

Planning of Water and Electricity Network Services in the Town of Tanout in Niger

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Abstract: This article analyzes the planning of drinking water and electricity network services in the town of Tanout in Niger. This Town is facing a problem of water and electricity supply despite the availability of significant water and energy resources. The aim of this paper is to understand the determinants of the water and energy insecurity in the town of Tanout. The argument is based on a collection of data from interviews with stakeholders in the urban governance of water and electricity services. The survey has involved 148 households in the city in order to get quantitative data on supplying network services. The results show that conventional services of drinking water and electricity could not follow the development of the town of Tanout. As a result, only 26% of the households have private connections to water network and 40% to the electricity network. The majority of the households have access to water and electricity network services of Tanout through alternative off-grid options by water vendors called "Ga-rua", solar panels and generators at a relatively high cost and often at risk. This water and energy insecurity is explained by a deficit of territorial intelligence, according to the stakeholders of the urban governance of Tanout.

Keywords: Planning, Network Services, Water and Electricity, City of Tanout, Niger

1. Introduction

Unequal access to basic social services such as water and energy has long been a problem studied [22, 20]. If in some developed countries the problem arises in terms of quality of service, in the South it is rather the lack of resources of these services, despite the availability of raw materials, that worries the populations. In fact, when elsewhere water and energy network services are considered to be systemic encompassing technic, social, politic, economic and environment, in the South is mainly a vital issue [19]. In a context characterized by rapid urbanization without support, the supply of essential urban services such as water and electricity barely widespread [13].

In Niger, a Sahelian country, water and energy resources exist in many forms. However, their accessibility in sufficient quantity remains to be desired despite the country's commitments under the Sustainable Development Goals (SDGs). Access to network services is characterized by

socio-spatial fragmentation as a result of urbanization in Niger's major cities such as Niamey [25, 1] and Zinder [15]. The country has an accelerated population growth rate of 3.83% [10]. This growth requires new infrastructures and service needs particularly in water and energy sectors. Since development water programs of the 1970s and the adoption of a water policy energy investments in 2004 are very scarce, with only a few reservoirs and extensions in the main cities of Niger with credits from the World Bank. So, the theoretical drinking water service rate is estimated at 67% and the electrification rate at 27% in 2017. However, Niger has water and energy potential of surface water, underground water, mineral coal, oil, sun, uranium and hydroelectric on the Niger River. Despite this, the country is very dependent on funding from the external supply for water and electricity. Following the privatization of the local water service in 2000, donor financing, especially the World Bank, has also taken up [16]. On electricity, close to 74% of electricity consumption in Niger in 2017 is imported from Niger at a low cost [18].

The concern is much greater in Niger's small and

medium-size cities 10,000 to 100,000 inhabitants where services are not systematically provided network for the majority of the population. The town of Tanout located approximately 90 miles away North of Zinder is a perfect illustration of this. At the level of the urban municipality of Tanout, the problem of access to network services is quite particular. Beyond the country's reality in general with respect to the gap between growth and investments in water and energy infrastructure, extreme poverty, the precariousness of the land and the depth of the intercontinental water mean that the whole town has a situation of water and electricity insecurity. Indeed, in Tanout, despite the fact that the city is located on the intercontinental table with a large water reserve and the presence of energy resources, it faces a problem of supply of water and energy. Such an observation leads us to investigate the urban planning and the roles of actors in the supplying of these services. Therefore, this analysis questions the organization and service of the Water and energy services in the town of Tanout in Niger. This fundamental question refers to secondary questions that take into account all the contours of the access to water and electricity network services in Tanout:

- 1) Are water and electricity systems incomplete or degraded to limit household access to these services?
- 2) Is the production of water and electricity services insufficient in Tanout?
- 3) Is the purchasing power of the inhabitants so low to explain the low access rates to the water and electricity services?

After a presentation of the framework of the study, we will describe the methodology used before analyzing the organization, planning and governance of drinking water services, and electricity in the town of Tanout.

2. Presentation of the Urban Municipality of Tanout and Methodology

2.1. Geographical Location of the Urban Municipality of Tanout

The Urban municipality of Tanout is located in the far north of the Region of Zinder between 14°5' and 17°30' latitude North and 7°20' and 9°37' longitude East. Its city town, the city of Tanout is located 145 km north of the town of Zinder as mentioned above. The town covers an area of approximately 6,780 km², or 22.42% of the total area of the Department of Tanout Estimated 30,247 km², and 4.35% of the total area of the Zinder Region estimated at 155,778 km². The town of Tanout is limited:

- 1) In the East by the Rural Municipalities of Tenhya and Allakos;
- 2) In the West by the Rural Municipality of Gangara;
- 3) In the North by the Rural Municipalities of Aderbissanatt (Agadez) and Tenhya;
- 4) And to the South by the Rural Municipalities of Olléléwa, Alakoss (Gouré) and Kangra Wamé (Mirriah).

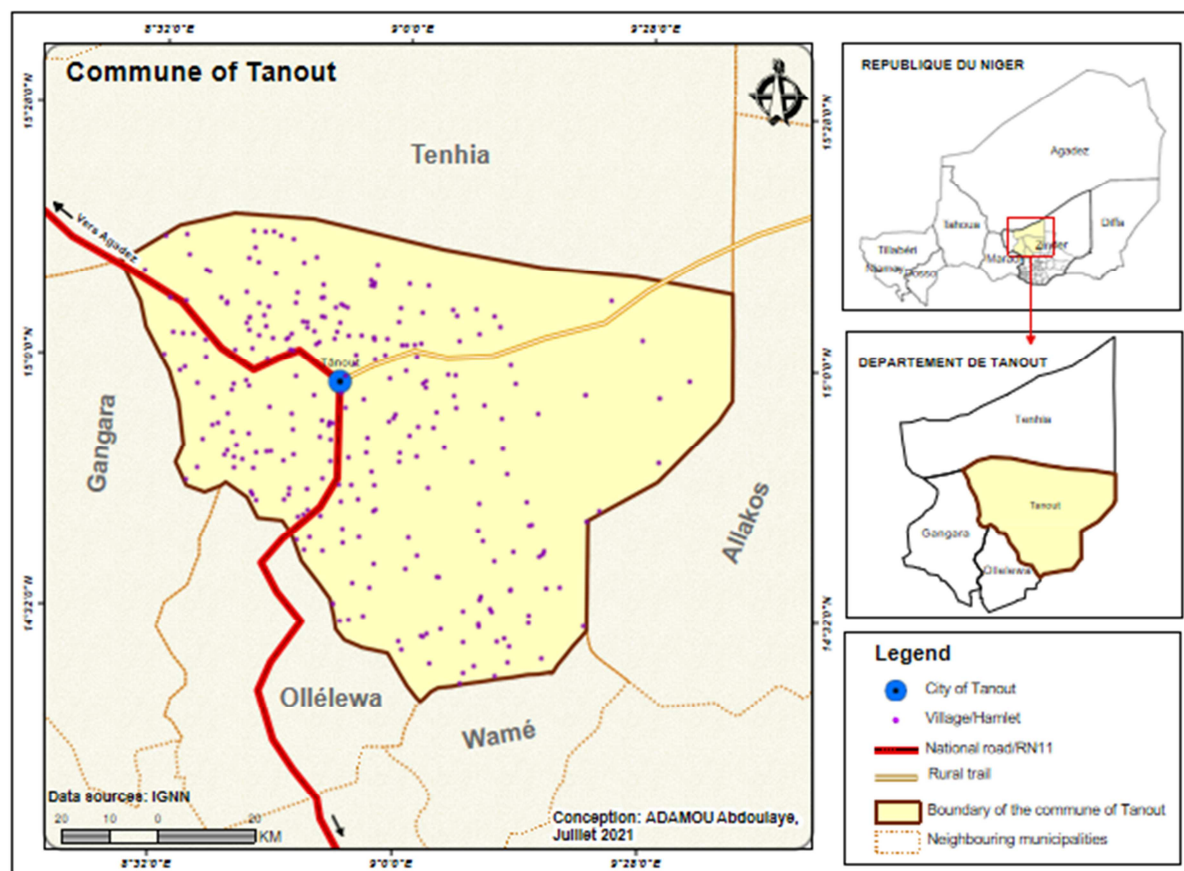


Figure 1. Geographical location of the urban municipality of Tanout.

2.2. Demography and Ethnolinguistic Groups in the Urban Municipality de Tanout

At the last 2012 General Population and Habitat Census, the population of the urban municipality of t Tanout was estimated at 154,238 inhabitants. With an annual growth rate of 4.1%, the population of this urban municipality would be 221,381 inhabitants in 2021, 111,376 men and 110,005 women. The graph below summarizes the evolution of the workforce population of the municipality from 2018 to 2025.

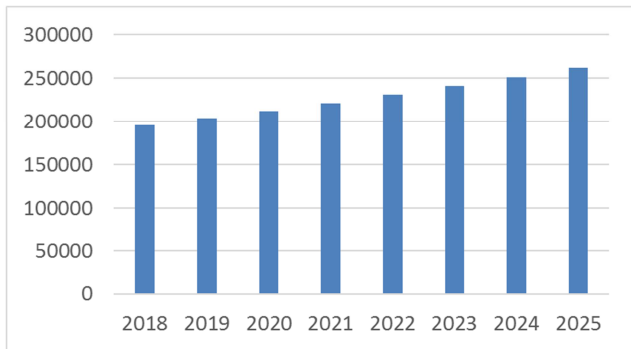


Figure 2. Evolution of the population of the urban municipality of Tanout from 2018 to 2025.

This rapid and steadily accelerating population growth is likely to continue in the over next few years. This has implications for the supply of quality of urban services, including water and electricity. The population is multi-lingual and is divided into seven (7) main ethnic groups, i.e. Dagrass/Kanouri, Fulfuldis/Fulfuldis, Hausa, Tuareg, Arabs, Tubous and Djermas, each keeping its own cultural values. Each ethnolinguistic group has its own history in the occupation and settlement of the municipality area. This human environment is quite well structured with the existence of several NGOs, and other associations and community management structures. The dominant migratory flows are those linked to the exodus, in particular young people seeking work to support themselves between the seasons of the year.

2.3. Water and Energy Resources of the Urban Municipality de Tanout

From a hydrological point of view, the urban municipality of Tanout has no permanent watercourse, no permanent pond. Surface waters consist of a few pools, all temporary, spread over the entire area of the municipality. However, there are some mini-dams built under various development interventions that provide the municipality real possibilities for mobilizing runoff water. From a hydrogeological point of view, however, the urban municipality of Tanout is full of enormous potential. In fact, two (2) main aquifer systems constitute the groundwater resources in the urban municipality of Tanout, namely the intercalary continental aquifers and the groundwater tables

of Damergou. If the Damergou aquifer is shallow because its average depth does not exceed thirty (30) meters, the Continental Intercalary is one of the most important aquifer systems in the region of Zinder. But the depth of more than 500 m makes it difficult to access. Accordingly, the works carried out with for its capture, in particular the drilling, are very deep and require very large financial resources, far exceeding the capacities of the communities and the municipality itself. This aquifer provides good quality water with conductivity around 200 $\mu\text{S}/\text{cm}$. It is par excellence the most operated in the urban municipality of Tanout.

The water supply for the population and the livestock is provided by an urban and rural hydraulic systems. Urban hydraulic is a drinking water network (AEP), operated by the Société d'Exploitation des Eaux du Niger (SEEN). The service is operated by three (3) boreholes with an average flow of 100 m^3/h , supplying the only 300 m^3 water tank. As for rural water, the urban municipality of Tanout has 137 modern cemented wells including 11 broken down, 641 traditional wells, 9 mini-Drinking water supplies, 6 multi-village boreholes, 2 autonomous water stations and 30 boreholes equipped with human-powered pumps, 13 of which have broken down, ensure the supply of the population and its livestock. Two hundred and thirty-eight (238) standpipes are connected to these MAEP, PEA and Multiple villages. Works in the middle rural areas generally have a depth of less than 150 m and flows of between 4 and 9 m^3/h [21].

As for energy, in Tanout, as in most Nigerien cities, wood continues to be the main source of energy for people. Biomass provides 94% of the energy consumed according to the Ministry of Mines and Energy. Yet, according to several development theories, the energetic question appears as one of the major issues in a country like Niger that has a satisfactory sunshine period to produce photovoltaic energy at any time. Beyond photovoltaic resources, the country has had coal and uranium since the 1970s and oil since 2011. Despite this, it is clear that Niger remains heavily dependent on its neighboring Nigeria for its electricity supply. The one in the city of Tanout, the capital of the municipality, is managed by the Niger electricity company (NIGELEC) via a Medium Voltage (MT) line. This line MT is supplied by the High Voltage line (HT) interconnection 132 KV Katsina (Nigeria) via Gazaoua and Maradi-Zinder (Niger) with a capacity of 40 MW. In addition to this line, the city of Tanout has an autonomous, regularly broken-down, diesel-fueled group that the Nigerien of Electricity (NIGELEC) has installed since 1985. The city of Tanout must not be in a situation of energy insecurity. Indeed, it is located less than 100 km from the Zinder refinery which produces electricity with gas and about 250 km from Agadez, an uranium-rich region with a coal-fired power plant. In rural areas, the only way to get electricity is through an off-grid system grid with solar panel or generator.

2.4. Methodology

The methodological approach of the study is based on observation of the field, cartographic surveys twinned with surveys and interviews with stakeholders involved in the provision of drinking water and energy services in Tanout. Thus, it was carried out for the most part on a qualitative and quantitative approach based on the use of funds data, existing statistics, a household survey by questionnaire and interviews with the heads of the decentralized water and energy services. After Semi-direct interviews, we organized focus groups with water carriers "Ga-rua". For the household questionnaire survey, we selected a sample of 148 households among the 3515 in the city [9]. The investigation took place in the 7 neighborhoods of the city of Tanout, according to a reasonable choice. The 148 households were grouped fairly, depending on the number of blocks in the neighborhood. At the level of each block, at least one household is chosen to be surveyed until the number to be surveyed has been exhausted in the concerned neighborhood. In each compound, the head of household was interviewed if present.

3. Space Planning and Organization of the City of Tanout

The city of Tanout is located between $14^{\circ}57'39''$ and $14^{\circ}59'39''$ latitude North and $8^{\circ}52'39''$ and $8^{\circ}53'39''$ of East longitude. It is part of the Nigerien secondary cities, whose functions are the main level of outreach. Indeed, even though the city of Tanout attracts a lot of migrants and has a regional market, its development logic is based on promoting exchanges with its hinterland. Its population was estimated at 20,339 in 2012 according to the General Population and Habitat Census (GPHN). This urban population would increase to about 30,750 inhabitants in 2021 according to projections by the national statistical institute. The city of Tanout, like several other secondary cities in the country, is therefore growing despite its position in a desert area. She counts today 7 administrative units: Dan Bouzoua, Dan Yari, Issakou, Hamidan, Sahara, N'Walla, and Zangon Captan. The first three neighborhoods are traditional. The facilities are concentrated in the northern and eastern parts, especially the districts Hamidan, Zangon Captan, Sahara and N'walla.

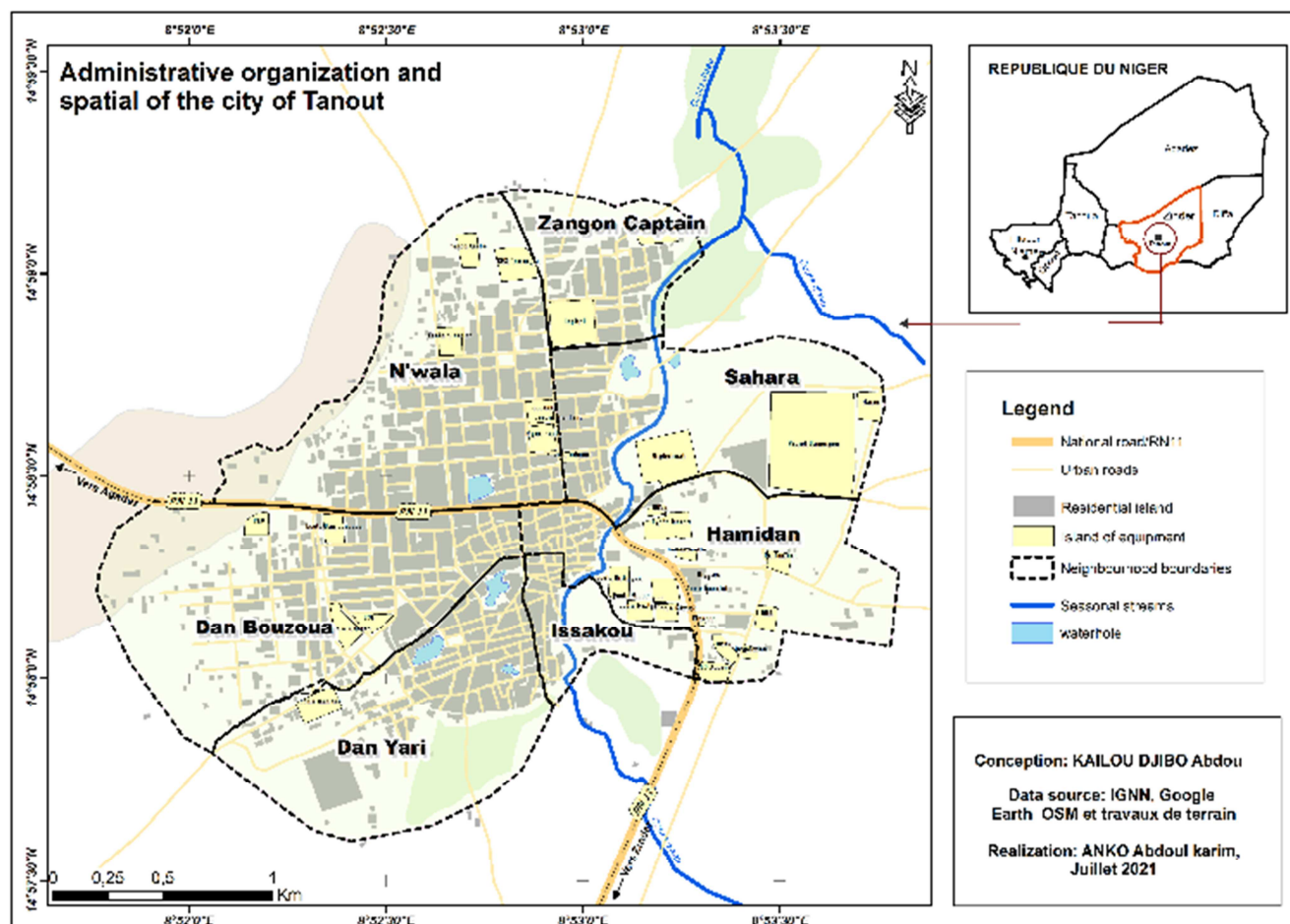


Figure 3. Administrative organization of the town of Tanout.

In terms of organization and space management tools, the city of Tanout has neither a Land Use Plan for its entire territory nor a Land development master Plan and Urban

Planning (SDAU). The space is managed in a rather traditional way, subject to some subdivisions for the development of the new quarters. The city of Tanout had four

(4) subdivision plans from 1963 to 2002. It is these subdivisions that have determined the different types of occupation within the urban perimeter, in particular housing areas, settlement areas, major equipment and infrastructure, as well as non-urbanizable areas due to their physical characteristics. In this sense, on a typo-morphological level, the town can be divided into two categories. The traditional area characterized by a dense urban fabric and the administrative, residential and diffuse area.

3.1. The Traditional Area

The first nuclei of the city of Tanout were the neighborhoods of Dan Bouzoua, Dan Yari and Issaku, due to its geographical position, is the traditional area. This area has an organic structure characterized by a dense urban fabric and an irregular road layout that makes it impossible to provide network services, including water and electricity. The plots are generally of any shape and the occupancy rate is very high compared to other parts of the city. With an area of 240 hectares, the density of the traditional area is 61 inhabitants/hectare. Therefore, the inhabitants of this area are most exposed to promiscuity and hygiene and sanitation problems, especially in winter season. Open spaces for community activities are extremely rare except in the Dan Bouzoua West neighborhood. The habitat is traditional, consisting essentially of houses of two to three rooms, with courtyards and latrines. Buildings are generally made of local materials with traditional architectural forms, sometimes typical to different ethnolinguistic groups and cultural. However, modern housing, built of final materials, is present in some plots, especially on the national road No. 11.



Figure 4. A traditional house in dan Bouzoua neighborhood.

This picture shows the house built of mud that dominates the traditional area. It often happens that several households live in a single courtyard called a compound. In this case, each household, when he can, prefers to have his own water and electricity meter as seen by the low voltage electric wires in the picture.

The traditional area is supplied with water via a few household connections that are on the streets at the edge of the network and the fountain terminals installed everywhere as in most informal neighborhoods in developing countries [23, 12]. There are approximately 322 individual connections and 18 terminal Fountains with average flow rates of 25 liters per minute to supply approximately 14,655 population, that is a theoretical water coverage rate of 24 liters per day and per

person for all purposes. This emergency ratio is very far from national and international standards (50 liters/day), even further from the pyramid of Maslow's water needs which recommends 280 liters per day per person. In addition to the Insufficient water production, people often face water cuts. This is especially during the hot season from April to July, when consumption increases. Long queues for several hours are noted for water. The populations of the traditional area of Tanout are forced to move around the neighborhoods where the supply of water is constant to satisfy their water needs or to get supplied at a much more expensive cost from water dealers called Ga-rua that are in large majority of migrants from the villages surrounding the Town.

For electricity, although most of the traditional area is not developed, there are 3 electrical transformers, about 612 NIGELEC subscribers, most of them counters for shopkeepers. Several households do not yet have a installation, resulting in a very low service rate causing informal, anarchic and very dangerous connections for people and their property. As for comfort equipment such as satellite dishes, televisions and other small household equipment, many households in the traditional area do not have them, due to the unavailability of electricity and the extreme poverty.

With regards to the living environment, it must be said that the traditional area of Tanout is regularly prone to flooding according to the Chief Environmental Officer and the District Chief Issaku. There are only a few meters of ditches for the evacuation of rainwater. But, the population use these structures very poorly by obstructing them with household waste. The households bad practices, which dump their waste water and solid waste into these ditches, constantly clog them, thus, depriving them of their role of evacuation rainwater. As a result of an unhealthy environment, several diseases such as malaria in 67% of the cases investigated or respiratory infections and diarrhea linked to water pollution are observed.

3.2. Subdivided Administrative and Residential Area

The town of Tanout has an administrative area located in its eastern part, at the level of Hamidan and Sahara neighborhoods. This area was built just after the independence towards the 1963 to shelter the city's administrative services. It has been extended around 1985 with the construction of the Damergou project. There are a few households that are most of the time the families of officials in the area. Habitat is generally built semi-hard, a combination of clay bricks and cement on very large regular and rectangular plots with an average surface of 1800 m². In the area, some of the facilities cover more than 17 hectares. This explains the low density of about 16 inhabitants/ha. The soil is clay in the area, resulting in permanent cracks in houses and classrooms built with concrete blocks. The land is amorphous and unbuilt in most cases. The road is not hierarchical, giving the impression of being in an unmarked area. Although diffuse, the administrative area has water and electricity network in almost all built plots. In Tanout, the

neighborhood of Zongon Captan, N'walla and the western part of the Sahara are unquestionably those considered to be the residential area where the middle class of the town lives. In these neighborhoods, the habitat is usually built in semi-hard and local clay on rectangular plots with an average area of 300 m². The free spaces for community activities (schools, health, sports field) are provided in all these neighborhoods that are also the most airy after the administrative area of the city of anyway. Secondary tracks have an average right-of-way of 15 m and tertiary tracks have an average right-of-way of 10 m.

For drinking water and electricity, the residential area is almost covered by networks of concession companies. In this sense, the majority of households are connected to networks. However, in Tanout as in most towns in Niger [17, 25, 1, 15], network presence is not synonymous with access to services. This situation creates, at times, protests and marches to denounce the precariousness of services. So, in 2018, after a month of blackout, the people of Tanout decided to stop paying water and electricity bills during a peaceful march that they organized (*Figure 5*). For the leader of the Movement for the Promotion of Responsible citizenship (MPCR), the main organizer of the march, the objective is "to express our dissatisfaction and despair concerning this social evil, this socio-economic scourge that we hold dear, namely the issue of electricity in the town of Tanout, which dates back to a decade" [3].



Figure 5. Demonstration to denounce power cut in Tanout on September 19, 2018.

4. Water and Electricity Services Service and Governance in the Town of Tanout

4.1. Water and Electricity Services in Tanout

In the city of Tanout, water and electricity services are mainly in network. In fact, 98.6% of our respondents say

they get water and 60.8% say they get electricity through public networks. However, only 26 percent of households have private water connections and 40% have their own electricity meters. These figures are far from the theoretical average rates of access to water and electricity which are respectively 95% and 97% in urban areas in Niger. The majority, more than 52%, access water service via standpipes. The rest passes through water carriers called "Ga-rua". The drinking water infrastructure of the town of Tanout consists of a supply network operated by Niger Water Exploitation Company, a 300 m³ water tank and three (3) boreholes of 972 m, 550 m and 450 m deep. The facilities providing the service, especially the pipes, are several years old. They are at the very old and insufficient to ensure the access of the whole town. Several neighborhoods are still waiting for the extension of the network in order to access drinking water more easily. The situation appears to be worsening as pressure on these facilities by villages located within a radius of 10 to 20 km from the town of Tanout and also during the season the population of the town is enlarged by exodants, a floating population that is not previously taken into account most often. Indeed, these surrendering villages, either by default of modern water point or for lack of productivity from existing water sources, regularly obtain supplies from Tanout. This is what explains largely the terrible congestion of people and animals and all day around the town fountain terminals. In addition, there is a relationship between water and energy. In Tanout, as soon as there is a power outage, water production stops automatically for alternative energy failure. Beyond Tanout, it must be said that the problem concerns several southern towns, often capitals like Dakar [7], Niamey [24] etc.

For electricity, the city has 9 transformers, 3 of which are industrial. Distribution of energy is standard with a variation of 33 to 400 volts. The city has 2,307 subscribers including 459 inactive and more than 420 (meters) owned by economic operators and industrials. Thus, about 40% of households in the town have an electric meter. In the event of a medium voltage network failure, the service is automatically suspended as the diesel group has been out of service for more than 2 to 2 years according to a responsible for Nigelec-Tanout.

4.2. Spatialization of Water and Electricity Services in Tanout Town

The spatial distribution of the networks obeys both Tanout and Zinder [14], to a logic of catching up. The subdivisions do not have networks at the base. The Essential water, energy and sanitation services come after. In some cases never! The administrative area and residential lotis areas Zongon Captan, Sahara, N'walla and western Dan Bouzou are the best equipped with networks because of their checkerboard that facilitates the carrying out of the serving works. However, the new subdivisions that are extensions of existing neighborhoods, albeit in checkerboard, are geographically remote and lack of investment. As for Issakou, Dan Yari and the East Dan Bouzoua, the problem is a lot more informality, land insecurity and environmental poverty. According to the civil society, to

have access to water and electricity in Tanout, you must have your house on a main or secondary track approximately 15 meters wide. However, these types of track conditions are very rare in traditional neighborhoods as we have said in point 2.1. This situation coupled with the delay in network expansion explains the low access rate to the network which is about 26% for water. This distribution of the network is not proportional to the density of the population in the different neighborhoods of the town of Tanout.

Most of the 1,422 water and 2,307 electricity subscribers are located in the around National Road No. 11 (RN 11) concentrating market equipment and in the residential and

administrative area. The distribution of the standpipes is subject to both market and social logic. More than 80% of them are located nearby the RN 11 and in traditional neighborhoods where people have low incomes. In Tanout, we found no other means of access to water except the public network. Therefore, there are currently no alternative options for access to drinking water as the water table is very deep. This situation does not allow private companies to drill for support the public offer as happens in other cities like Matameye [2], Ho Chi Minh City [5] etc. For electricity, however, we found that about 11% of households use solar panels to electrify their homes.

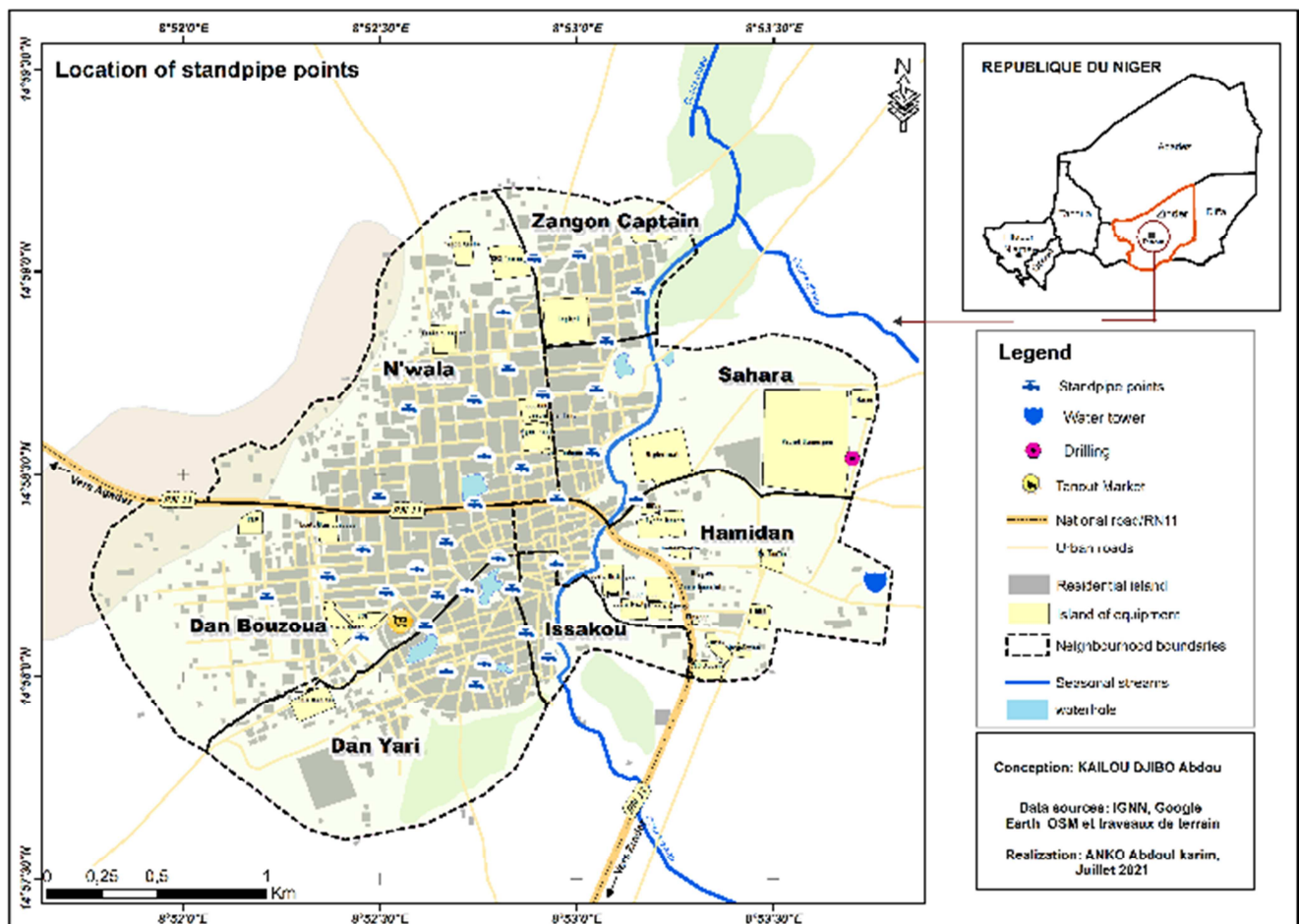


Figure 6. Supply of water and electricity in the town of Tanout.

4.3. Governance of Water and Electricity Services in the City of Tanout

In Niger, the provision of drinking water service in urban areas has been provided since 2001 by the Niger Water Development Corporation (SEEN), which is a private company with as principal shareholder Veolia France. Apart from SEEN, the Société de Patrimoine des eaux du Niger (SPEN) under public law and the Water Sector Regulatory Authority (ARSEAU) are involved in urban water. The SPEN is bound to the State by a contract of and a plan contract and SEEN is linked to SPEN by a leasing contract

and a performance contract. ARSEAU is responsible for regulating the activities carried out in the water sector throughout Niger and to ensure its development, but also ensures the application of the laws and regulations governing the sector under objective, transparent and non-discriminatory conditions'. So, drinking water supplies to the 52 urban centers of which Tanout is insured by the SEEN in collaboration with SPEN and ARSEAU. The leasing contract stipulates that SEEN is responsible for the operation of the public service, transport and distribution of drinking water in urban and semi-urban areas. The construction of drinking water infrastructure (Castle, Dam,

etc.) is the responsibility of the SPEN. However, it must be said that since 20 years, only a few investments have been made in the major cities, regional capitals through World Bank (WB), West African bank of Development (BOAD) and Chinese Cooperation.

Secondary centers like Tanout have been left behind despite the fervent desire to the public to contribute to the financing of the service. Indeed, as we said in point 1.3, the town of Tanout has only three (3) boreholes with an average flow of 100 m³/h, a water tank of 300 m³ and a drinking water system of less than 12 000 m all diameters. Gross water production of 100 m³/h for an estimated population of 30,750 inhabitants, a ratio of 39 liters per day per person for all purposes confounded, remains relatively very low. It is below the national standard of 50 liters per day per person from the city. Also, the tank capacity is very small to make population pressure.

NIGELEC is the only provider of the public electricity network. Being a state owned company, its management is characterized by political considerations and not by technical skills. The result is a lack of a better managerial and organizational policy. At Tanout for example since the medium voltage line supplies the In the city, the generator that used to provide electricity is no longer in use despite the incessant cuts. The lack of effectiveness is also noted by the inability of Nigelec to sign an agreement with the Zinder Refining Company which produces in access electricity with gas. In short, in Tanout, the management of water and electricity services is not liberalized. There is therefore no hybrid governance of these services as is the case in small centers in West Africa [4].

5. Conclusion

Access to water and electricity services remains a worrying problem in the town of Tanout where, according to our surveys, only 26% of households have taps and 40% have electricity meters. Most households access network services through third parties ranging from purchase at the standpipe or from "Ga-rua" dealers to informal connection for electricity. The determinants of this situation are multiple. Insufficient production, lack of means and the disconnect between spatial and demographic evolution can partly explain the problem of access to water and electricity in Tanout. Thus, there is a socio-spatial distinction for the use of water supply sources according to the social categories of the city and the residential areas. The middle classes, made up of employees and certain merchants who can pay their monthly water and electricity bills, have special connections in their households, while the most disadvantaged populations (craftsmen, farmers, workers, etc.) use other strategies. The first category lives in the subdivided residential area and the administrative area making up the Hamidan, Sahara, Zongon Captan and N'walla neighborhoods. The others are located in the Issakou, Dan yari, Dan Bouzou neighborhoods and recent extensions. This observation confirms the unanimity that emerges almost everywhere in relation to the high investment costs of network

services (transport, water, sanitation, energy) in diffuse and low-density areas [8, 6, 11]. In addition, the analysis of the urban governance of water and electricity services in the town of Tanout and beyond shows that since 2001, the mode of water management is the delegation to the private company SEEN through an affermage contract. The electricity management is still centralized. These current water and energy governance systems exclude municipalities and civil society from active management. The non-involvement of these key players in urban governance in the programming, financing and spatial distribution of services in Tanout as in all the 52 urban centers in Niger worsens the situation.

In view of the above, the water and electricity services in the city of Tanout in Niger are facing a lot of problems. Most of these problems are due to insufficient production and uncontrolled spatial and demographic changes. The causes of the problem of access to water and electricity services are therefore not solely attributable to the urban planning of the city. In this sense, in relation to programs and projects in the field of water and electricity in the era of sustainable development objectives, it would be interesting to orient the reflections on water and electricity network services in a context of urban precariousness. Research on household poverty, land status, and urban sprawl would be useful in Tanout to understand the inefficiency of water and electricity services. In addition, studies to understand the benefits of liberalization of water and electricity services may be relevant in Tanout. This would seem to be essential given the growing awareness of the role that private providers of independent water and energy services can play.

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