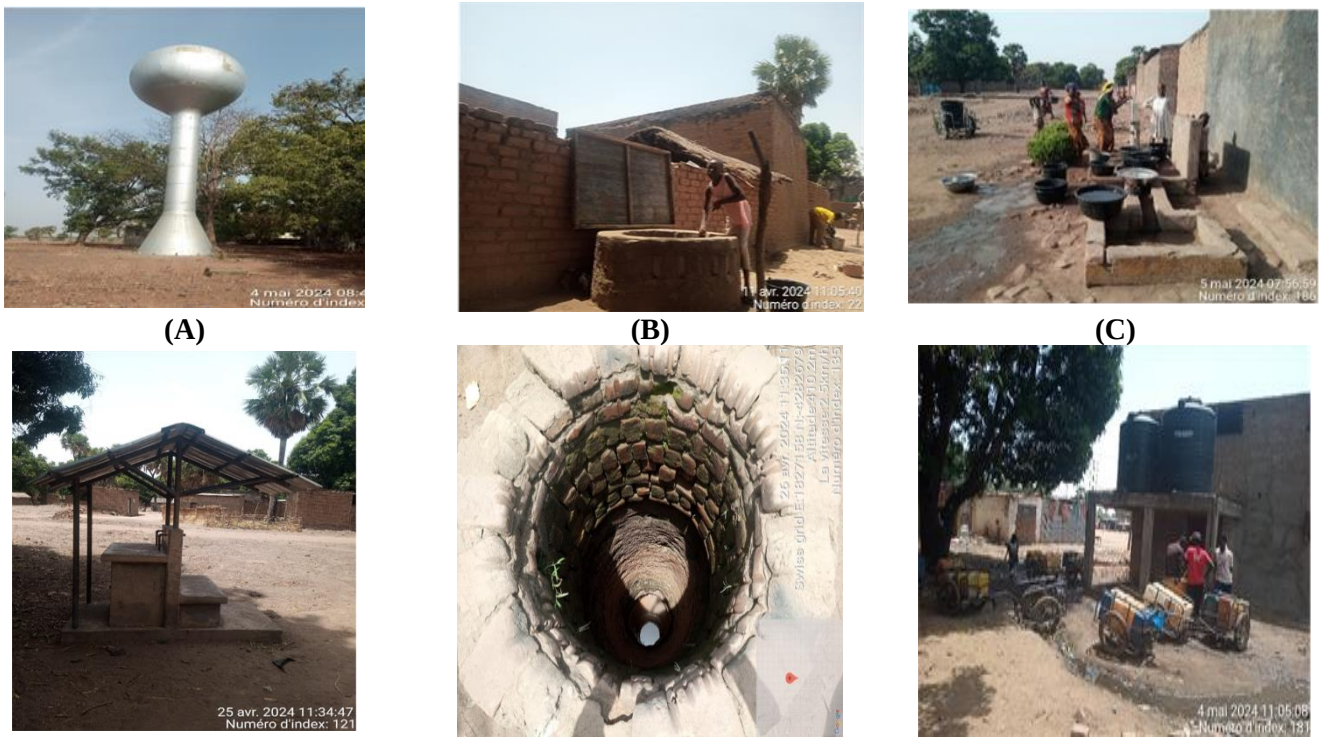
3.1.1. Rapidly growing population without a corresponding increase in infrastructure

The city of Doba has experienced significant population growth over the past few decades. Estimated at 18,052 inhabitants in 1993 [24], the population rose to 702,885 in 2009, giving an estimated annual growth rate of 5% [25]. According to our field surveys, population growth became spectacular as from year 2001 due to the discovery and exploitation of crude oil in some regions of Doba. Nowadays, the population is increasing at an exponential rate and STE has difficulty supplying the

city due to the poor state of infrastructure, inadequate finances and low technical know-how. The drinking water supply infrastructure is aging and insufficient (Plate 1). The main facility was constructed by the Germans in 1973 and its capacity has not been increased or renovated till then. Pipes connecting water from the storage centers to households have not been replaced while the number of users has increased substantially**.** As such, we have more people over fewer water sources.

Figure 4 shows that water supply facilities in Doba are not in a good state. Photos A is the main water reservoir that was constructed by the Germans in 1973 and its capacity is far below the present demand. As such, the population has opted for other sources (**Figure 4B, C**) but those individual initiatives still suffer from poor infrastructural developments. For instance, **Figure 4D** shows a water fountain abandoned due to technical issues while photo E is a well drying up. This situation has prompted some individuals to store water in large quantities (**Figure 3F**) and sell to those in need. At the individual level, challenges equally abound such as limited finances to acquire facilities or connect to the STE network. Reacting to this, a household head said;

> "….. *we are making efforts because water is life and we cannot live without it. However, we do not have the needed money to dig boreholes or pay connection fees. The connection procedures require a registration fee that varies between 2,500 to 5,000 FCFA and the installation costs between 25,000 to 50,000 FCFA depending on the quarter. It is too much for us*…" (Interview, 2024).



(A) **(B)** **(C)**

(D) **(E)** **(F)**

Figure 4. State of water infrastructure in the town of Doba. **(A)** Water reservoir; **(B)** A well; **(C)** A borehole; **(D)** Abandoned fountains; **(E)** Drying well; **(F)** Water in storage for sale.

Through this explanation, it appears clear that dwellers with low monthly incomes cannot afford to have pipe born water in their homes despite efforts made

by STE to expand their networks to new neighborhoods. It was revealed from the questionnaire survey that about 33% of the population has a monthly income between 25.000 to 30.000fcfa, 26% between 35000fcfa to 40,000fcfa, 20% between 45,000fcfa to 50,000fcfa and only 8% with incomes above 65,000fcfa per month. The commodification of drinking water is an element of a situated UPE of drinking water that aggravates inequalities and exacerbates social injustice. With this precarious situation, these majorly urban poor tend to consume water of very doubtful quality.

3.1.2. Poor water quality

Physico-chemical and bacteriological analyzes were carried out to determine the degrees of pollution of the water sources consumed by the population of Doba. The analysis of sampled waters focused on the search for fecal and environmental pollution indicators such as total coliforms (TC), Escherichia coliforms (EC), fecal streptococci (SF), salmonella and shigella. It is a valuable tool for determining the effectiveness of protection, water treatment and prevention measures. Physico-chemical analysis revealed an iron level in tap water of 0.24 mg/L and the turbidity level of 48.20 NTU in well water while bacteriological analysis gives a total aerobic chlorine level content of 100 CFU/100ml in all water samples analyzed (tap, borehole and well). Total Coliforms which constitute a group of bacteria of fecal and environmental origins serve as an indicator of microbiological contamination because they are easy to detect and enumerate in water. Their presence in water intended for human consumption indicates that the bacterial quality of the water is deteriorating. The CT concentration is 100 CFU/100ml in all the 3 samples and according to the [24], they must be absent in drinking water. Its presence in tap water is an indicator of disinfection effectiveness. Escherichia coliform is present in all water sources and its level fluctuates from between 0, 6 and 9 CFU/100 mL. Water from boreholes and wells recorded the highest concentration (9 CFU/100 mL) and tap water had the lowest (0.6 CFU/100 mL). Therefore, there is need for an improvement in treatment by the STE in order to supply good quality water to the population. The population linked the recurrence of water borne diseases to the poor water quality (typhoid 45%, cholera 36%, dysentery 14% and other diseases 5%). Corroborating these results a dweller said,

> "…. *Sometimes tap water is so dirty that you cannot drink it. It has color and it smells…. Maybe that's what gives us illnesses…."* (Interview, 2024).

The supply of poor quality by the STE has been an object of social protest and conflicts. As such, reconciling quantity and quality require more investments and concerted efforts. Changes in the quality and quantity of water are sometimes attributed to the impacts of climate change with extreme rainfall anomalies.

3.1.3. Impacts of climate change on water

Water is a natural resource and its availability has a direct relation with the changing climatic conditions, especially rainfall. Rainfall contributes in stocking the water table but unfortunately, rainfall has become very unstable in Doba with coefficients of variations ranging between 16% and 21%. These fluctuations are characterized by the alternations between years of positive anomalies and negative

anomalies. This is materialized using the standardized rainfall anomaly index (**Figure 5**).

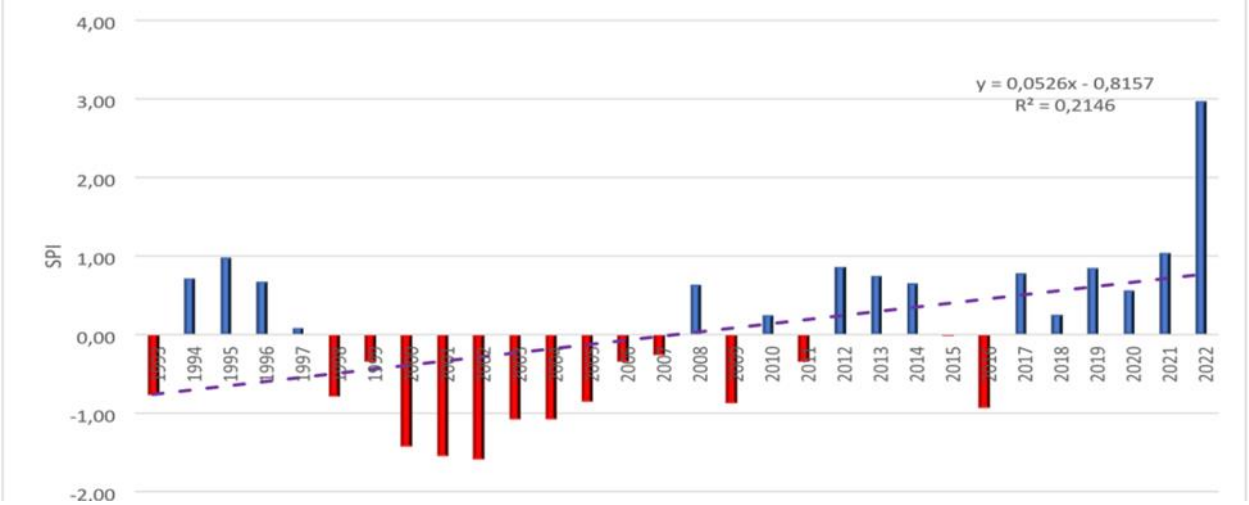


Figure 5. Rainfall anomaly and trend in Doba.

Years of positive anomalies recorded rainfall amounts above the normal with a high likelihood of floods while years with negative anomalies had less rainfall and a high probability for the occurrence of drought and acute water shortages. **Figure 4** shows that years of negative anomalies were more than years of positive anomalies with SPI values ranging from −1.54 mm to +3.0 mm. This implies that rainfall in this area is highly unreliable and the trend is falling over the years. The population has perceived an increase in the frequency of extreme weather events with direct consequences on drinking water as captured during an interview with an agent of STE;

> "……. *there is a general situation that affects the entire Sahel zone. Climatic conditions have become very harsh, characterized with extreme conditions. The frequency and intensity of drought events have increased and when rains finally come, they are intense and floods occur*…." (Interview, 2024).

These extreme conditions reduce the quality and quantity of drinking water. Archives have revealed that natural constraints such as droughts in the 1970s caused a decline in water tables, leading to the drying up of water courses with negative outcomes on the supply of drinking water to the population as opined;

> "…. *Indeed, with the decrease in the volume of groundwater caused by droughts, our boreholes and wells no longer contain the usual quantities of water*…" (Interview, 2024).

These excerpts demonstrate that climatic phenomena are more erratic than ever and all natural systems are vulnerable, especially in the Sahel region that is under the influence of the advancing Sahara desert. Climate change has the effect of reducing the quantity and quality of water. The rise in temperature favors an extension and intensification of the period of evapotranspiration, thus reducing the level and flow of rivers and boreholes. These natural causes of water insecurity demand appropriate adaptation measures and collaboration between actors.

3.2. Stakeholder participation in drinking water management and challenges

From the construction of the first drinking water reservoir in 1973 by the Germans and continuous challenges involved in drinking water supply, the management of water infrastructures in Chad has seen the multiplication of stakeholders, ranging from state institutions to private and civil society organizations.

3.2.1. The state and its interventions

The government of the Republic of Chad has promulgated laws, decrees and codes in order to provide solutions to water problems in general and that of access to drinking water in particular. Law No. 016/PR/99 on the water code, which is Chad's first reference text on water, proposes legislative and regulatory measures in the water sector. It considers water resources, located within the limits of the national territory, as a collective good for which the State has the duty to ensure its protection and management. The supply of drinking water, for its part, is placed as a priority above other needs. It gives power to the State, through the policy of decentralization, to bequeath to decentralized local authorities (CTD) its powers of management, maintenance, operation and development of the drinking water distribution network within the national territory. Also, Law No. 004/PR/2011 ratifying Ordinance No. 014/PR/2011 on the water hygiene code stipulates that water intended for human consumption, whether free or paid for, must comply with the drinkability standards set by international and national regulations. In towns with a public drinking water distribution network, decree No. 383/PR/PM/2011 designates the STE as the main institution in charge of the drinking water services in urban and peri-urban areas. The state provided the financial and technical support to this structure and gave it the objective to serve 70% of the urban population with drinking water by the end of 2015. It was created in 2010 following the dissolution of the Chadian Water and Electricity Company (STEE). The STE is managed by a board of directors with headquarters in Ndjamena. It has a hydraulics department in charge of groundwater. It makes inventories, monitor the maintenance of equipment and control the quantities and qualities of groundwater withdrawals. For instance, from the year 2000, the town of Doba benefited from 27 standpipes connected by the STE network to supply its population with drinking water.

Despite this rich regulatory framework, the drinking water crisis has intensified in the past few years. The implementation of the water code has not been effective and the STE has failed to meet up with the water needs of the population. Decentralization has not been effective as local authorities have not been given the financial and technical means to maintain infrastructure and expand the supply network. The inability of the state to provide basic services to the population, especially drinking water occupies a central place in public debates with political and civil society organizations clamoring for equality in resource distribution.

3.2.2. The Doba municipality

Within the context of decentralization, the provision of drinking water at the local level is the responsibility of local authorities. The legislative framework for

decentralization in Chad finds its basis in the Constitution of the Republic of 03/21/96, which provides for the creation of decentralized territorial collectivities endowed with a legal personality. Decentralization policies result in a transfer of responsibility from the State to local authorities for the provision of services such as drinking water, sanitation and waste collection. The municipality of Doba controls all the hydraulic infrastructures located within its territory of jurisdiction. They take the needs of the population and work with private institutions and NGOs operating within its territorial jurisdiction. Never the less, there are many challenges. Findings show that the Doba council has no control over the activities of the STE such as (procedures for connecting to the network and getting new subscribers in different neighborhoods). This partial transfer of competences to the local authorities have limited their ability to provide basic needs to the population. A household head thinks the municipality is lagging in her duties;

> "…*municipal authorities do not assume their responsibility and engagements with the population. STE agents act on their own and carry out unacceptable activities such as the increase in m3 of the water consumed by the population leading to increases water bills, variations in connections costs across households and neighborhoods*..." (Interview, 2024).

This assertion has proven that local authorities cannot guarantee the supply of drinking water to its population. This situation has paved the way for private investments in the water sector and a good number have transformed it into a money making activity.

3.2.3. Private actors and their interventions

In the Eastern Logone region in general and Doba in particular, several non-governmental organizations and private individuals intervene in the provision of drinking water to the population. This mainly concerns the intervention of the various technical services of NGOs that work for the socio-economic development of the city such as: BELACD, AFD/ATADER, APPOFODEL, WORLD VISION, PADL-GRN and RED CROSS. These NGOs support communities and organized groups in areas of water treatment or filtration and installation of boreholes. They provide financial aid to the population for the realization of water related projects. However, with the deterioration of public water points and untimely cuts, most households get their supplies from water resellers locally called (Boulala) in order to satisfy their water needs. Apart from NGOs, rich individuals and business men have set up water points where the population can buy drinking water. Drinking water business is lucrative as a water seller testifies;

> "… *I prefer that there is no water in the city so that we can make profit because the abundance of drinking water in the city reduces our profits. We have invested and our families depend on it. A 20litres container of water costs 50fcfa but when STE cuts water, the price may go up to 200fcfa*…." (Interview, 2024).

Drinking water supply in Chad has become a money making activity. From the STE to private individuals, investments in the water sector are conditioned by financial motives thereby continuously widening the gap between the rich and poor.

This has added to the economic burden of the population and as such, majority has tended to consume water of doubtful quality.

3.3. Power/social relations and conflicts resulting from water management

3.3.1. Water as an object of social construction

Water is an object of social construction because it allows several people to come together around water points. In Chad, the provision of drinking water to the population is a sole responsibility of the state. As a public good, it is at the center of all human activities. Thus statements such as "water is life" are frequent in most debates concerning drinking water supply. In the Sahel region of Africa where harsh climatic conditions and a rapid increase in urban population are placing enormous pressure of water, scarcity has become the order of the day and multiply users need to build and maintain social relationships to overcome the ordeal of water scarcity. In this regard, two aspects are therefore configured to allow us approach water as an object of social representation. First is the fact that drinking water is an object of controversy and of conflict between individuals, groups and nations. Second, the supply of drinking water is an object of knowledge, skills, competences and policies. The increasing number of NGOs and private enterprises in the water sector in this region is a clear indicator that social representations have their interests and relevance for addressing the interaction of individuals and their environment. Social representations are thus forms of thoughts shared by a group or a specific social group, making it possible to understand their social and physical reality. Social representations are constructed in the difference existing within a society on "objects invested by individuals with utility or social value" [26]. And it is in this context that we consider that water is indeed an object of social representation. It allows the construction, organization and communication of social knowledge, that is to say, the genesis, the adaptation to the sociocultural framework and the use of this knowledge in exchanges and social practices.

The urban waterscape is socially and naturally constructed. Given the inadequate drinking water supply situation in Doba, the population maintains multiple social relationships to guarantee their need for drinking water. This has change practices but with socio-political and economic implications. Apart from revindications towards STE and municipalities, it is difficult to envisage the forms of neighborhood relations between households. However, majority are conflicts.

3.3.2. Drinking water related conflicts

The household survey revealed that conflicts around drinking water in Doba are common due to existing inequalities. First, within households (24%), between households and the STE (17%) and between households in the neighborhood (59%). Conflicts around water sources result from the inability to satisfy everyone during periods of shortage. In most cases, the struggles to fetch water before the others after long periods of queue have led to violent confrontations. In most households, fetching water is the responsibility of women and children, especially the girls. This gendered differentiation has led to conflicts as revealed in the excerpt;

> *"…. women and children move for long distances to fetch drinking water during periods of scarcity. Many have been abused sexually during these periods and many girls have dropped out of school due to the long hours spent in the searching for water on daily basis…*" (Interview, 2024).

This excerpt shows aspects of discrimination and inequalities within households and many voices are rising in support of the girl child, which in some cases creates another level of conflict within the traditions, beliefs and customs of the people. The relationship between the population and STE is not cordial. Complaints of over billing, poor maintenance of infrastructure, corruption and poor water quality are frequent. The population expects good water services and their frustration lead to violent confrontations with agents of the water supply company as captured during an interview;

> "*…last year I drove away an agent who came here for bills because the tap had not run for more than two weeks but the bills kept on rising…*" (Interview, 2024).
>
> "*….. what are we really paying for? They put a lot of chlorine into water and it has taste and odour….*" (Interview, 2024).

On the other hand, agents of STE believe the population is responsible for most of the problems in the water sector. They destroy public standpipes and waste a lot of water. In some urban neighborhoods where the STE network passes, children destroy standpipes, vehicles break pipes and individual during construction works. When such happens, they allow water to flow wastefully without calling the attention of the STE agents. In neighborhoods where there is a pump installed by the State and/or an NGO, and the population have to contribute in its maintenance, conflicts have been reported among households in such neighborhoods. Households that refused or are unable to contribute are usually denied access to water points. It has become a source of conflict. Conflicts equally occur when there are long lines waiting in front of a water point. Fights break out when queues are not respected as elderly people usually attempt to get supplies before the children who were there before them. These conflicts resulting from inequalities are essential components in understanding the interactions between physical and societal components in the urban waterscape.

4. Discussion

Water is life and it is the sole responsibility of the state to supply drinking water to her population. This work has shown that in the town of Doba, a greater proportion of the population (80%) is not connected to the National water network provided by the state and thus makes use of other sources. Concretely, 31% of the population drinks water from boreholes, 41% from wells, 20% from taps and 8% from natural springs. This shows a situation of inequality and discrimination in the supply of water which is a public good. These situations are attributed to the combination of physical and human factors [4,26,27]. Doba has experienced a significant population growth from 18,052 inhabitants in 1993 to 702,885 in 2009, giving an estimated annual growth rate of 5% [23]. This rapid population growth has not been accompanied with infrastructural development. For instance, the water tank constructed by the Germans in 1973 is still in use but its capacity is far below the

present demand. The restriction of the drinking water supply network to some parts of the urban center while others are deprived of such services has aggravated inequalities. Residential quarters with mostly middle class citizens have regular supply while poor populous quarters consume water of doubtful quality [28]. Unequal distribution of drinking water in urban centers can lead to political unrest. Water is a basic necessity and the state has the duty to provide drinking water to its population without discrimination. However, these inequalities result from the interaction between natural and human factors. In this work, the UPE perspective analyzes the various actors and their interests, their discourses and representations. It starts from the postulate that all technical problems lie within social problems. In studying issues of inequality and social justice, UPE considers marginalization and discrimination as socially and naturally constructed [20]. This has led to the multiplication of actors in the Chad waterscape, especially NGOs that protect the rights of the urban poor. As such, we noticed a shift of responsibilities from state institutions to private and civil society organizations.

In Chad, the [5], reported a drop in home water connections from 43% to 33% since 2012 and attributed the drop to inadequate finances, infrastructural and technological barriers as well as policy limitations [9]. The provision of drinking water requires collaboration between multitudes of actors with different engagements and sphere of interventions. In Sub Saharan Africa in general, the state has failed in the provision of basic services to its population, including water and sanitation. [29] demonstrates that state institutions are incapable of providing basic services such as water due to adequate infrastructural, financial and technical know-how. In Chad, the states has put in place strong regulations and decentralized competencies to the local authorities but water supply in urban centers is the responsibility of STE. In many countries, municipalities are responsible for water management but this often appears insufficient because municipalities have borders that do not correspond to the contours of the watersheds. Coordination between diverse actors is crucial in the management of water resources, especially underground water [30]. For example, watershed management was gradually imposed across the entire territory of Chad following the 2002 National Water Policy [31]. However, this has not improved on drinking water security.

The commodification of drinking water is another element of UPE that has reshaped the water supply network in Chad. Findings have shown that water connection charges have increased from 25,000fcfa to 50,000fcfa over the past years while the commercialization of drinking water has become a lucrative economic venture. Individuals with boreholes sell drinking water to the have-nots and it has contributed in aggravating inequalities. Inequalities are observed within households as women and girl children trek for long distances to fetch drinking water thereby compromising their education. The UPE studies how social relations of class, gender and race influence the urbanization process leading to the codification of geographical zones and unjustly producing healthy environments for some while others live in risky environments with less access to resources [32]. This approach helps to comprehend the behaviors and conflicts between users and stakeholders, the strategies for distributing drinking water, the means available to the latter and the physical conditions that impact on drinking water. Our findings revealed that water

is an object of social construction because it allows several people to maintain social relationships around water in order to overcome the problem of inaccessibility and scarcity. As these relationships are less dynamic and effective, they often result in conflicts. Conflicts within households (24%), households and the STE (17%), and between households in the neighborhood (59%). These conflicts have been reported in other areas and are linked to high bills, poor quality and poor infrastructure [33]. The involvement of multiple actors calls for a new water governance [33–39]. Whether in the city or in the countryside, expert management alone can no longer respond to problems and decide on the new social issues of water. There is need for an integrated system of water management which through participatory governance, reconciles conflicting uses of water and take into account the new values of water.

5. Conclusion

This work entitled "Unequal access to drinking water in the city of Doba (chad): an urban political ecology perspective" had as primary objective to examine challenges involved in ensuring effective drinking water supply and how they have reshaped relations in urban waterscape. A mixed methods approach was employed and analysis made using the UPE perspective. Findings demonstrated that the rapid population growth in Chad in general and Doba in particular did not go in pace with the provision of water resources. The water facility in use now was constructed by the Germans in 1973 and can no longer meet the current needs. The Government in 2010 created STE to ensure the provision of water to the population but this institution is challenged by inadequate finances, unqualified personnel and climate change that have made water supply a daunting task. Face with these inadequacies, more than 80% of the population in Doba drink water from boreholes and wells. The quality of water in boreholes and wells do not met the standards of drinking water stipulated by WHO as indicated by the physic-chemical and bacteriological analysis. Attempts to get drinking water have generated conflicts among water users (within households (24%), households and the STE (17%) and between households in the neighborhood (59%)). UPE has deepened the understanding that, interactions between the societal and natural factors creates new relationships that shape the provision of drinking water and other services in towns. Unequal distribution of drinking water in Doba is caused by natural and human factors whose interactions are translated into practices. For instance, the emerging of new actors in the Chadian waterscape and the commodification of drinking water are indicators of failed policies. This work therefore has implications for practices and policies in the urban waterscape. There is need for new water governance that will reduce inequalities, integrate all the actors in the management process and ensure use efficiency.

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