



doi: <https://doi.org/10.20546/ijcrar.2023.1105.004>

Consumption of Ground Water in Angondje Ntom (Gabon)

Marthe Ndjeri Ndjouhou* and Julia Minfoumou Minko

Laboratoire Pluridisciplinaire des Sciences (LAPLUS), Ecole Normale Supérieure, B.P. 17009, Libreville, Gabon

*Corresponding author

Abstract

Angondje Ntom is a district in the suburbs of Libreville, not supplied by the national drinking water supply network. To meet their daily water needs, people primarily resort on groundwater. The aim of this study is to determine the different types of drinking water consumed by Angondje Ntom populations. For this purpose, a questionnaire survey was carried out among households. The results showed that well water is the most common drinking water in the Angondje Ntom area with 62% of the households surveyed consuming it. Drilling water comes in second position with 38% of the surveyed households using it. In addition to these two types of groundwater, households surveyed reported that 77.1% of them consumed additionally either bottled mineral water or water purchased from retailers, or rainwater (during the rainy season). The rest of the households surveyed (22.9%) claim to use either well water or drilling water exclusively. Although groundwater is considered by the populations of Angondje Ntom as pure natural water, suitable for human consumption. This study has shown that treatment is often applied periodically to well water before consumption; individual wells particularly, used by a single household. The treatment consists in bleaching and/or filtration.

Article Info

Received: 18 March 2023

Accepted: 30 April 2023

Available Online: 20 May 2023

Keywords

Well water, drilling water, Angondje Ntom, bottled mineral water, water treatment.

Introduction

Water is a vital resource covering 70% of the Earth's surface, though unevenly allocated. On the African continent, nearly 300 million people do not have access to drinking water (Bazié, 2014). It is also problematic in Sub-Saharan Africa, where only 24% of the population has access to a safe source of drinking water (UNESCO, 2019). For example, in the province of Kasai Central, in the Democratic Republic of Congo, only 8.4% of villages have an improved water source (Ngalamulume *et al.*, 2021). Furthermore, the development of drinking water supply systems, the poor management of supply points and their high cost (Ngalamulume *et al.*, 2021) are major obstacles that makes the access to quantitative and

qualitative drinking water difficult (Tshivuadi *et al.*, 2021). The most recurring difficulties faced by populations are: the remoteness of supply points (Idi *et al.*, 2020; Fangnon *et al.*, 2016; Yoro *et al.*, 2016) and poor water quality (Zoungrana, 2021), in particular organoleptic characteristics (Kouame *et al.*, 2021; Ballet *et al.*, 2018; Yoro *et al.*, 2016).

Thus, to meet their daily water needs, the consumers resort to unsafe water sources (Ballet *et al.*, 2018). People often use alternative drinking water sources such as well water, drilling water (Sokegbe *et al.*, 2017; Lagnika *et al.*, 2014; Amadou *et al.*, 2014), rain or rivers (Maoudombaye *et al.*, 2016; Tshivuadi *et al.*, 2021; Orelie, 2017; Safougne *et al.*, 2020). For example, in

Dakar, Senegal, people draw water from often shallow groundwater table, because of frequent cuts in the water supply (Diop *et al.*, 2021).

In Libreville, the public service for the production, transport and distribution of drinking water is managed by the national company. But the provision of drinking water is the subject of many complaints from consumers, especially the frequency of water cuts and the colouring of water. In addition, we notice that many areas in Libreville and its vicinity are not yet provided with the drinking water supply system. This is the case of Angondje Ntom, an area on the outskirts of Libreville where people use almost exclusively unconventional sources of water. These are often used concurrently since the choice of water source varies from one household to another.

Thus, the main purpose of this study is to determine the favorite type of drinking water of the Angondje Ntom population and the criteria of their choice. For this, a survey was carried out after residents of the neighborhood of Angondje Ntom. This work will also clarify the treatments often used by respondents to improve water quality.

Materials and Methods

Geographical presentation of the study area

Angondje Ntom is a district of Akanda (Figure 1). Created in 2013 (Ordinance no. 008/PR/2013), the municipality of Akanda is part of the province of Estuaire. It is located in the Northeast of Libreville, on the Northwest coast of the country. It is surrounded by a large expanse of forest. The forest and the mangrove covers a vast and almost uninhabited area. The Atlantic coast, extending from the North to the South of the city, is dotted with sandy beaches. Akanda is subject to a transitional equatorial climate of the central zone (MalobaMakanga, 2011). Its average annual temperature is 26.3°C and precipitation averages 1970.6 mm per year (DGMN, 2018). The climate cycle consists of four seasons: a small dry season from January to February, a large rainy season from March to June, a large dry season from July to September and a small rainy season from October to December.

Choice of study area

The district of Angondje Ntom is a new district confronted with urban expansion: the occupation and the

anarchic servicing of the forest area bordering the district is a typical phenomenon of the area. The population has grown faster than the development of road infrastructures and drinking water supplies. Indeed, it is a neighborhood that is not yet provided with a drinking water supply network. Angondje Ntom is a vast residential area, home to a large and growing proportion of the population, which relies almost exclusively on drinking water from underground sources such as boreholes and wells.

Sampling

The sample size was calculated by first considering the latest census of the Gabonese population which indicates a population of 30141 inhabitants living in Angondje in 2014 (DGSEE, 2015). Secondly, based on the formula proposed by Réa *et al.*, (1997), ensuring a level of confidence of 95% and a margin of error of 5%, we obtain a sample size of 103. Thus, 103 households were surveyed from June to August 2022. The questionnaire was pre-tested. The interviewers were recruited and trained. In this work, the heads of families are the main targets. The information concerning the drinking water consumed was collected from a detailed questionnaire submitted to the head of the family during an individual interview. The questionnaire is the data collection instrument used in this study. This questionnaire was developed around four aspects relating to the consumption of drinking water in Angondje Ntom: the type of drinking water which is most consumed, the consumption of bottled mineral water, the origin of the water purchased from retailers and the treatments applied to drinking water. The exploitation of the data collected was made using Sphinx Plus and Excel software.

Results and Discussion

Most Consumed Drinking Water in the Angondje Ntom Area

The survey shows that well water is the most commonly consumed drinking water with 62% (46.5% + 7.2% + 5.5% + 2.8%) of households using it regularly (Figure 2). Drilling water is the second most consumed drinking water in Angondje Ntom, with 38% (33.7% + 4.3%) of the households surveyed using it as their main source.

The survey also shows that the use of well water is, in most cases, supplemented by three different types of water (bottled mineral water, water purchased from water dealers and rainwater). Only 7.2% of households surveyed reported using well water exclusively, with no

additional source. For 2.8% of households surveyed, well water consumption is supplemented by rainwater in rainy periods. Moreover, our survey shows that well water is mainly consumed for domestic uses such as cooking, housekeeping and laundry.

Consumption of Bottled Water per Household

Well water and drilling water are the two most commonly consumed drinking water. Among the three types of drinking water used in supplement, bottled mineral water is mostly used by 68.8% of households (Figure 3). The latter claim to consume about 25 to 45 liters of bottled mineral water on average per week, depending on financial resources and the number of people per household, which is 6 on average according to our survey. During our investigation, 3 isolated people claimed to consume exclusively bottled mineral water for health reasons. People mostly consume local brands of mineral water, particularly Andza and Akewa.

Origin and Price of Water Purchased from Retailers

In the Angondje Ntom district, drinking water purchased from retailers has two main origins (Figure 4): tap water (33.2%) from other districts supplied with drinking water and drilling water (66.8%). Drilling water purchased from retailers comes from boreholes often dug in concessions of other commercial activities such as the rental of apartments or even car washes. This survey has identified 9 drinking water retailers. Tap water, sold throughout Gabon at about 471 fcfa (~ 0.72 euros) per cubic meter (by the national company), is resold at 12000 fcfa (~ 18 euros) per cubic meter in the Angondje Ntom district, including delivery.

Drilling water is resold at the same price (12000 fcfa). The retailers justify that expensive price by the poor condition of the roads which is the cause of many breakdowns of the water delivery vehicles. Thus, if the delivery is not included, the drinking water purchased from retailers costs 2500 fcfa (~ 4 euros) per cubic meter. The retailers claim to have spent an average of 3 at 5 million fcfa (~ 4600 at 7650 euros) to dig their boreholes.

Well Water Treatment

Despite the fact that groundwater is often considered by populations in Angondje Ntom to be fit for human consumption, treatment is often applied to well water, especially individual wells. The majority of wells are dig

to a depth of 8 to 10 meters. Individual wells are closed by a concrete lid or heavy board. It protects well water from plant debris or coarse waste, but also ensures the safety of children. On the other hand, communal wells, used by both owners and their immediate neighbors are often left open to facilitate access and use by neighbors. Those ones are poorly maintained. In most cases (82.6%), a treatment is applied to well water.

It may be bleaching and/or filtration (Figure 5). Bleaching alone is used in 16.18% of cases and filtration alone is used in 18.10% of cases. However, both bleaching and filtration are used in 48.32% of cases (figure 5). Bleach used is directly introduced into the well on a periodic basis. Water filter used is often placed at the outlet of the well and changed periodically.

In Angondje Ntom, residents consuming well water explain that when they arrived in Angondje Ntom district, they used well water only for domestic purposes (laundry, housekeeping and cooking). They used to drink only bottled mineral water. But the expensiveness of bottled mineral water has led to a change in consumption habits. The consumption of bottled water has decreased to become occasional, while well water has become drinking water. It is therefore for financial reasons that people buy bottled mineral water only on an ad hoc basis and resort to resale water as a supplement to well water. For drill water users, there has been no change in water consumption patterns.

Indeed, drilling water has always been used, since the arrival of the families in Angondje Ntom, both as drinking water and for other domestic uses. This is justified by the fact that drilling water is obtained by digging even deeper than well water.

Drilling water would then, according to users, be of better quality than well water and suitable for human consumption. It also explains why drilling water users only occasionally buy bottled mineral water. The minority of households using exclusively well water in Angondje Ntom district says that the latter is underground, thus, protected from anthropogenic pollution. In several regions, well water is the most commonly consumed drinking water (Sokegbe *et al.*, 2017; Azonnakpo *et al.*, 2020). It is used both as drinking water and for other domestic uses (Safougne *et al.*, 2020). In the commune of Fatik in Senegal, well water is used by 99% of the population to meet all water needs (Sène, 2012). This would be due to the insufficient coverage of the public distribution network (Sène, 2012).

Fig.1 Location of Angondje Ntom (from Makita-Ikouaya, 2020).

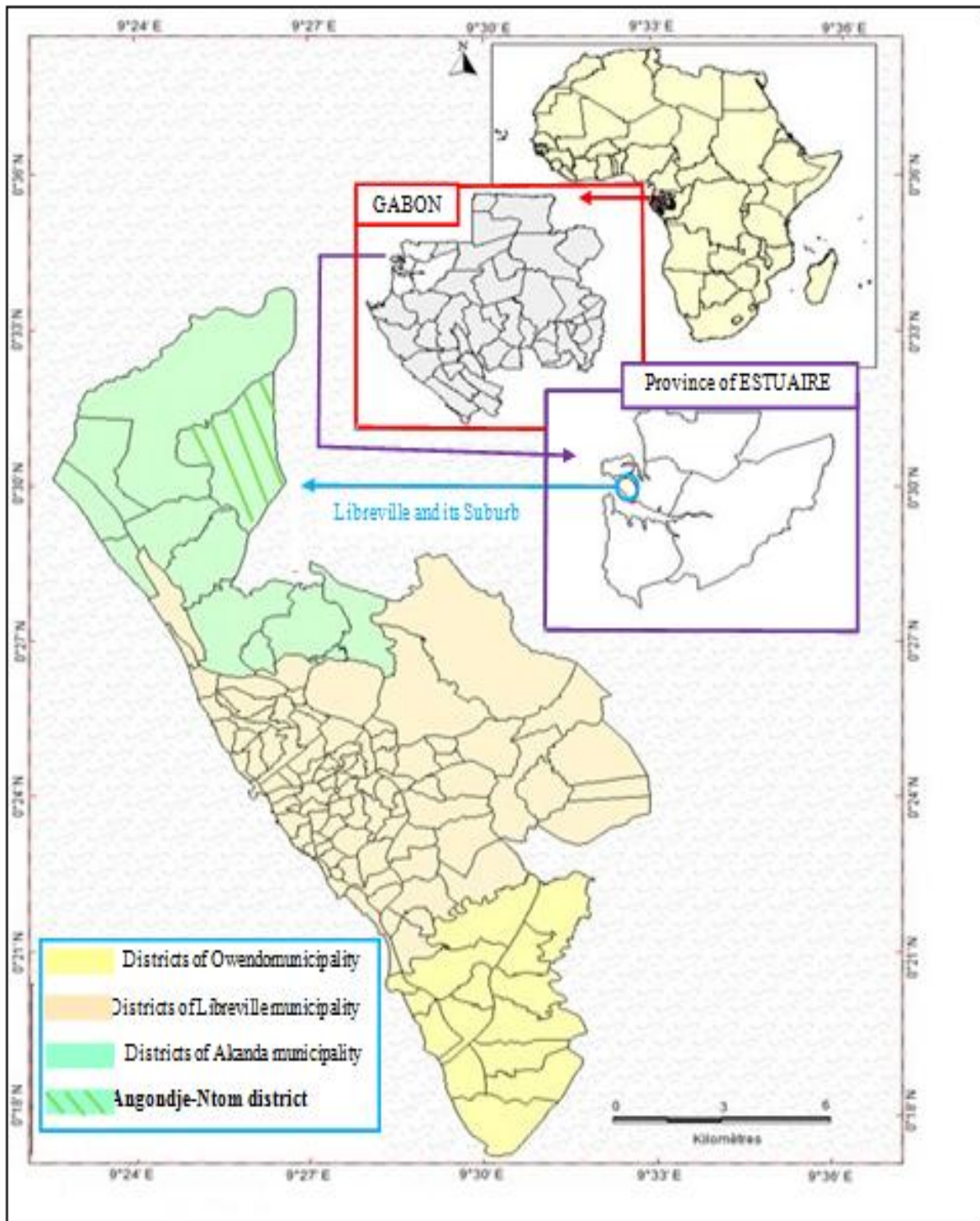


Fig.2 Most consumed drinking water in Angondje Ntom.

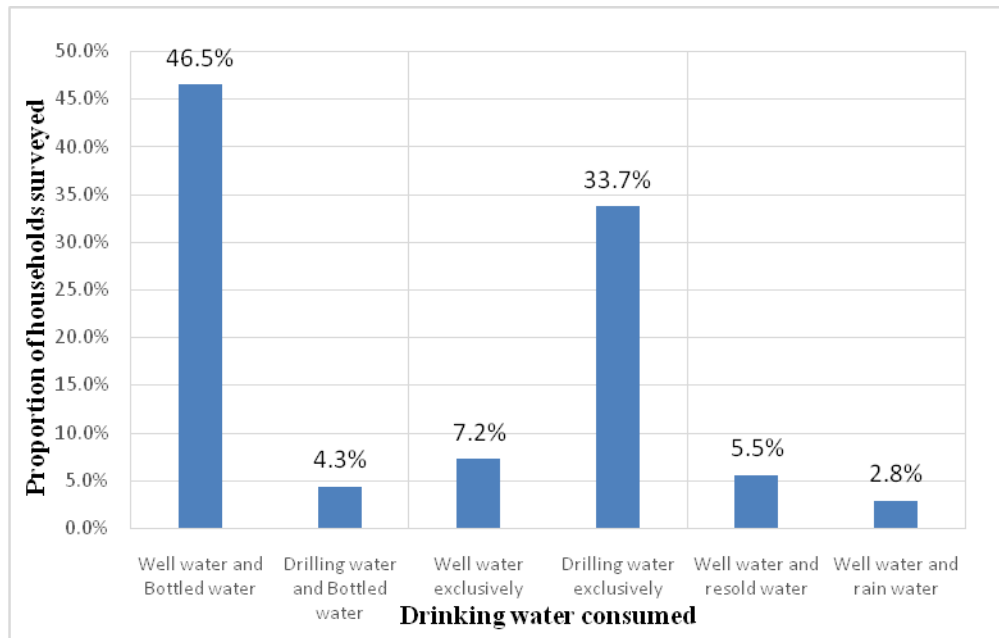


Fig.3 Types of drinking water consumed in a complementary manner in Angondje Ntom

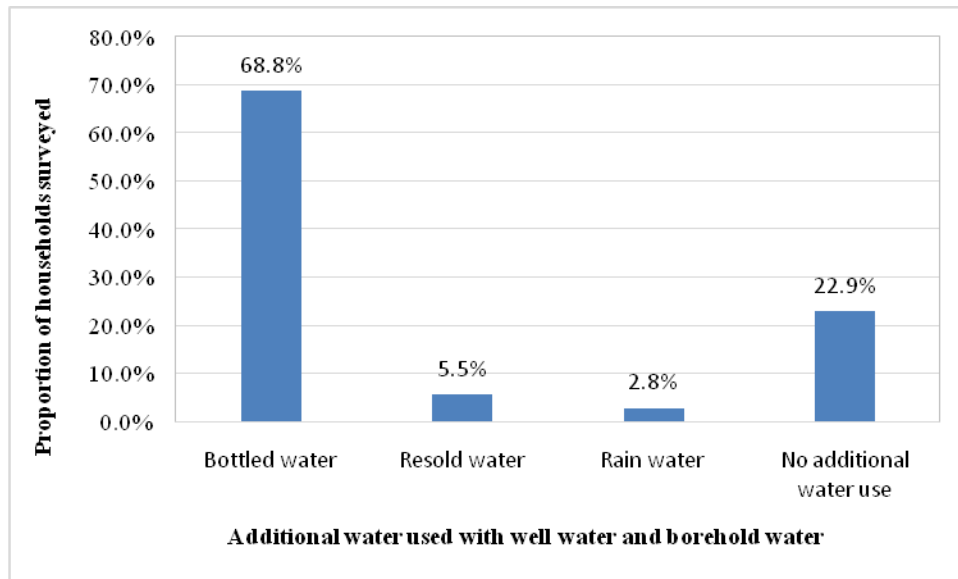


Fig.4 Origin of water resold at Angondje Ntom

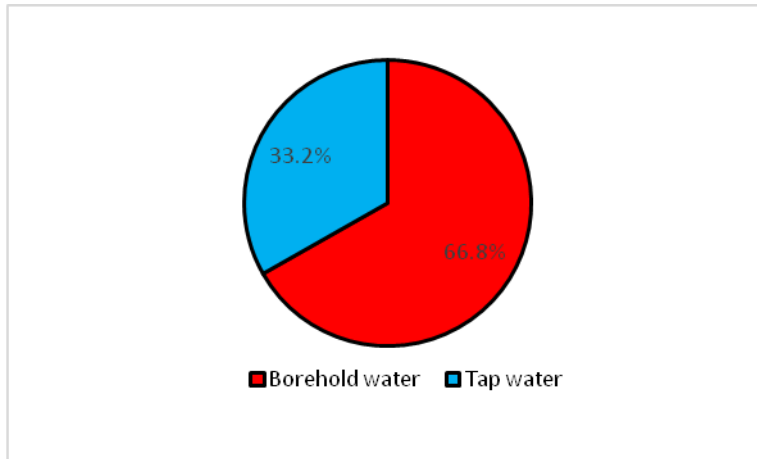
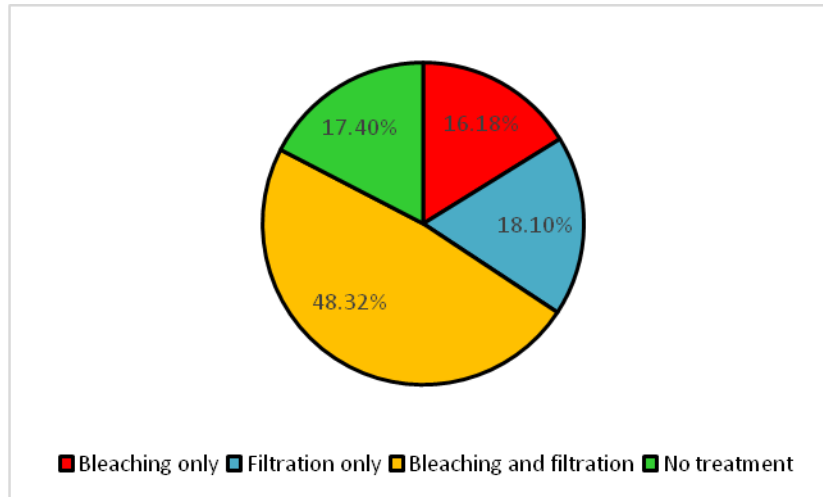


Fig. 5 Well Water Treatments



Contrary to our results, other studies describe a source-dependent water use: in the Doula V district in Cameroon, borehole water is used as drinking water. Well water is used for washing dishes (Djuissi Tekam *et al.*, 2019). In the Parcelles Assainies commune of Dakar in Senegal, tap water is used for drinking and cooking, water from pumps is used for showering, laundry and housework (Diop *et al.*, 2021).

Drilling water is also the second most consumed drinking water in other regions. Indeed, in households, drillings are found less frequently than wells due to their higher cost (Safougne *et al.*, 2020). In contrast to our results, in the Akpro-Missérété health centers in Benin, boreholes are the main source of drinking water for the population (Fangnon *et al.*, 2016). Also, in the peripheral

area of Lome, the population mainly uses borehole water (52%), against 41% of the population who uses well water (Somadjago *et al.*, 2019). A study carried out in Niger shows that borehole water is used primarily as drinking water and cooking only. Household chores are not carried out every day to save water (Idi *et al.*, 2020). In the district of Doula V, drilling water is also hit by considered as the best source of drinking water (Djuissi Tekam *et al.*, 2019).

The use of bottled mineral water as a complementary drinking water is also mentioned in literature (Diop *et al.*, 2021). The high consumption of bottled mineral water can be explained by people's trust in the quality of bottled mineral waters found on the local market. It is highly appreciated in Southern Benin for its quality and

safety (Ahoey *et al.*, 2022). Other reasons are cited to justify it. It may be shortage of tap water, affordable price or easy digestion (Ngono Eteme Melingui *et al.*, 2021). A survey carried out in the South of Douala in Cameroon reveals that 54.3% of households combine two sources of water (well and borehole) for all their needs, 31.4% combine three sources (well, borehole and rain) and 10% combine four water sources (well, borehole, rain and bottled mineral water) (Safougne *et al.*, 2020).

Rainwater is enjoyed by people because it is immediately available, free and does not require digging (Somadjago *et al.*, 2019; Azonnakpo *et al.*, 2020). Rainwater can be collected through gutters installed on the lower edge of roofs (Somadjago *et al.*, 2019) or in plastic drums, buckets and basins (Fangnon *et al.*, 2016; Somadjago *et al.*, 2019).

The sale of drinking water is a phenomenon often observed in areas without access to drinking water (Idi *et al.*, 2020; Fangon *et al.*, 2016; Azonnakpo *et al.*, 2020). In the Angondje Ntom district, more and more drillings are being done for commercial purposes. Retailers believe that cost related to drilling are quickly absorbed by the high demand for this drinking water. Drinking water purchased from retailers comes in a minority from tap water. Indeed, tap water is less and less appreciated by consumers, probably because of its turbidity (Ballet *et al.*, 2018). This price of 12000 FCFA is about four times higher than drinking water prices indicated in others studies (Fangnon *et al.*, 2016; Idi *et al.*, 2020).

The insufficient protection of wells and the lack of hygiene measures make well water treatment necessary (Coumare *et al.*, 2018). Filtration and the use of bleach are the main treatment methods mentioned in literature (Diop *et al.*, 2021; Idi *et al.*, 2020; Safougne *et al.*, 2020; Sokegbe *et al.*, 2017). It is followed at a smaller extent by settling (Diop *et al.*, 2021; Idi *et al.*, 2020) and boiling (Djuissi Tekam *et al.*, 2021). Similar to our results, studies show that a significant proportion of consumers of well and borehole water use it without prior treatment (Djuissi Tekam *et al.*, 2019; Idi *et al.*, 2020). Some of them justify it by the fact that the earth naturally filters water (Safougne *et al.*, 2020). But home water treatment methods can improve drinking water quality and prevent disease, only if used correctly (Diop *et al.*, 2021).

This study showed the different sources of drinking water used in the district of Angondje Ntom, a residential area not supplied by the national drinking water supply

network. People are using groundwater, which is available, abundant, easily accessible and considered by people to be naturally pure. Well water is the most consumed, followed by drilling water. Indeed, the costs associated with digging wells are much less expensive than those associated with drilling. Bottled mineral water is consumed in a complementary and limited manner due to its high cost. The study also revealed the existence of other drinking water sources such as water purchased from retailers or rainwater. The absence of a drinking water supply network in Angondje Ntom has led to the multiplication of alternative drinking water sources without prior quality control, thus exposing populations to waterborne diseases.

Declaration of competing interest

The authors declare that they have no conflict of interest.

References

- Ahoey, A. E. C., Sanni, M. A., Sètonджи, T. H. 2022. Evidence of a second life for post-consumer mineral water bottles in Benin. *Revue Africaine d'Environnement et d'Agriculture* 5(4) : 42-51.
- Amadou, H., Laouali, M. S., Manzola, A. S. 2014. Caractérisation hydrochimique des eaux souterraines de la région de Tahoua, Niger. *Journal of Applied Biosciences* 80 :7161-7172. <http://dx.doi.org/10.4314/jab.v8i11.6>
- Azonnakpo, O. V., Agbossou, E. K., Aminou, T. 2020. Perception of water pollution by the population in the Ouémé Delta. *International Journal of Progressive Science and Technologies* 21(1) :303-317.
- Ballet, T. G. N., Gnagne, A. E. J., Fofana, V., Yapou, B. O. 2018. Assessment of household perception of tap water quality in two municipalities, Cocody and Yopougon in the city of Abidjan, Côte d'Ivoire. *Africa Science* 14(6) :48-57.
- Bazé, J. B. 2014. Access to water: between abundance and scarcity. *Day after tomorrow*, 31-32 (NF) : 28-29.
- Coumare, K., Diallo, T., Siby, L., Haidara, A., Traoré, M., Coulibaly, M., Sangare, D., Traoré I. T., Tangara, D., Coulibaly, S.M., Koumare, B.Y. 2018. Bacteriological quality of drinking water (drilling and wells) in three circles of the Koulikoro region, Mali. *Revue Malienne d'Infectiologie et de Microbiologie* Tome 11 :25-32.

- DGMN Direction Générale de la Météorologie Nationale du Gabon 2018. Données climatiques de la région de Libreville-Owendo-Akanda, 10 p.
- DGSEE Direction Générale de la Statistique et des Etudes Economiques 2015. Résultats globaux du Recensement Général de la Population et des Logements de 2013 du Gabon (RGPL-2013), Libreville.
- Diop, C., Toure, A., Bah, F., Lam, A., Cabral, M., Fedior, S., Fall, M. 2021. Water supply in the municipality of Parcelles Assainies de Dakar (Senegal): perception of the quality and practices of the populations. *European Scientific Journal* 17(7) : 256-271.
<https://doi.org/10.19044/esj.2021.v17n7p256>
- Djuissi, T. D., Vogue, N., Ngwayu, N. C., Ebode, E. M., Nambile, C. S. 2019. Access to drinking water and sanitation: case of the district of Douala V (Cameroon). *Pan African Medical Journal* 33(244) : 1-8.
<https://doi.org/10.11604/pamj.2019.33.244.17974>
- Fangnon, B., Babadjidé, C. L., Dossou, P. J., Houssou, F. 2016. Constraints related to the supply of water in the health centers of the district of Akpro-Misséréte in Benin. *Tropical Geography and Environment Review* 2 : 119-129.
- Idi, M. M. S., Mamadou, I. 2020. Access to drinking water for households in the village of Nawaskalé in District 5 of the city of Zinder in Niger. *Territories, Societies and Environment* 015 : 211-231.
- Kouame, Y. F., Kedi, A. B. B., Kouassi, S. S., Konan, N. J. A., Assohoun, E. S., Yapo, O. B., Gnagne, T. 2021. Physico-chemical characteristics of domestic drilling water in the town of Daloa (west-central Ivory Coast). *International Journal of Biological and Chemical Sciences* 15(2) :835-845.
- Lagnika, M., Ibikounle, M., Montcho, J. P. C., Wotto, V. D., Sakiti, N. G. 2014. Physico-chemical characteristics of well water in the commune of Pobè (Benin, West Africa). *Journal of applied Biosciences* 79 :6887-6897.
<http://dx.doi.org/10.4314/jab.v79i1.13>
- Makita-Ikouaya, E. 2020. Determinants of home children in cities of sub-saharan African: case of then Libreville agglomeration (Gabon). *Revue Espace, Territoires, Société et Santé* 3(6) : 57-66.
- Maloba Makanga, J. D. 2011. Precipitation in Gabon: analytical climatology in Africa. L'Harmattan, Paris, France.
- Maoudombaye, T., Ndoutamia, G., Ngakou, A. 2016. Bacteriological quality assessment of well, drilling and river water consumed in the Doba oil basin in Chad. *International Journal of Recent Scientific Research* 7(6) :12236-12243.
- Ngalamulume, L. L., Katangala, J. P. B., Kabamusu, G. T., Kapambu, R., Kalala, B. B., Mbanza, P., Lukadi, S., Bantukujika, F.B., Bakatubala, A. B., Lusamba, A. N. 2021. Analyse microbiologique de l'eau de boisson de différentes sources consommées par la population de la province du Kasai central : Cas de la zone de santé rurale de Mutoto. *Revue de l'Infirmier Congolais* 5(1) :1-8
- Ngono Eteme Melingui, B., Assene, M. N., Kemoe-Nzali, A. 2021. La personnalité perçue des marques des eaux minérales en milieu étudiantin au Cameroun : une approche combinatoire. *Revue africaine de management* 6(3) : 187-206.
- Ordinance No. 8/2013 of 21 February 2013 (of Official Journal of the Republic of Gabon) abolishing the Cap Esterias department of the commune of Cap Esterias and creating the commune of Akanda, number 189 from 7 to 14 January 2014, 1663 p.
- Orelie, F. 2017. Etude de la qualité de l'eau destinée à la consommation humaine dans le sous-bassin versant de Ravine-Diable (Anse-A-Veau). Master de spécialisation en sciences et gestion de l'environnement dans les pays en développement, Université Catholique de Louvain, 2p.
- Safougne, D. B. L., Yemmafoue, A., Dzalla, N. G. C. 2020. Problem of the supply of drinking water in the «mangroville» south of Douala, Cameroon. *European Scientific Journal* 16(2) :11-29.
<https://doi.org/10.19044/esj.2020.v16n2p11>
- Sène, E. 2012. Approvisionnement en eau potable dans la commune de Fatick. Mémoire de Master, université CheikhAnta Diop, Dakar, Sénégal, 77 p.
- Sokegbe, O. Y., Djeri, B., Kogno, E., Kangni-Dossou, M., Mensah, R. T., Soncy, K., Ameyapoh, Y. 2017. The health risks associated with drinking water sources in district 2 of Lomé-commune: the case of the Adakpamé district. *International Journal of Biological and Chemical Sciences* 11(5) : 2341-2351.
<http://ajol.info/index.php/ijbcs>
- Somadjago, M., Cissokho, D., Suka, D. K. 2019. Difficulty of access of the peripheral area of Lomé to water from the public distribution network and alternative solutions. *Larhyss Journal* 38 :35-48.

- Tshivuadi, K. N., Lubo, M. M., Tshibanda, I. G., Nzembela, T. S., Kalonji, K. F., Katuku, C.C., Kazadi, T. M., Musawu, G., Kabongo, B. J., Kankulu, B. E., Bukasa, T. J. C. 2021. Analyse physico-chimique et bactériologique des eaux consommées dans la cité de Lukalaba/zone de santé de Kasansaen R. D. Congo. *Global Scientific Journals* 9(12) : 1912-1918.
- UNESCO, 2019. Programme mondial de l'Unesco pour l'évaluation des ressources en eau (WWAP), Ne laisser personne pour compte. Rapport mondial des Nations unies sur la mise en valeur des ressources en eau 2019, Paris, France.
- Yoro, B. M., Ehui, P. J., Silue, D. 2016. Perceptions of water quality and risks of Schistosomiasis transmission among rural populations in Tonkpi (Ivory Coast). *Revue Africaine d'Anthropologie, Nyansa-Po20* :176-191.
- Zoungrana, T. D. 2021. The determinants of the choice of drinking water supply for rural households in the commune of Koudougou in Burkina Faso. *Société française d'économie rurale* «Economie rurale», 377(3): 65-81.
https://doi.org/10.4000/economie_rurale.9135

How to cite this article:

Marthe Ndjeri Ndjouhou and Julia Minfoumou Minko. 2023. Consumption of Ground Water in Angondje Ntom (Gabon). *Int.J.Curr.Res.Aca.Rev.* 11(05), 21-29. doi: <https://doi.org/10.20546/ijcrar.2023.1105.004>