

THE USE OF TRADITIONAL WELLS TO THE RISK OF DIARRHEAL DISEASES IN THE TOWN OF BONON (CENTRAL-WESTERN CÔTE D'IVOIRE)

DE LA SOLLICITATION DES PUIITS TRADITIONNELS AUX RISQUES DE PATHOLOGIES DIARRHÉIQUES DANS LA VILLE DE BONON (CENTRE-OUEST DE LA CÔTE D'IVOIRE)

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ABSTRACT: The article raises the problem of diarrheal risks in the face of the solicitation of traditional wells in the city of Bonon. It aims to show the diarrheal risks generated by the use of traditional wells in the city of Bonon. To achieve the results, a methodology based on documentation and field data (direct observations, interviews and questionnaire surveys of households) was adopted. The field data collection was based on a sample of 200 heads of households drawn from the 08 districts of the city of Bonon. The results reveal that the population of the city of Bonon has difficulty accessing drinking water. Only 19% of respondents have access to drinking water on a daily basis (HV, BF and HV). As for the 81% of the population, they get their water from traditional (private or collective). At the same time, waterborne diseases represent a public health situation in the city with 34,37% of cases of diarrhea and 17,43% of typhoid fevers. The strong dependence of diarrheal diseases on drinking water makes it a health risk factor in the said city. In Bonon, the results show a positive and significant correlation between the use of traditional wells for drinking and diarrheal diseases, with a high intensity of 75%. The correlation coefficient R equal to 0.86 demonstrates this.

KEY WORDS: City of Bonon, traditional wells, risks, diarrheal diseases

RÉSUMÉ : L'article soulève le problème de risques diarrhéiques face à la sollicitation des puits traditionnels dans la ville de Bonon. Il a pour objectif de montrer les risques diarrhéiques engendrés par la sollicitation des puits traditionnels dans la ville de Bonon. Pour l'atteinte des résultats, une méthodologie basée sur la documentation et les données de terrain, notamment, les observations directes, les interviews et les enquêtes par questionnaire auprès des ménages a été adoptée. Sur le terrain, les données ont été collectées à partir d'un échantillon de 200 chefs de ménages tirés dans les 08 quartiers de la ville de Bonon. Les résultats révèlent que la population de la ville de Bonon accède difficilement à l'eau potable. Seulement 19% des enquêtés disposent quotidiennement d'eau potable (HV, BF et HV). Quant aux 81% de la population, ils s'approvisionnent via les puits traditionnels (privés ou collectifs). Parallèlement, les maladies hydriques représentent une situation de santé publique dans la ville avec 34,37% de cas de diarrhées et 17,43% de fièvres typhoïdes. La forte dépendance des affections diarrhéiques à l'eau de boisson fait d'elle un facteur de risque sanitaire dans ladite ville. A Bonon, les résultats montrent une corrélation positive et significative entre l'usage des puits traditionnels pour la boisson et les maladies diarrhéiques avec une forte intensité de 75%. Celle-ci est prouvée par le coefficient de corrélation R égal à 0,86.

MOTS CLÉS : Ville de Bonon, puits traditionnels, risques, pathologies diarrhéiques

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I. INTRODUCTION

Several factors account for the prevalence of diarrheal diseases. In particular, the consumption of certain foods, the drinking of unclean water, sanitation problems or even the absence of domestic hygiene.

Bearing, in case of disease, a population is unable to produce good yield for its development. This is why States place health at the heart of their development policy by devoting significant budgets to it. Otherwise, by making, through the causes that lead to health problems, such as issues of sanitation and drinking water, planetary interests. The relationship between these sectors of life and health being obvious, concern is becoming more and more imperative. When it is estimated that access to running water seems to slow down child mortality and a factor associated with a lower risk of death (S. Dos Santos et al., 2007, p. 368). The water problem thus becomes an essential element of public health. However, in the world, there are more than 2.2 billion people, or 29%, who have problems with their domestic drinking water supply managed safely (Water Coalition, 2021, p.1). Moreover, between now and 2025, around 5.5 billion people will still experience drinking water supply difficulties (United Nations, 2003, quoted by J. N. Yéradé, 2018, p. 228). To say that as many populations will be exposed to health risks related to water and other socio-economic issues. This gloomy picture makes access to water a global problem, and of which health is a universal concern.

The least developed areas, particularly African countries, are the most exposed to this situation. In the West African sub-region, drinking water is seen as a luxury, although it enjoys the character of a fundamental right (Y. V. Kramo et al., 2020, p. 274). Côte d'Ivoire, despite its water potential, is experiencing enormous difficulties in providing drinking water (Op. Cit.); and this relates to all its local authorities, including the town of Bonon. The sub-prefecture of Bonon is faced with the problems of supplying drinking water, a source of life. In 2018, 66% of households in the said sub-prefecture did not have access to drinking water, of which 31.7% were supplied by surface water (F. N. N'Guessan et al., 2018, p. 213). What about the realities in the city of Bonon? What is the status of any health risks associated with this situation?

The article raises the problem of diarrheal risks faced with the use of traditional wells in the town of Bonon. It is a question of showing the diarrheal risks generated by the solicitation of traditional wells in the city of Bonon. Specifically, the study aims to analyze the drinking water supply situation in Bonon, to study the prevalence of pathologies in households in the city of Bonon and to assess the relationship between these two components.

II. METHODOLOGY

II.1. PRESENTATION OF THE TOWN OF BONON

Located in the center-west of Côte d'Ivoire, the city of Bonon is part of the decentralized local authorities of the Marahoué region (Figure 1).

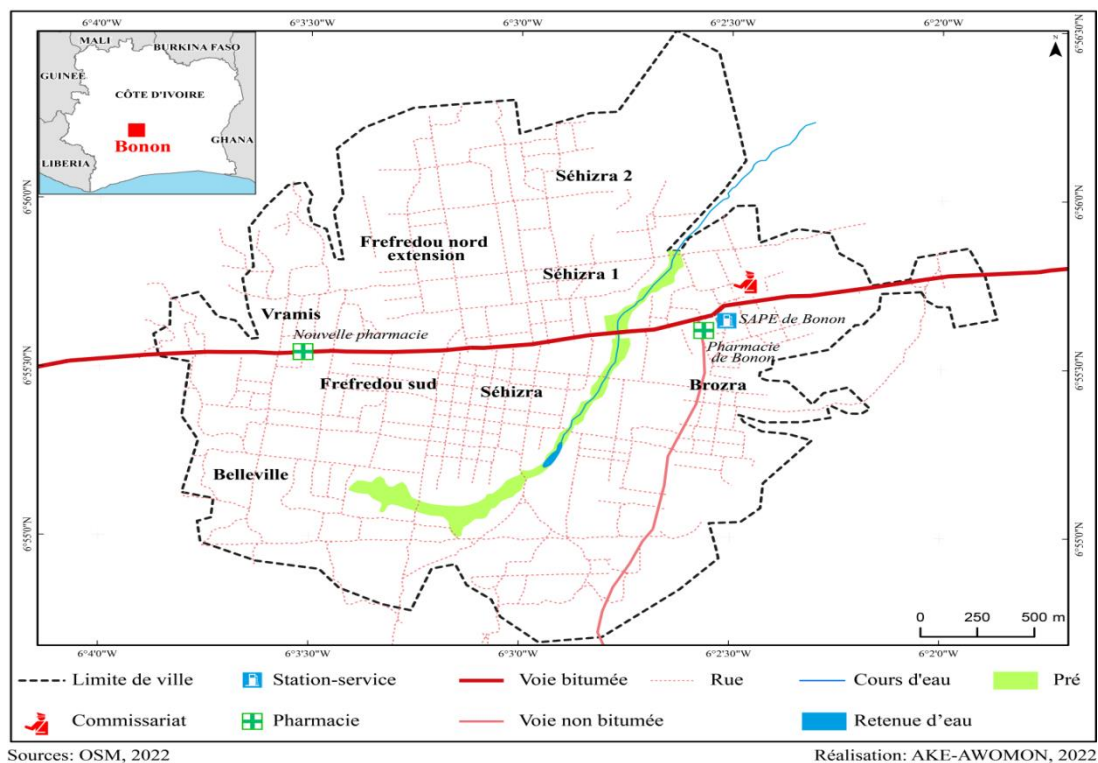


Figure 1: Presentation of the town of Bonon

The town of Bonon has 92,523 inhabitants with a masculinity rate of 119.6 (INS, 2015, p. 7). As for the sub-prefecture of Bonon, it has a total of 112,629 inhabitants for a sex ratio of 118.8 (Op. Cit). This testifies to the superiority of the male gender in the city: also synonymous with the labor force or the attractiveness of the city in terms of job offers. Bonon is an agricultural production area. Apart from industrial export products of which the space is a major producer (coffee, cocoa, cashew, rubber and others), Bonon is one of the major food production areas in Côte d'Ivoire, particularly plantain, yam, taro, vegetables, citrus, etc. (A.C.A. Kouakou et al., 2018, p. 207). These assets define types of migration, and therefore represent a factor of densification and the ethnic plurality of the city.

II.2. DATA COLLECTION METHODOLOGY

For data collection, in order to verify our hypothesis, we adopted two techniques. These are documentary research and field surveys (observations, interviews and the questionnaire sent to households). The documentation allowed us to identify the subject and engage in discussion through articles, books, memoirs and others. As for the field surveys, they enabled us to have information via observation and figures from the population in order to analyze and assess with them the water points available, the access systems to water and its issues. In order to assess the relationship between the water points used and the possible health risks. The field data were obtained from a sample of 200 heads of households drawn in a reasoned way in the 8 districts of the city of Bonon. In each district, 25 heads of households were surveyed (Table 1).

Table 1: The districts of the city of Bonon and the number of households surveyed

NAMES OF THE DISTRICTS OF THE CITY OF BONON	WORKFORCE
BELLE VILLE	25
BOZRA	25
FREFREDOU NORD	25
FREFREDOU SUD	25
SEHIZRA	25
SEHIZRA 1	25
SEHIZRA 2	25
VRAMIS	25
Total	200

Source : Diabia et Aké-Awomon, 2022-2023

The town of Bonon is organized into 8 districts. These constitute the enumeration areas of our study. The information sought from households relates to the socio-demographic situation, sources and modes of water supply, difficulties relating to water services, recurring health problems in the city, etc. As a result of data collection, we have adopted several data processing techniques.

II.2. DATA COLLECTION METHODOLOGY

The raw data was entered by EPI INFO and analyzed by SPSS. Word, ArcGis10.2 and Excel software were used for data processing and analysis. Word was used to enter texts and ArcGis10.2 was used to produce the thematic maps. As for Excel, it was used to produce the tables and graphs. The statistical tools made it possible to analyze the results from the statistical formulas. We used the Bravais-Person (R) correlation coefficient to assess the existence of a link between the variables. Also, the coefficient of determination (R²) was used to assess the intensity of the relationship between these different variables. As for the equation on the right, it was requested in order to understand the part of the variables explained in the phenomenon studied. All these techniques allowed us to have the following results.

III. RESULTS

III.1. State of drinking water supply sources in the town of Bonon

III.1.1. Strong demand for safe untested water in the town of Bonon

The drinking water listed in the town of Bonon is listed in Table 2. Table 2 presents the distribution of households according to the type of drinking water point requested in the town of Bonon. Thus, 19% of these households use drinking water sources, 18% of which have a private residential connection and 1% relies on retailers connected to the distribution network. Not all neighborhoods have the same proportions in terms of accessibility to drinking water. In Vramis, 40% of respondents attest to having access to drinking water via a private connection, in Sehizra 1, it is 28%, in Fréfrédou Nord 20% and 16% in Belle Ville,

Table 2: Distribution of the different water supply sources in Bonon

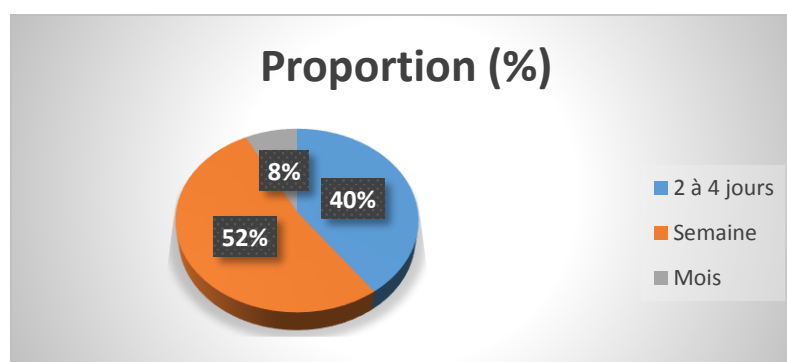
Water sources Neighborhoods of Bonon	Drinking water sources				Sources of unproven drinkable water			
	Private Connection (BC)		Resellers		Traditional private well		Collective or neighbour's well	
BELLE VILLE	4	16%	0	0%	15	60%	6	24%
BOZRA	4	16%	0	0%	15	60%	6	24%
FREFREDOU NORD	5	20%	1	4%	16	64%	3	12%
FREFREDOU SUD	4	16%	0	0%	8	32%	13	52%
SEHIZRA	2	8%	1	4%	12	48%	10	40%
SEHIZRA 1	7	28%	0	0%	15	60%	3	12%
SEHIZRA 2	0	0%	0	0%	24	96%	1	4%
VRAMIS	10	40%	0	0%	10	40%	5	20%
Total	36	18,00%	2	1%	115	57,50%	47	23,50%

Source : Diabia et Aké-Awomon, 2022-2023

Bozra and Fréfrédousud. No household in Sehzira 2 has BP, while in Sehzira there are 8%. As for sources of unproven drinking water, they are requested by 81% of Bonon respondents, 57.50% of traditional wells in (private) homes and 23.50% draw water from collective wells or from neighbors. There are also disparities between neighborhoods for access to these waters. In Séhizra 2, all respondents claim to use well water as their main source, including 96% from private wells and 4% from collective wells. In Belle Ville, Bozra and Séhizra 1, 60% use traditional resident wells and 24% and 12% respectively traditional collective wells. In Fréfrédou Nord, 76% have access to water through traditional wells, 64% of which are private and 12% collective. In addition, in Séhizra, 88% request wells with 48% private and 40% collective wells. On the other hand, in FréfrédouSud, of the 84% of households that use traditional wells, 32% have them in their homes and 52% either with a neighbor or a collective well. Several factors are at the origin of the strong demand for traditional wells for domestic needs in Bonon.

III.1.2. A variety of factors limiting access to drinking water and encouraging heavy use of traditional wells use in the town of Bonon

In the city of Bonon, respondents present several factors that limit access to drinking water. For the inhabitants of the old districts such as Bozra, Séhizra, Séhizra 1 and FréfrédouSud, the high population, the mismatch between equipment and populations and the aging of water equipment are at the origin of the underpressure in Bonon. According to them, the water tower is of small capacity compared to the size of the population and the rapid expansion of the city. Anything that prevents the population from having drinking water on a continuous basis. This situation caused long waiting times to obtain drinking water in Bonon (Figure 2).



Source : Diabia et Aké-Awomon, 2022-2023

Figure 2: Time of the water cut in the city of Bonon

For 40% of respondents, the water cut can extend over 2 to 4 days, while 52% speak of a week and 8% of months depending on the season. For 97.3% of the population surveyed, in the event of a cut, they systematically resort to traditional wells, while 2.7% prefer to refer to HVs in neighboring villages. In Bonon, 98.1% of people say they use water from traditional wells for drinking without treatment and 1.9% for other needs than drinking. Moreover, in the outlying districts of Belle Ville, Fréfrédou Nord, Séhizra 2 and Vramis, the lack or even absence of pipes is responsible for drinking water problems. A situation that forces the population to find alternative responses such as traditional private or collective wells. During the rainy season,

in fact, because of the quality of the water, often considered unsuitable, 11.7% abandon the wells in favor of rainwater and 88.3% keep them. The results of the survey attest to a recurrence of water-related pathologies in the town of Bonon.

III.2. A variety of pathologies identified in the city of Bonon

III.2.1. Importance of water pathologies in the city of Bonon

According to field data, the population of the town of Bonon is constantly exposed to certain pathologies in varying proportions (Table 3).

Tableau 3 : Répartition des pathologies fréquentes dans la ville de Bonon

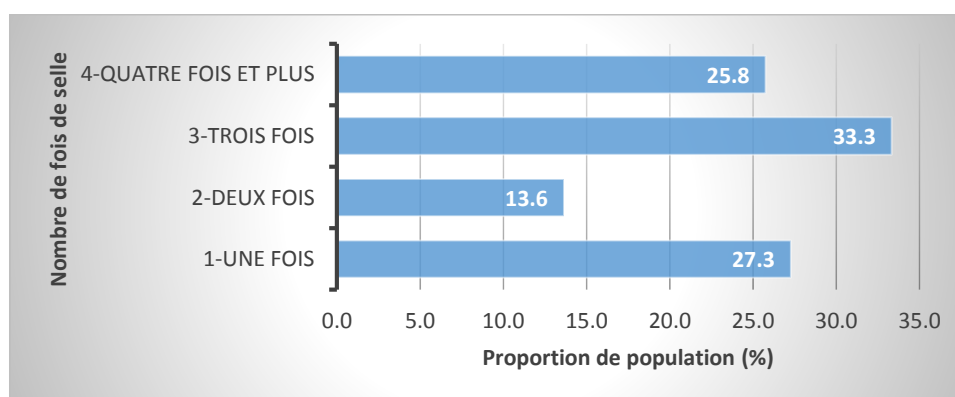
Neighborhood names	Malaria (%)	Abdominal pain (%)	Typhoid fever (%)	Diarrhea (%)	ARI (%)
BELLE VILLE	50	32	4	23,99	24
BOZRA	52	4,2	8,4	29,20	32
FREFREDOU NORD	49	24	11	22,99	11
FREFREDOU SUD	57	17	12	44,39	17
SEHIZRA	50	16	12	50,76	12
SEHIZRA 1	49,50	18	8	20	8
SEHIZRA 2	54	34,6	64	67,68	16
VRAMIS	52	29,6	20	16,01	14
Total	51,69	21,93	17,43	34,37	16,75

Source : Diabia et Aké-Awomon, 2022-2023

The results in Table 3 reveal the presence of several pathologies in households in Bonon. Malaria occupies, in fact, the first place with 51.69% of declared cases. This proportion is relatively representative in the different districts with a difference of around 2%, except for FrefredouSud. In this district, 57% of respondents attest that malaria is the dominant disease. In addition, acute respiratory infections (ARI) have been reported by the population. They represent 16.75% of recurrent illnesses in Bonon. Bozra is the most affected district with 32% of cases, comes Belle ville (24%) and Frefredou Nord with 17%. Sehizra 1 has less than half cases compared to the average of 16.75%. In addition, waterborne diseases including diarrhea, typhoid fever and stomach aches were identified with diarrhea dominance. Diarrheal pathologies are the second cause of health problems in Bonon with 34.37% of reported cases, just after malaria. Varieties exist from one neighborhood to another. In Sehizra 1 there are 20% of diarrheal cases while in Sehizra 2, 67.68% of patients were counted. This proportion is 16.01% in Vramis against 50.76% in Sehizra, 22.99% in Frefredou Nord, 23.99% in Belle ville, 44.39% in FrefredouSud and 29.20% in Bozra. For the WHO, diarrhea is recognized in a given area according to certain characteristics.

III.2.2. Recognition of diarrhea according to the WHO in Bonon

In a given space, diarrhea is recognized according to standards, according to the WHO (Figure 3).



Source : Diabia et Aké-Awomon, 2022-2023

Figure 3: Expression of diarrhea in Bonon

Figure 3 presents the different characteristics of diarrhea recorded in households in the town of Bonon. A subject sick with diarrhea cannot be appreciated when he makes at least three soft emissions / day, that is to say, three soft stools / day following a diarrheal episode. In the city of Bonon, 33.3% of reported cases have three loose stools/day following diarrhea while 25.8% show 4 loose stools/day or more. On the other hand, 13.6%

have two bowel movements per day and 27.3% have only one bowel movement per day during diarrhea. These, unfortunately, according to the WHO are not among the subjects sick with diarrhea. This situation makes it possible to really understand the link between households that use traditional wells and diarrheal diseases.

III.3. Report on water sources and the spread of diarrheal pathologies in the city of Bonon and recommendations

III.3.1. Significant correlation between the drinking of well water and diarrheal pathologies in the city of Bonon

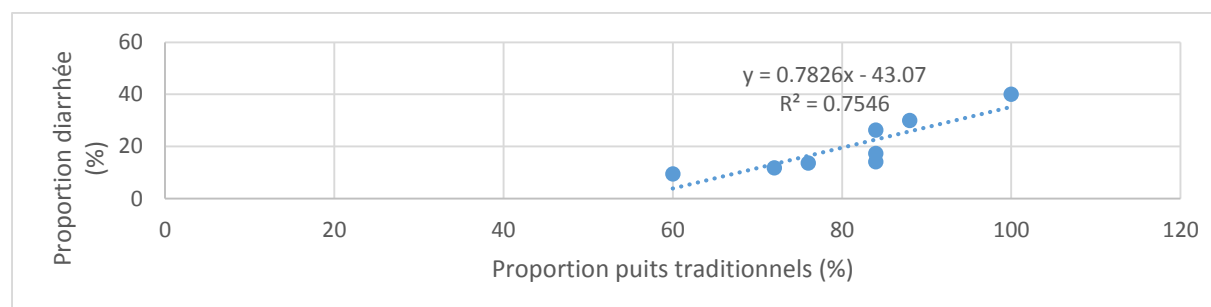
The results show the correlation between the populations who use traditional wells as a source of drinking water and the prevalence of diarrhea in the town of Bonon (Table 4).

Table 4: Correlation between well water and diarrhea in Bonon

Quartiers de Bonon	All traditional wells (private + collective) (%)	Three or more loose stools/day according to a diarrheal episode
BELLE VILLE	84	14,18
BOZRA	84	17,26
FREFREDOU NORD	76	13,59
FREFREDOU SUD	84	26,24
SEHIZRA	88	30
SEHIZRA 1	72	11,82
SEHIZRA 2	100	40
VRAMIS	60	9,46
Correlation Coefficient (R)	0,86867549	
Coefficient of Determination (R²)	0,75459711	

Source : Diabia et Aké-Awomon, 2022

In the town of Bonon, there is a significant and positive correlation between households that use well water and the spread of diarrheal diseases. This link is proven by the Bravais-Person correlation coefficient which is equal to $R = 0.86$. The linear regression method, through the coefficient of determination $R^2 = 0.75$, confirms the existence of this relationship and the degree of intensity between these variables (Figure 4).



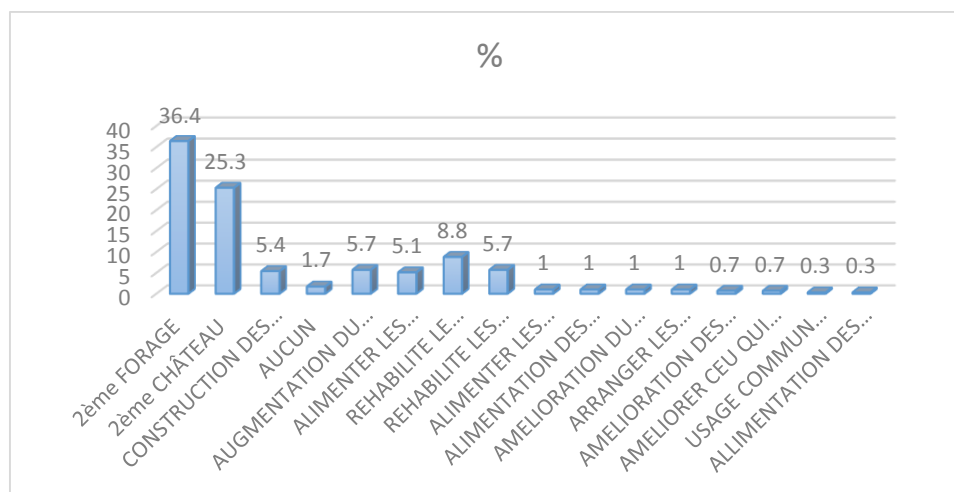
Source : Diabia et Aké-Awomon, 2022-2023

Figure 4: Correlation between households using wells and diarrheal diseases in Bonon

Figure 4 makes it possible to better explain this correlation, it attests to the existence of a very significant correlation between the two variables. This is visually justified by the shape of the linear regression curve and the sign of the leading coefficient of the equation on the right. This equation gives to understand that this correlation is of a significant intensity; i.e. 0.7546, otherwise 75.46%. This means that 75.46% of the share of diarrheal diseases can be attributed to drinking well water. In addition, the equation on the right reveals that if the population of the city of Bonon managed to access safe drinking water by 0.7546 units, the health situation related to diarrheal diseases can be reduced by 0.7826 unit with respect to the constant value equal to 43.07. Faced with this situation, proposals have been made by the population to improve access to drinking water.

III.3.2. Recommendations for reasonable access to drinking water, a source of health risk limitation

In order to limit the health risks relating to drinking water problems in the town of Bonon, the population made recommendations (Figure 5).



Source : Diabia et Aké-Awomon, 2022-2023

Figure 5: Recommendations from the population of Bonon

Figure 5 presents the recommendations of the population of Bonon. Far from being recommendations that invite a material and financial contribution from the population, they are rather grievances with regard to local and national policies. Thus, 67.1% of respondents suggest the construction of a second water tower with a large capacity. In different terms, 36.4% speak of a second borehole, 25.3% of a second castle and 5.4% of the construction of water points, while 1.7% made no proposal. In addition, for 25.3%, the existing castle must be rehabilitated in order to increase the flow of water and supply the pipes to serve households. In a word, for the population, the authorities must promote the permanent availability of water in the different districts of the city of Bonon.

IV. DISCUSSION

The study made it possible to understand the relationship between the use of water from traditional wells and diarrheal pathologies in the town of Bonon. There is a positive and significant correlation of 0.86 between the two variables. The intensity of this relationship is 75%, which proves the significance of this report. Thus, from these results, the study confirms the hypothesis that there is a significant correlation between the misuse of water from traditional wells and diarrheal diseases in the city of Bonon. This article highlights the issues related to the unavailability of drinking water in urban areas, particularly in sanitary areas.

In a given locality, drinking water is that which the populations have for all their domestic needs. As for drinking water, it comes from modern technologies (Village Hydraulics “HV”, Improved Village Hydraulics “HVA” and Urban Hydraulics “HU”, commonly called water tower). Generally, the establishment of a drinking water point follows a hygienic study or this water regularly undergoes specific treatments in order to maintain its potability according to WHO standards. This is not the case with traditional wells and surface waters (backwaters, sumps and other watercourses). The correlation between well water and waterborne disease, especially diarrhea, is supported by several studies. In the city of Gagnoa, in the south-west of Côte d'Ivoire, the difficulties relating to the supply of drinking water have resulted in the emergence of new types of businesses which affect household budgets (68% use water in sachets bought in the neighborhood shop) and the high demand for water from traditional wells (75%), (Y. V. Kramo et al., 2020, p. 279 and 284). All things that increase health risks (Y. V. Kramo et al., 2020, p. 282-285). In addition, in the sub-prefecture of Vavoua, in the center-west of Côte d'Ivoire, despite the difficulties relating to access to drinking water, households in addition to using untested safe water, practice water conservation. Water over several days in barrels, metal drums and others (T. M. Diabia et al., 2022, p. 105). In the said sub-prefecture, the existence of a significant relationship between water conservation methods and waterborne diseases has been demonstrated (Op. Cit).

In addition, other factors, in particular, certain foods, the problem of hygiene, the absence of suitable sanitation, the lack of regular washing of hands with soap, etc., can justify the prevalence of diarrhea and other diseases in a given place (B. Sane, 2020, p. 146). Indeed, water contaminated by human and animal waste is the cause of several diseases, including typhoid fever, scabies, amoebic dysentery, diarrhea, schistosomiasis, itching and malaria (D. V. B. Toussia, 2020, p.146). In certain districts of the city of Gagnoa, it has been shown that lifestyles, environmental hygiene, consumption of well water in deplorable sanitary conditions lead to the emergence of waterborne diseases (A. M. Kouadio et al. ., 2019, p. 21). In the town of Bonon, following these difficulties in obtaining drinking water, 21.93% of the households surveyed declared that they were regularly exposed to stomach aches, 17.43% spoke of typhoid fever and 34.37% of diarrhea. Several factors are at the root

of these problems of drinking water supply in local communities. In Bonon, only 19% get their drinking water supply, including 18% from a private connection and 1% from retailers, while 81% use traditional wells (both private and collective). Respondents from the old neighborhoods attest that the continuous increase in population, the aging of water equipment and the inadequacy of the size of the population to this equipment are responsible for the water problems in Bonon. This, for them, justifies 97.3% of cases of water cuts, which for 40% extends over 2 to 4 days, for 52% over weeks and for 8% over months. As for the populations of the outlying districts, the absence of the pipe network explains the demand for water from traditional wells.

Indeed, for 98.1% of respondents, this water is used for all domestic needs without treatment, including drinking. These realities are not only relative to Bonon. The city of Gagnoa, despite its location in the Ivorian wetland, is experiencing drinking water supply difficulties due to its rapid spatial spread and accelerated demographic dynamics (Y. V. Kramo et al., 2020, p. 274). In Gagnoa, the drinking water distribution network by SODECI is concentrated in the central and intermediate districts, and is owned by 61% of urban households (Y. V. Kramo et al., 2020, p. 277). The water produced by SODECI is subject to fluctuations, as it is highly dependent on rainfall from the Drébot stream (Y. V. Kramo et al., 2020, p. 279). Thus, for a daily need of 9,866 m³ in 2019, SODECI only produced 3,861 m³ (Y. V. Kramo et al., 2020, p. 281); this situation makes more than 71,327 city dwellers in Gagnoa vulnerable to drinking water. In addition, in the district of Abidjan, 60.90% of the population of precarious neighborhoods get their supplies from drinking water dealers and 19.60% use traditional wells and other unsanitary sources (J. N. Yéradé, 2018, p. 237). This situation has resulted in the use of illegal connections to the network by 12.20% in precarious neighborhoods and by 9.7% in the entire population surveyed in the district of Abidjan (J. N. Yéradé, 2018, p. 237).

Given the various issues related to drinking water problems, particularly health problems, the leaders of local authorities must use several strategies to solve this equation (F. Lasserre, 2012, p. 251). When we know that diseases (epidemics) increasingly threaten global health security; high population mobility. This global mobility is a channel for the spread of diseases around the world (WHO, 2007). Especially since even the use of contaminated well water for watering market garden products such as tomatoes, lettuces, cucumbers, cabbage, etc., constitutes a health risk factor in M'Pouto, in Abidjan for consumers, when they eat them raw (D.A. Alla et al., 2019, p. 218). For 67.1% of respondents in Bonon, the construction of a second water tower is necessary and for 25.3% they rather want the rehabilitation, the strengthening of the capacity of the existing castle and the extension of the network of drinking water throughout the city. Even if the extension of the network does not automatically lead to the connection of populations to the network (J. N. Yéradé, 2018, p. 236), the ideal is to promote the availability of drinking water in all neighborhoods of communities local.

V. CONCLUSION

The use of water from traditional wells favors the prevalence of diarrheal pathologies. The study conducted in the city of Bonon showed the scientific relationship between households using these waters for drinking and diarrheal diseases. This link is justified by the correlation coefficient which is $R=0.86$, with an intensity of 75%, revealed by the coefficient of determination (R^2). This attests that 75% of cases of diarrhea in households in Bonon can be attributed to the consumption of water from traditional wells. Diarrhea being the second cause of health problems in Bonon with a rate of 34.37%, just after malaria (51.69%), it is essential to help the population in order to reduce these health risks. This, taking into account its recommendations; anything that would allow it to respond effectively to the sustainable development challenges of Bonon and even Côte d'Ivoire. Especially since the space is a large area of agricultural production (industrial products such as food). Otherwise, what scenario would we witness in the face of the persistence of the problem of drinking water, the growing increase in the population and the continuous spreading of Bonon's space?

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