JCBPS; Section D; November 2018 – January 2019, Vol. 9, No. 1; 051-066. E- ISSN: 2249 –1929

[DOI: 10.24214/jcbps.D.9.1.05166]

Journal of Chemical, Biological and Physical Sciences

An International Peer Review E-3 Journal of Sciences

*Available online at*www.jcbsc.org

Section D: Environmental Sciences

CODEN (USA): JCBPAT Research Article

Evaluation of the health and environmental impacts of the malfunction of the wastewater network in the municipality of Port-Bouët (Abidjan-Côte d'Ivoire)

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Received: 15 November 2018**; Revised:** 30 November 2018; **Accepted:** 15 December 2018

Abstract: The municipality of Port-Bouët, like other municipalities in the city of Abidjan, faces enormous difficulties for the management of its wastewater with the rapid growth of its population. Added to this is the deterioration of existing sanitation facilities, domestic sewage runoff, stagnant in empty spaces, streets, pavement and drains, resulting in foul odors. In order to assess the health and environmental impacts related to the malfunction of the Port-Bouët municipality wastewater system, surveys were conducted. One addressed to 384 households in the areas of Port-Bouët Center and Vridi provided with sanitation network, and two others with the DCBA (Regional Directorate of Sanitation South Abidjan) and hospitals Port-Bouet and Vridi City. The analyzes of the physicochemical and bacteriological parameters were carried out thanks to the French standard and the methods described by Rodier. They reported high average concentrations for the chemical parameters of pollution. The results of the bacteriological analyzes

confirm the presence of various organisms such as total and fecal coliforms and fecal streptococci in a very appreciable quantity which exceeds the guidelines of the World Health Organization (WHO). Also, the data collected in the Port-Bouët and Vridi-Cité hospitals show percentages (88.31% for the Port-Bouët Center sector and 89.16% for the Vridi zone) which are very high for diseases such as ; diarrhea, malaria, and typhoid fever. It should be noted that the malfunctioning of the Port-Bouët municipality's wastewater system is leading to the proliferation of diseases related to the poor sanitation of wastewater, and the deterioration of the living environment of local residents.

Keywords: Wastewater, wastewater network, physicochemical parameters, bacteriological parameters, public health.

INTRODUCTION

Global population growth and urbanization are accompanied by increasing production of wastewater discharges [1,2]. From various sources (fireplaces, hospitals, factories ...), wastewater carries pollutants dissolved or in suspension of a chemical nature (organic molecules, heavy metals, nutritive salts, etc.) or bacteriological (bacteria, parasites) [3,4]. When not pre-treated, wastewater may disturb the balance of receiving environments [3,5,6], such as the eutrophication of surface water [3,5] or the contamination of water resources [3 , 5,7,8]. In developed countries, wastewater discharges are collected in sewage systems, which transport them to treatment plants, where they receive adequate treatment [9]. Unfortunately, this is not the case in sub-Saharan countries, and particularly in Côte d'Ivoire, where the inadequacy of sanitation networks and the lack of connection of the majority of the population to the networks have led to significant discharges of untreated sewage directly into the natural environment [8,10,11]. Added to this is the dysfunction of existing sanitation facilities, leading to the runoff of domestic sewage into the streets, pavements and drains, resulting in foul smelling odors [12,13]. The dysfunction of the sanitation facilities leads to the direct contact of the domestic wastewater with the populations [14], thus exposing them to possible disease linked to the bad sanitation of wastewater, such as malaria, cholera, diarrhea, etc [14,15].

Port-Bouet, a town south of the city of Abidjan, is not on the fringe of the problem of poor wastewater management. In fact, at several points in the town, there are regular reports of wastewater from the manholes and their stagnation in the living environment of the populations [16].

The main objective is to evaluate the health and environmental impacts related to the malfunction of the wastewater network in the municipality of Port-Bouët. This is specifically to study the level of knowledge of the populations on the sewerage network, to characterize on a physicochemical and bacteriological level the wastewater effluents of the municipality of Port-Bouët, in order to determine the health and safety impacts related to the malfunction of the wastewater system.

2. MATERIAL AND METHODS

2-1. Study area: The municipality of Port-Bouët is located in the southeast of the city of Abidjan (**Figure 1).** It is a peninsula located between the Atlantic Ocean and the Ebrié Lagoon, which stretches along the coastline for nearly 30 km from East to West [17] with an area of 111 km^2. Sectors namely the Port-Bouët Center sector, the Vridi sector and the Bassam [18] road sector.

The sectors of Port-Bouët Center and Vridi present numerous cases of dysfunctional sanitation facilities, hence their choice in the context of this study. The choice of sectors was made on the basis of the following criteria:

• Effective presence of a wastewater network;

• Good coverage in wastewater network;

• High recurrence of malfunctions on the network.

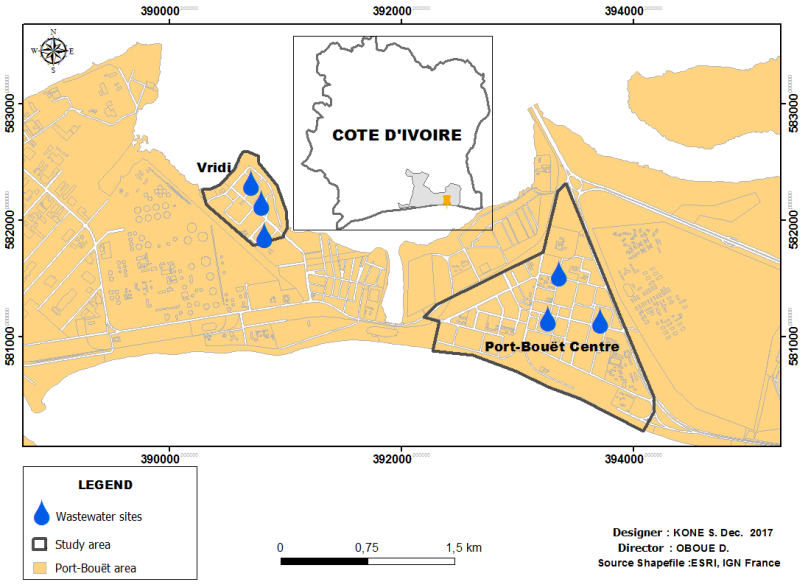

Figure 1: Location map of the wastewater sampling points at Port-Bouët Center and Vridi

2-2. Study material: The study material consists of wastewater from the wastewater network of the municipality of Port-Bouët.

2-3. Survey material: The survey material consists of a camera for shooting, a survey card for households, the register of customer requests of the maintenance and repair service of the Regional Directorate Abidjan South Sanitation (DRASA) of the Water Distribution Company of Côte d'Ivoire (SODECI), patient consultation registers from the general hospital of Port-Bouët and the municipal hospital of Vridi-Cité.

2-4. Analytical material: In situ measurements were made using a HACH HQ 40d multimeter for determination of pH, temperature, and dissolved oxygen. Conductivity was measured using a HANNA HI 99301 multimeter. In the laboratory of the Ivorian Center for Pollution Control (CIAPOL), the following devices were used for the determination of physicochemical and bacteriological parameters: an oven intended for the determination of bacteria, an OHAUS ANALYTICAL electronic balance for weighing, a QW324A-type UV-2700 spectrophotometer for the determination of nitrogen compounds, phosphorus compounds and the chemical oxygen demand (COD), a BOD-TRACK apparatus for determination Biochemical Oxygen Demand (BOD_5) after five (5) days of incubation, a filtration pad filter discs for the determination of Suspended Solids (SS), a pasteur oven for drying glassware, SANO Clav mark for the sterilization of glassware and culture media.

2-5. Methods

Household survey: The purpose of this survey was to assess people's knowledge of sanitation, wastewater management and the health impacts of poor wastewater management. According to the sampling formula (equation 1) recommended by the WHO World Health Organization[19], the survey was conducted with a sample of 384 households divided into 2 sectors (Port-Bouët Center and Vridi). The questionnaire of the survey is intended for each zone, to the heads of households or their representatives. The distribution of household size to survey by sector is shown in **Table 1.** The choice of households was random. All households at the same level are not to be investigated. We proceed by jumping from one to two households to reach the next to investigate [20].

$$N = \frac{T^2 \times P\,(1-P)}{M^2} \qquad (1)$$

N = required sample size;

T = 95% confidence level (standard value of 1.96);

M = 5% error margin (typical value 0.05);

P = Proportion of the population connected to the wastewater network (P = 0.6).

Table 1: Distribution of households by sectors of the municipality of Port-Bouët

Sectors	Population [21]	Sample
Port-Bouët Center	44796	283
Vridi	15944	101
Total population	60740	384

Survey in health centers: A survey was conducted in the general hospital of Port-Bouët and the municipal hospital of Vridi-Cité, in order to make a connection between the state of health of the population and the sanitation problems encountered by the households. Only statistics of patients from these neighborhoods were taken into account. Visits to the two hospitals evaluated the proportion of people affected by diseases (malaria, typhoid fever, cholera, diarrhea, etc.) generally due to poor sewage treatment over a period of twelve months.

2-6. Physicochemical and biological characterization of effluents from the wastewater network of the municipality of Port-Bouët: Six (6) sampling points were chosen, three (3) in the Port-Bouët Center sector and three (3) in the Vridi sector. These points are located at the sites of dysfunction of the tertiary network of each sector **(Figure 1**). The sampling took place over three months (August 2016 to October 2016) with one sampling per site. Samples were taken between the hours of 8am and 9.30am corresponding to the periods when housework is intense. The samples intended for the analysis of physicochemical parameters were taken from polyethylene bottles of 500 ml capacity. In the case of bacteriological analysis, sterile 500 mL borosilicate glass vials were used to collect wastewater to provide complete protection against external contamination. After sampling, all samples were transported to the laboratory in a cooler containing cold accumulators. Sampling, transport and preservation of the samples were in accordance with the protocol defined by AFNOR [22] and RODIER [23].

Physical parameters (temperature, pH, dissolved oxygen and conductivity) were measured in situ. Other physicochemical and bacteriological parameters were analyzed within 48 hours at CIAPOL's Central Environmental Laboratory.

Physicochemical parameters: The analyzes of the physical, chemical and bacteriological parameters were carried out thanks to AFNOR 22, AFNOR [24] and the methods described by RODIER [23].

pH, temperature and dissolved oxygen were measured with the HACH HQ 40d multimeter. Electrical conductivity (EC) was measured using the HANNA HI 99301 multimeter. Ammonium (NH_4^+), nitrates (NO_3^-), nitrites (NO_2^-), orthophosphates (PO_4^{3-}) and Total Phosphorus (PT) were determined by colorimetry using the spectrophotometer QW324A, UV2700 according to AFNOR [22] and Rodier [23]. Chemical Oxygen Demand (COD) was determined by the oxidation method with potassium dichromate, SS were determined by filtration on glass fiber 0.45 µm diameter, and BOD_5 was measured using oxytop probes placed at constant incubation temperature (20 °C) in a thermostatted cabinet [22].

Bacteriological parameters: Fecal Coliforms (FC) and Fecal Streptococci (FS) were enumerated by surface spreading method [22]. The following media were used: Violet Red Bile Lactose (VRBL) for the enumeration of FC, Esculin Bile and sodium azide (BEA) for FS.

Statistical treatment of data: The counting of household survey cards was done using the Sphinx software. The statistical processing of the data collected in the hospitals and the Sanitation Department as well as the data relating to the values of the physical, chemical and bacteriological parameters were made possible thanks to the statistical software 7.1.

3. RESULTS

3-1. Household knowledge of the wastewater system and their living environment

3-1-1. Proportion of households having modified their dwellings: Field surveys reveal that 79% of households in Vridi and 77.8% of households in Port-Bouët Center made modifications to their homes, compared to 21% and 22.2%, respectively, who did not make changes **(Figure 2**).

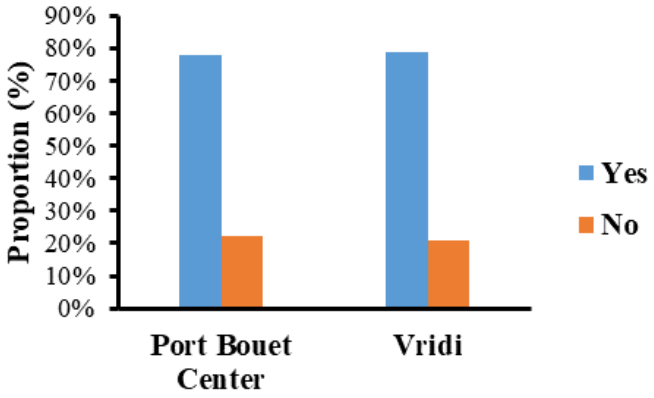

Figure 2: Proportion of households that made changes to their home

3-1-2. Demographic pressure: Table 2 presents the number of inhabitants per household. The average size of the surveyed population is 8 people per household.

Table 2: Distribution of surveyed population size by household

Population / Sectors	Minimum size	Average size	Maximum Size	Total Population Visited
Port-Bouët Center	3	8	18	2501
Vridi	2	8	16	865

3-1-3. Level of household knowledge on the sanitation network: Figure 3 shows respectively that 56% of households in Port-Bouët Center and 67% of households in Vridi do not know what a sanitation system is. On the other hand, 44% of Port-Bouët Center respondents and 33% of Vridi respondents have a notion of the sanitation network.

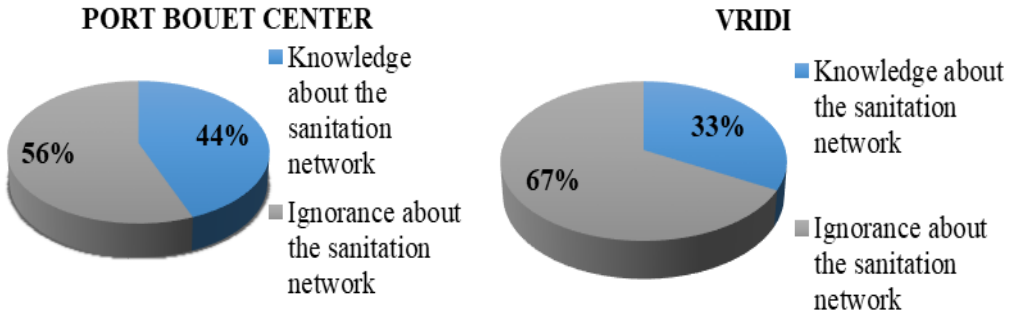

Figure 3: Level of household knowledge about the sanitation network

3-1-4. Households evoking recurrent sanitation problems: Figure 4 shows the proportion of household complaints following sanitation problems. It is noted that 70% of households in Port-Bouët Center and 75% of households in Vridi complain of the inconvenience caused by the dysfunction of the sanitation facilities. In contrast, 30% of households in Port-Bouët Center and 25% of households in Vridi do not mention any problems.

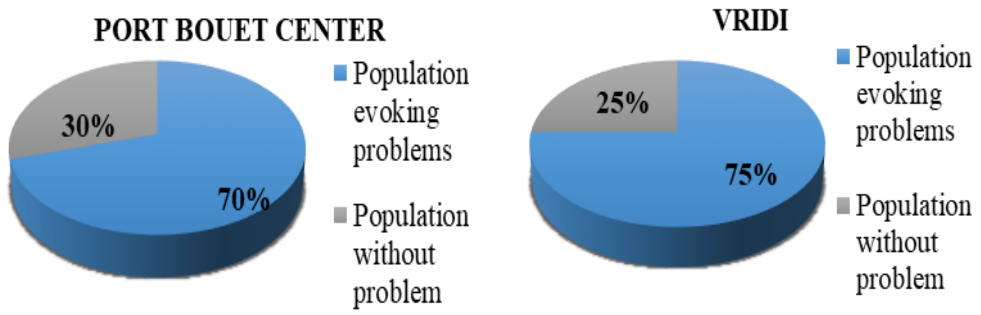

Figure 4: Proportion of household complaints following sanitation problems

3-1-5. Structures requested in case of malfunction of the wastewater network: The services of individuals are solicited 49% in Port-Bouët Center and 50% in Vridi to solve problems of malfunction on the wastewater network. 30% of households in Port-Bouët Center and 38% of households in Vridi use SODECI- Sanitation. The technical services of the town hall are often solicited by the population with a proportion of 2% for both sectors. Private enterprises, on the other hand, are solicited at 15% by households in Port-Bouët Center and 10% by households in Vridi. The others (parent or friend) have an intervention proportion of only 4% in the households of Port-Bouët Center **(Figure 5).**

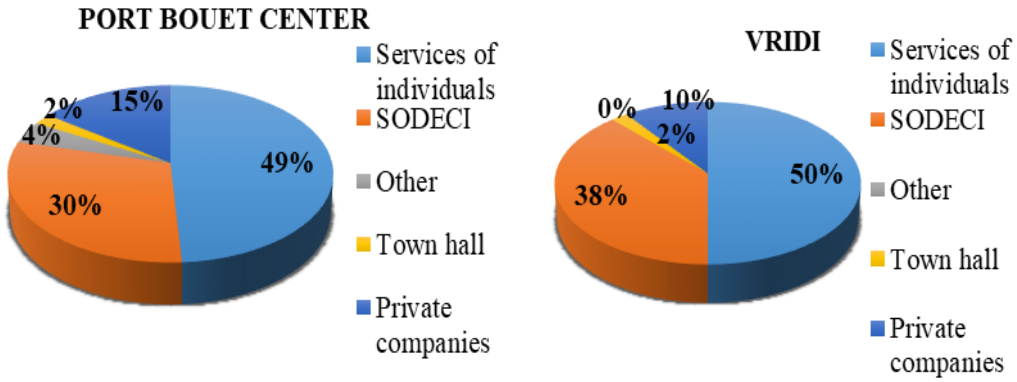

Figure 5: Structures solicited to solve problems related to malfunction

3-1-6. Customer queries related to network malfunction: The consultation of the client request management register of the commune of Port-Bouët with the DCBA (Regional Direction of the sanitation of Abidjan South) over a period of 12 months, made it possible to elaborate the following histogram **(Figure 6).** The months of October and June show the highest values for both sectors, hence the recurrence of sanitation problems observed during this period.

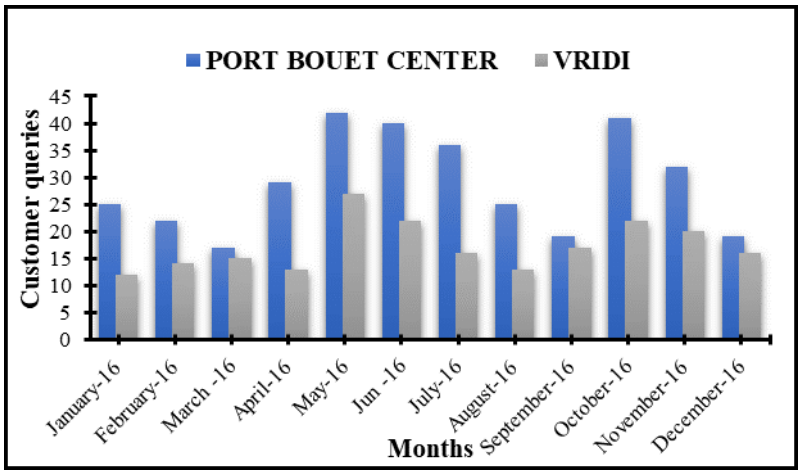

Figure 6: Customer Requests Processed by DCBA in 2016

3-2. Physicochemical and bacteriological characterization of effluents from the wastewater network of the municipality of Port-Bouët

3-2-1. Physical characterization: Table 3 presents the average values of the physical parameters of effluents from the wastewater network in the Port-Bouët Center and Vridi sectors. The average pH value of the Port-Bouët Center wastewater is 7.55 ± 0.16 and 7.54 ± 0.07 for Vridi, these wastewaters have a slightly alkaline pH. With average temperatures of these are 29.46 ± 1.69 for Port-Bouet Center and 27.3 ± 0.04 for Vridi, characteristics of the tropical zone. The average EC of these waters is 1230 ± 120 µS/cm for Port-Bouët Center and 668.33 ± 288 µS/cm for Vridi. Finally, SS have an average concentration of 367.83 ± 274.80 mg/L for Port-Bouët Center and 237.5 ± 81.67 mg/L for Vridi.

Table 3: Average concentrations of the physical parameters of wastewater effluents in the Port-Bouët Center and Vridi sectors

Sectors		**pH**	**T (°C)**	**EC (µS/cm)**	**SS (mg/L)**
Port-Bouët Center	**Average**	7.55	29.46	1230	367.8
	Standard deviation	0.16	1.69	120	274.8
Vridi	**Average**	7.54	27.3	668	237.5
	Standard deviation	0.07	0.04	288	81.67

3-2-2. Chemical characterization: Table 4 presents the average values of the chemical analyzes of wastewater effluents from the Port-Bouët Center and Vridi. Average COD concentrations range from 752.73 ± 131 mg/L to 880.13 ± 296.91 mg/L and those from BOD_5 range from 473.33 ± 84.44 mgO_2/L to 690 ± 377.32 mgO_2/L respectively in effluents from Vridi and Port-Bouet Center. As for the COD/BOD_5 ratio, they vary from 1.27 ± 0.78 to 1.59 ± 1.55, reflecting a biodegradable wastewater. With regard to nutrients, NH_4^+ concentrations vary from 53.44 ± 23.29 mg/L to 75.84 ± 30.21 mg/L, those of NO_3^- vary from 3.68 ± 1.22 mg/L to 5.36 ± 1.34 mg/L, those of PO_4^{3-} oscillate from 5.96 ± 3.14 mg/L to 8.86 ± 3.37 mg/L respectively in the effluents of the sectors of Vridi and Port-Bouët Center. NO_2^- and PT concentrations range from 0.95 ± 0.04 mg/L to 0.98 ± 0.12 mg/L and from 11.71 ± 3.12 mg/L to 12.16 ± 8.83 mg/L respectively in effluents from the Port-Bouët Center and Vridi. Regarding the total Kjeldahl nitrogen (NTK) concentrations, they vary between 75.07 ± 5.24 mg/L and 147.07 ± 53.24 mg/L respectively in the effluents of the Vridi and Port-Bouët Center.

Table 4: Mean concentrations of chemical parameters of wastewater effluents in the Port-Bouët Center and Vridi sectors

Sectors		**COD (mgO_2/L)**	**BOD_5 (mgO_2/L)**	**COD /BOD_5**	**NH_4^+ (mg/L)**	**NO_2^- (mg/L)**	**NO_3^- (mg/L)**	**NTK (mg/L)**	**PT (mg/L)**	**PO_4^{3-} (mg/L)**
Port-Bouët Center	**Average**	880.13	690.00	1.27	75.84	0.95	5.60	147.07	11.71	8.86
	Standard deviation	296.91	377.32	0.78	30.21	0.04	1.34	53.24	3.72	3.37
Vridi	**Average**	752.73	473.33	1.59	53.44	0.98	3.68	75.07	12.16	5.96
	Standard deviation	131.00	84.44	1.55	23.29	0.12	1.22	5.24	8.83	3.14

3-2-3. Bacteriological characterization: Table 5 presents the average values of TC, FC and Fecal Streptococci (FS) contained in effluents from the wastewater system in the Port-Bouët Center and Vridi. The TC counted in the wastewater areas of Port-Bouët Center and Vridi have respective average values of $5.44.10^7 \pm 1.24.10^7$ CFU/100mL and $9.86.10^7 \pm 3.68.10^7$ CFU/100mL. The Port-Bouët Center and Vridi wastewaters contain respectively $2.75.10^7 \pm 9.41.10^6$ CFU/100mL and $4.32.10^7 \pm 8.84.10^6$ CFU/100mL for FC. As for FS, the values obtained are respectively $6.69.10^6 \pm 1.73.10^6$ CFU/100 mL for Port-Bouet Center and $1.68.10^7 \pm 2.89.10^6$ CFU/100mL for Vridi. The average FC ratios on FS are 4.11 ± 5.42 for Port-Bouet Center and 2.57 ± 3.04 for Vridi.

Table 5: Mean concentrations of bacteriological parameters of sewage system effluents in the Port-Bouët Center and Vridi sectors

Sectors		**TC (CFU/100mL)**	**FC (CFU/100mL)**	**FS (CFU/100mL)**	**FC/FS**
Port-Bouët Center	**Average**	$5.44.10^7$	$2.75.10^7$	$6.69.10^6$	4.11
	Standard deviation	$1.24.10^7$	$9.41.10^6$	$1.73.10^6$	5.42
Vridi	**Average**	$9.86.10^7$	$4.32.10^7$	$1.68.10^7$	2.57
	Standard deviation	$3.68.10^7$	$8.84.10^6$	$2.89.10^6$	3.04

3-3. Health and environmental impacts related to sewage network malfunction

3-3-1. Health impacts

At the level of health centers: The survey conducted in the health centers shows that the populations are more exposed to the diseases related to the bad sanitation of the sewage (malaria, typhoid fever, cholera, diarrhea, respiratory infection, etc ...), with respectively 88,31% for the Port-Bouët Center and 89.16% for the Vridi area, compared to 11.69% for Port-Bouët Center and 10.84% for Vridi for other diseases (Tuberculosis, HIV, fractures etc ...) (**Figure 7 and 8)**. Children aged 0 to 4 years have high percentages (93.45% for Port-Bouët Center and 90.13% for Vridi) for diseases related to poor sanitation of wastewater in both sectors (**Table 6 and 7).**

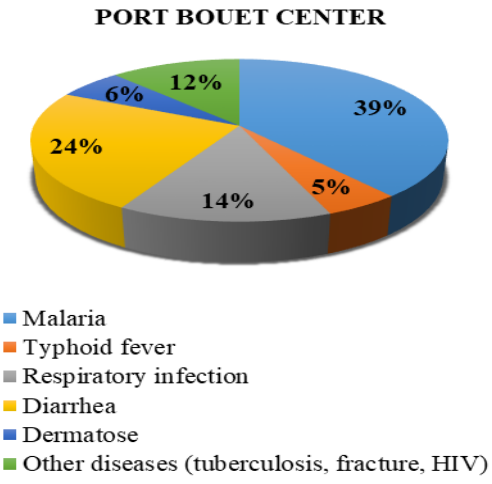

Figure 7: Proportion of diseases recorded in Port Bouët General Hospital

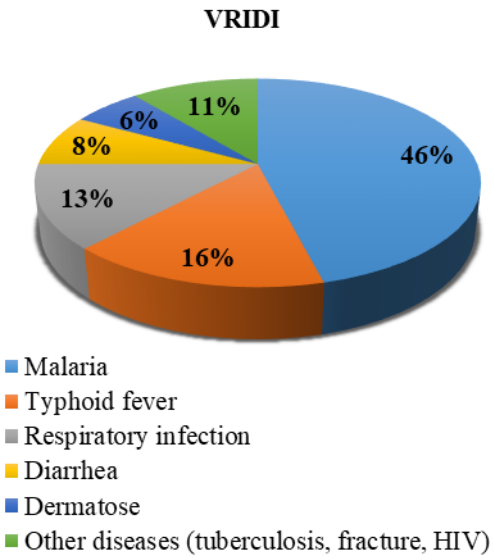

Figure 8: Proportion of diseases recorded in the Vridi-Cité Municipal Hospital

Table 6: Data from consultations at the Port-Bouët General Hospital

	Age range	Diseases related to wastewater	Other (HIV, Tuberculosis, Fracture)	% Diseases related to sewage	% Other (HIV; Tuberculosis; Fracture)
Total annual consultations by age group	**0-4 years**	23972	1681	93,45	6,55
	5-14 years	6225	494	92,65	7,35
	15 years and over	13412	3596	78,86	21,14

Table 7: Data from the consultations of the Vridi-Cité Municipal Hospital

	Age range	Diseases related to wastewater	Other (HIV, Tuberculosis, Fracture)	% Diseases related to sewage	% Other (HIV; Tuberculosis; Fracture)
Total annual consultations by age group	**0-4 years**	1707	187	90,13	9,87
	5-14 years	1482	183	89,01	10,99
	15 years and over	3636	460	88,77	11,23
Total		**6825**	**830**	**89,16**	**10,84**

DOI:10.24214/jcbps.D.9.4.05166.]

At the household level: The results of the household survey show that the populations evoke health problems related to the dysfunction of the wastewater network. Thus 88% of households in Port-Bouët Center against 90% of households in Vridi had people with diseases related to poor sanitation of wastewater (**Figure 9).**

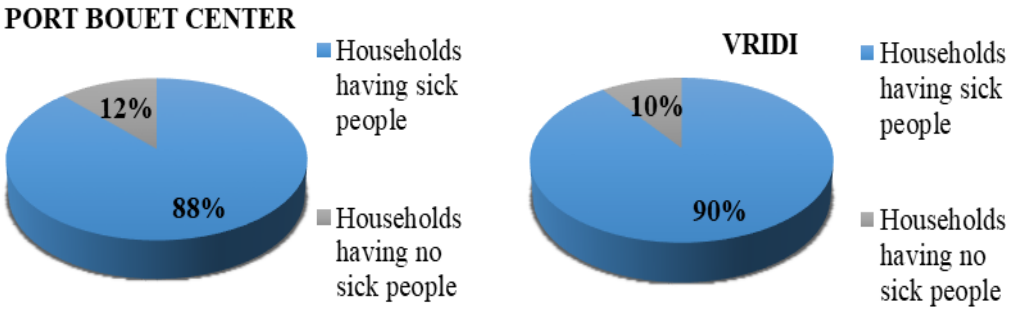

Figure 9: Cases of diseases related to poor sanitation of wastewater reported by households

3-3-2. Environmental impacts: The flow and stagnation of wastewater in the living environment of the populations are frequent in the commune of Port-Bouët. In **Figure 10**, it can be seen that the flow of wastewater causes the deterioration of a road network in the Vridi sector, the stagnation of wastewater causes erosion of the soil near the foundation of a house **(Figure 11).** Thus, the permanent flow of wastewater is at the origin of the degradation of the living environment of the populations. These sectors lose their luster and become unhealthy.

Figure 10: Roadway degraded by the permanent flow of sewage

Figure 11: Degradation of the foundation of a house by water

4. DISCUSSION

The study conducted on the wastewater network of the municipality of Port-Bouët revealed numerous cases of malfunction. The causes of the malfunction are related to the dilapidated network, built since 1972 and its occupation by buildings. According to OBOUE [16], 60% of this network is occupied by buildings. In our study, surveys showed that 77.8% of households in Port-Bouët Center and 79% of households in Vridi made modifications to their homes. These changes are an obstacle to network maintenance. Added to this is the demographic pressure with an average of eight (8) people per dwelling. According to BALLET [13], this demographic pressure is at the origin of the increases in discharges of wastewater discharged by households, and not dimensioned for the wastewater network, resulting in subsequent refoulings. Also, the dysfunction of the network is due to the deposit of garbage like the sponges, the linens, the remains of food, the gravas of earth in the works of sanitation [12]. This incivism of the populations would be explained by the fact that, 56 % of households in Port-Bouët Center and 67% of households in Vridi are unaware of the role and operation of sewage systems. Similar results were obtained by BALLET [13,] with 59% of households in Niangon North in Yopougon commune in Abidjan (Côte d'Ivoire) who did not know the concept of sanitation network. This would explain, the resurgence of wastewater from looks, eventually causing runoff and stagnation and of these in homes, corridors and streets. Thus, 70% of households in Port-Bouët Center and 75% of households in Vridi mention recurrent sanitation problems. To compensate for these inconveniences in Port-Bouët Center and Vridi, most households use the service of individuals and SODECI. For this purpose, each month SODECI receives on average for Port-Bouët Center 29 requests in terms of intervention and 17 for Vridi. Unfortunately, SODECI can not satisfy all the requests for intervention, in question, the immobilization of these machines for failure, the insufficiency of cureuses or the extension of the spaces inhabited by the populations to the technical corridors of servitude [10]. Households are forced to direct to private individuals and businesses. This same observation was made by WAYOU [12] and BALLET [13]. The physicochemical and bacteriological analyzes of the wastewater in the Port-Bouët Center and Vridi sectors showed high concentrations of pollutants and rich in SS (237.5 ± 81.67 mg/L to 367.83 ± 274.8 mg/L), characteristics of domestic raw sewage. And the examination of the COD/BOD_5 ratio below 2.5 clearly underlines the biodegradability of these waters [25,26]. These results are comparable to the values recorded by these different authors [13,26,27]. Mean values of nitrogen compounds such as nitrates with 3.68 ± 1.22 mg/L to 5.36 ± 1.34 mg/L, and nitrites with 0.95 ± 0.04 mg/L to 0.98 ± 0.12 mg/L, responsible for methemoglobinemia or blue baby [28-30] do not exceed the recommended guideline values (less than 50 mg/L for nitrate and 3 mg/L) in drinking water by WHO in drinking water [31]. Stagnation of these wastewater near the places of residence, also the space of play of the children who can swallow it. The values of the pH effluents of Port-Bouët Center and Vridi alkaline character are favorable to the bacterial activity [26], which could explain the high bacterial levels obtained in the wastewater of the two zones. The bacteriological contamination far exceeds the standard (1000 CFU/100ml) set by the World Health Organization for wastewater for irrigation [31]. The bacteria contained in these waters are indicative of contamination by bacteria or viruses, pathogenic for humans [15,31,32]. The stagnation of these waters close to the places of residence, as well as the smells released by them would cause diseases related to a bad sanitation like the diarrhea, the typhoid fever, the cholera, the hepatitis, or due to the vectors related to water (malaria, filariasis, dengue fever) [33], and the progressive degradation of the living environment of local populations [13,34]. These diseases related to poor sanitation were mentioned by households during our investigation. Over a period of one year, 88% of households in Port-Bouët Center and 90% in Vridi reported having at least one member of their family suffering from illness related to poor sanitation

(diarrheal diseases, typhoid fever, malaria and respiratory infections). These results are far superior to those found by BALLET [13] in a similar study with the population of Yopougon commune in Abidjan, where 45% of the households surveyed claimed to have at least one member of their family suffering from diseases related to poor sanitation. The data from the different hospitals corroborate these results. In fact, 88.31% and 89.16% respectively of the General Hospital of Port-Bouët and the Municipal Hospital of Vridi had been registered for diseases related to poor sanitation. Children younger than 4 years were the most affected by these diseases, with more than 90.13% in both hospitals. According to HOUNGA [15], the persistence and frequency of water-related diseases, hygiene and sanitation among children have an impact on socio-economic life and lead to increased poverty in the community (lower financial income). family, the inability of parents to go about their income-generating activities when children are sick, the effects of illness in children, etc.).

5. CONCLUSION

At the end of this study, it appears that the urban sewage disposal network of the municipality of Port-Bouët knows many cases of malfunctions. The results obtained during the surveys showed that households are partly responsible for the uncontrolled occupation of the easement zones (60% of the network). This attitude of the population is an obstacle to the maintenance and maintenance of the network by SODECI. Thus, sewage stagnates regularly in the living environment of surrounding populations, resulting in the degradation of their living environment and environmental impacts. The physico-chemical and bacteriological analyzes of these waters revealed a high concentration of pollutants such as SS, NO_2^-, NO_3^-, NH_4^+, PO_4^{3-}, total coliforms, faecal coliforms and faecal streptococci characteristic of domestic raw wastewater. These pollutants close to homes are at the origin of diseases related to poor sanitation of wastewater such as malaria, typhoid fever, diarrhea, respiratory infections. The data collected in hospitals in Port-Bouët and Vridi-Cité show percentages greater than 88.31% of diseases related to poor sanitation of wastewater, and a rate of over 90.17% in children from 0-4 years.

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Online publication Date: 15 .12.2018