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Cohabitation of populations with household waste: Source of environmental and health risks in the Dioulabougou District in the city of Sinfra (Centre-West of Côte d'Ivoire)

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Abstract
The Dioulabougou district made up of Dioulabougou 1, 2 and 3 sub-districts in the city of Sinfra is facing a continuous deterioration of its living environment. A degradation which is characterized by the proliferation of waste water discharge points and the proliferation of household waste. The objective of this study is to show the environmental and health risks related to household waste in the Dioulabougou district. The methodology adopted is based on documentary research and a questionnaire survey addressed to heads of households. The results show that the streets constitute for 86.88% of the households the places of waste water disposal. A practice that forces 67.21% of respondents to live less than 25 meters from waste water discharge points. Household waste is dumped in the street by 44.81% of households. These practices expose populations to cases of diseases such as malaria (44%), influenza (28%) and diarrheal diseases (15%). Children under 5 are the most affected (35.33%) by cases of illness. Pharmacies are the main recourse in case of illness in the Dioulabougou district.

Keywords: sinfra, dioulabougou, household waste, environmental risks, sanitary

Introduction

Environmental health risks remain a concern in cities in sub-Saharan Africa, which are urbanizing very rapidly (FB DJOURDEBBÉ, 2015, p. 11) [5]. This densification of cities is accompanied in particular by a significant increase in the production of waste, while the infrastructures and social services necessary for healthy urban life are not evolving at the same pace (F. ABDOULHALIK, 2011, p.6) [1]. A simple observation of several cities in developing countries highlights the seriousness of the problem: accumulation of garbage in the streets, clogged sewer networks, nauseating odors...

Household waste management is a major challenge for Ivorian cities. They encounter significant difficulties in providing this service correctly. The city of Sinfra, located in the center-west of the country, is no exception to this reality. Unnoticed for a long time, household waste no longer leaves anyone indifferent because of the environmental nuisances and health risks they cause. The city is collapsing under the considerable weight of household waste and is characterized by an increasingly unhealthy and unhealthy environment. This situation is very noticeable in the Dioulabougou district. In this district, the living environment of the populations is unfortunately confronted with the problem of insalubrity which is manifested by the proliferation of garbage dumps, the precariousness of the habitat, the runoff of waste water through the streets. This situation exposes the population to so-called environmental diseases. The Dioulabougou district subjected to these environmental problems is confronted with numerous pathologies. Data provided by the Sinfra health district show that malaria is the most recurrent disease with 93.81% followed by diarrheal diseases (2.6%), and typhoid fever (2.02%) in 2021 in the region. town of Sinfra (Health District, 2021).

These findings pose the problem of environmental and health risks caused by the poor management of household waste in the Dioulabougou district. So, what are the environmental and health risks linked to the poor management of household waste? This article shows the environmental and health risks that result from the poor management of domestic wastewater and household waste. Specifically, this article presents the methods of household waste management and highlights the resulting health and environmental risks in the Dioulabougou district in the city of Sinfra.

Presentation of the study area and methodology adopted

Presentation of the study area

The municipality of sinfra extends over an area of 248,600 km², and with a population of 90,711 inhabitants (rgph, 2014). The city of sinfra is one of the three major cities in the marahoué region (bouaflé, sinfra and

zuenoula). It is located in the center-west of côte d'Ivoire between 6°37'18" north latitude and 5°54'37" west longitude. It borders to the north with the sub-prefecture of bouaflé, to the south with the sub-prefecture of bayota, to the east with the sub-prefecture of kononfla and to the west with that of kouétinfla (figure 1). Its population increased from 49,497 inhabitants in 1998 to 78,393 in 2014 (ins, 2014); ie an average annual growth rate of 6.2%. Sinfra is populated by indigenous gouro peoples, there are baoulé, malinké, and populations of the sub-region including burkinabés, malians, guineans, mauritanians, etc. This population is divided into twenty-four districts of the city and seventeen villages. The dioulabougou district is located in the northeast of the town and is formed from three sub-districts dioulabougou 1, 2 and 3).

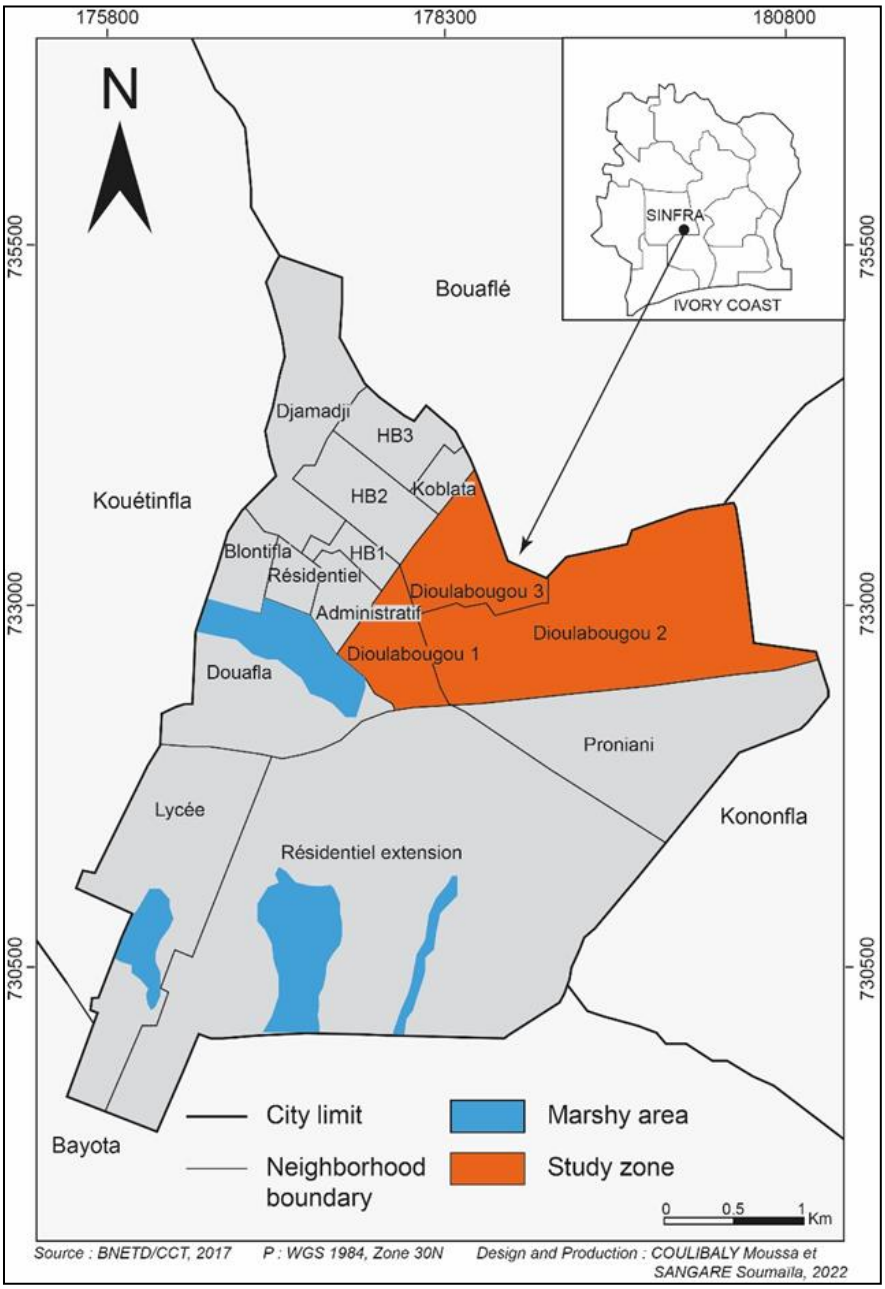


Fig 1: Presentation of the study area (Dioulabougou district)

Information collection method

The methodology used in this study is based on documentary research and questionnaire survey. The documentary research was supported in the field by direct observation and a questionnaire survey in the Dioulabougou district. Regarding the documentary research, the information collected made it possible to take stock of the research on the methods of managing household waste and the resulting environmental and health risks. It also enabled the collection of demographic and health statistics. The observation provided a general overview of the state of degradation of the living environment of the populations and their behavior in terms of household waste management. The questionnaire survey was conducted with heads of households. It was carried out in August 2021. The survey covered a sample of 183 heads of household distributed evenly between the three sub-districts that make up the Dioulabougou district (Table n°1). The size of our sample was obtained by using Fisher's formula: N= t 2. P. (1-P) / e 2 where t = 1.65 with 90% confidence rate: e = 6% and p = 50%.

Table 1: Distribution of heads of households surveyed in the Dioulabougou district

Sub-district	Number of households surveyed
Dioulabougou 1	61
Dioulabougou 2	61
Dioulabougou 3	61
Dioulabougou	183

Source: *Personal calculation, August 2021*

The data collected was analyzed and processed from a quantitative and qualitative point of view using statistical software: Le Sphinx Plus 14.5 and Excel. The results of these data allowed the development of tables and graphs and the production of the location map using Arc View and Adobe Illustrator software.

Results

Dioulabougou, a district characterized by a very degraded living environment

Wastewater management and valves, a difficult equation to solve in Dioulabougou

Various toilets used by households

The populations of the Dioulabougou district have recourse to various toilets (Table 2).

Table 2: The main toilet facilities in the Dioulabougou district

Sub-districts	Lavatories						Total	
	WC with flush		WC without flush		Traditional latrine			
	CLEAR	%	CLEAR	%	CLEAR	%	CLEAR	%
Dioulabougou 1	03	4.92	12	19.67	46	75.41	61	100
Dioulabougou 2	03	4.92	06	9.84	52	85.24	61	100
Dioulabougou 3	00	0.00	03	4.92	58	95.08	61	100
Total	06	03.28	21	11.46	156	85.26	183	100

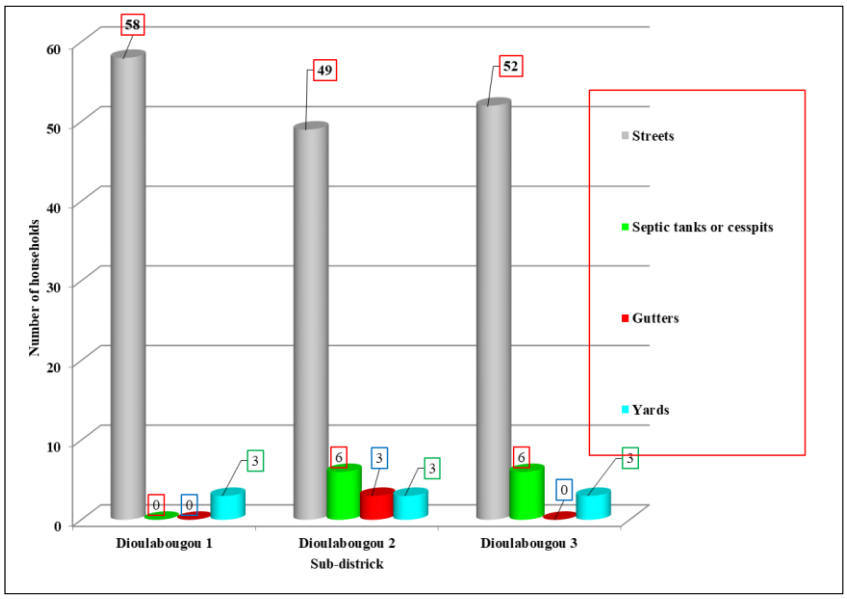
Source: *Field survey, August 2021*

Traditional latrines are the most used by households (85.26%). This trend is observed in the various sub-districts. In the Dioulabougou 3 sub-district, 95.26% of households use traditional latrines. HAS Dioulabougou 2, households mainly use traditional latrines (85.24%) and toilets without flushing (09.84%). The populations of Dioulabougou 1 prefer traditional latrines (85.24%) and toilets without flushing (19.67%).

Domestic wastewater management, a headache for populations

Proliferation of waste water discharge points for laundry and dishes

The management of waste water from laundry and dishwashing is a real environmental problem. Wastewater from domestic activities (laundry and dishes) is generally in the street (Figure 2).



Source: *Field survey, August 2021*

Fig 2: Methods of disposing of wastewater from laundry and dishes

The analysis of Figure 2 shows that 159 households, or 86.88% of respondents, evacuate waste water from dishes and laundry in the streets of the district. Septic tanks or cesspits are used by 12 households, which gives 6.56% of the total. The streets (Fig 3) are the main places where domestic wastewater is discharged in the three sub-districts.

Photo: *TRAORE D, August 2021*

Fig 3: a street invaded by domestic wastewater in dioulabougou 1

A living environment characterized by the runoff of wastewater from showers

In the Dioulabougou neighborhood in the town of Sinfra, households resort to various methods of disposing of wastewater from showers (Table 3).

Table 3: Shower waste water disposal locations

Study zone	Places for the disposal of waste water from showers				Total	
	Septic tanks or cesspools		streets			
	Del	%	Del	%	Del	%
Dioulabougou 1	24	39.34	37	60.66	61	100.00
Dioulabougou 2	24	39.34	37	60.66	61	100.00
Dioulabougou 3	40	65.57,	21	34.43	61	100.00
Total	88	48.09	95	51.91	183	100.00

Source: *Field survey, August 2021*

The streets are the main places for the disposal of shower waste water (51.91% of respondents) in the three sub-districts of Diaoulabougou (Fig 4 and 5). Those who have connected the showers to the lost wells are 88 in number, which corresponds to 48.09% of the whole. In the Dioulabougou 1 and 2 districts, 60.66% of households use the streets as a place to drain waste water from showers, while 39.34% use cesspits. HAS Dioulabougou 3, cesspits are used more (65.57%) by households.

Cliché: *COULIBALY M, Août 2021*

Fig 4: une rue servant de lieu d'evacuation des eaux usees a dioulabougou 2 case report

Cliché: *COULIBALY M, Août 2021*

Fig 5: un reservoir des eaux usees a proximite d'une cour a dioulabougou 3

Proximity to wastewater, sources of nuisance in the Dioulabougou district
The populations of Dioulabougou live near household wastewater (Table 4)

Table 4: The distance of populations from domestic wastewater

Sub-districts	Distance between dwellings and sewage						Total	
	Less than 25 meters		25 to 50 meters		50 meters and more			
	CLEAR	%	CLEAR	%	CLEAR	%	CLEAR	%
Dioulabougou 1	40	65.57	15	24.59	06	09.84	61	100
Dioulabougou 2	46	75.41	09	14.75	06	09.84	61	100
Dioulabougou 3	37	60.66	24	39.34	00	00.00	61	100
Total	123	67.21	48	26.23	12	06.56	183	100

Source: *Field survey, August 2021*

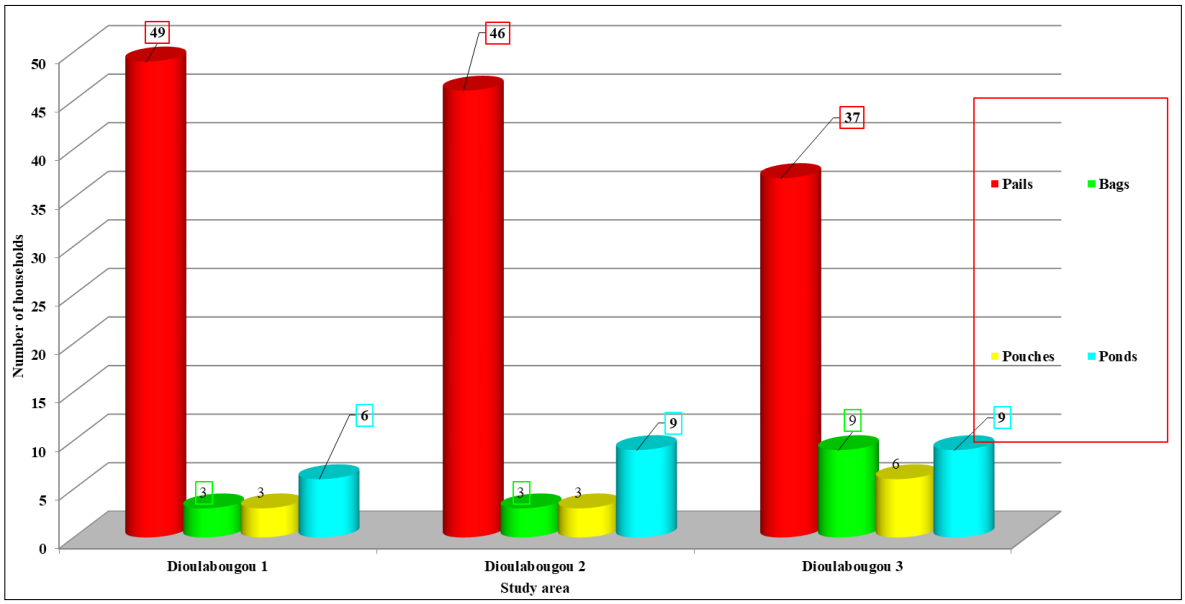
Of the 183 households surveyed, 123 households, or 67.21% live less than 25 meters from wastewater (Fig 6) while 26.23% and 6.56% live respectively between 25 and 50 meters from wastewater and more than 50 meters from wastewater from housework. This situation is well observed in the various sub-districts of Dioulabougou.

Photo: TRAORE D, August 2021

Fig 6: A toilet waste water discharge point on a window in Dioulabougou 2

Household waste management methods in the Dioulabougou district
Household waste management in Dioulabougou is a difficult equation to solve given the proliferation of waste produced and the lack of household waste management equipment.

Home household waste packaging equipment
For the packaging of household solid waste, households use various types of containers (Figure 3).



Source: *Field survey, August 2021*

Fig 7: Household waste storage equipment at home

Buckets (72.13%), basins (13.66%), bags (8.20%) and sachets (6.56%) represent the main containers (fig 8 and 9) used by households for storage of domestic solid waste. The buckets used by 49 households, i.e. 80.33% of respondents in the Dioulabougou 1 sub-district. respectively 75.41% and 60.66% of respondents.

Cliché: *COULIBALY M, Août 2021*

Fig 8: Des seaux de conditionnement des déchets à proximité d'une cour à Dioulabougou 1

Cliché: *COULIBALY M, Août 2021*

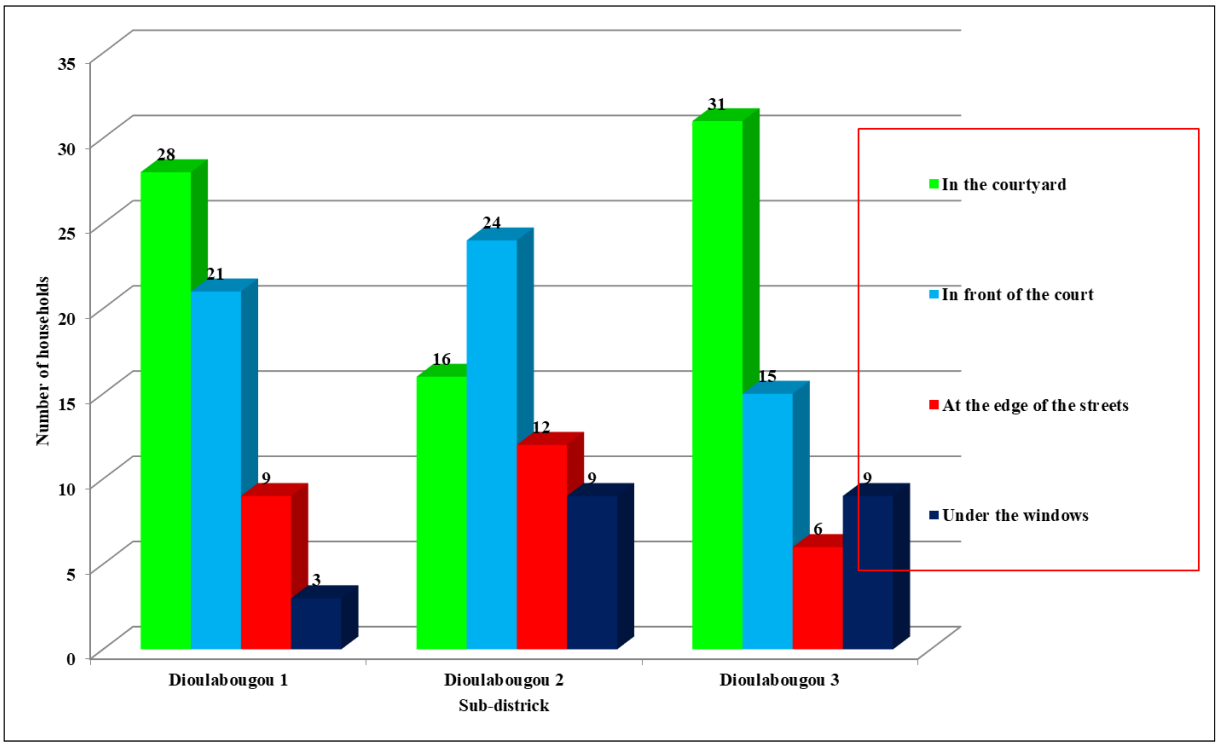
Fig 9: Un sac servant de récipient de stockage des ordures à Dioulabougou 3

Condition of household waste packaging equipment at home

In the various households surveyed, the garbage containers do not generally have closures, 156 households have unclosed garbage packaging materials, ie 85.25% of the respondents. These unclosed bins in turn become nests of flies and odors. The closed containers belonged to 27 households, which gives 14.75% of the whole.

Places for depositing garbage cans before evacuation

Receptacles containing household waste are placed in various places in the different sub-districts studied (Figure 10).



Source: *Field survey, August 2021*

Fig 10: Places for depositing garbage cans in the Dioulabougou district

There are 75 households that deposit garbage cans in the yard, which corresponds to 40.98% of respondents. Households that prefer to store garbage in front of the yard represent 32.79% of the sample. The edges of the streets and under the windows are used respectively by 14.75% and 11.48% of the whole. In the Dioulabougou 1 and Dioulabougou 3 sub-districts, households have more recourse to the courtyard for depositing garbage cans. It is the storefronts of courtyards that are used the most (39.3%) by households.

The streets, the main places for the disposal of household waste in Dioulabougou

For the disposal of household waste, households in the Dioulabougou district use various methods (Table 5).

Table 5: Methods of disposing of household waste in the Dioulabougou district

Sub-districts	Garbage disposal sites								Total	
	streets		Incineration		Private pre -collector or municipal collection		Nature			
	Clear	%	Clear	%	Clear	%	Clear	%	Clear	%
Dioulabougou 1	31	50.82	06	09.84	12	19.67	12	19.67	61	100
Dioulabougou 2	27	44.26	00	0.00	07	11.48	27	44.26	61	100
Dioulabougou 3	24	39.34	03	04.92	00	0.00	34	55.74	61	100
Total	82	44.81	09	04.92	19	10.38	73	39.89	183	100

Source: *Field survey, August 2021*

The streets (44.81%), nature (39.89%) are the main places for the disposal of household waste in the Dioulabougou district. Some households (04.92%) incinerate garbage in the open air (Fig 11). In the Dioulabougou 1 sub-district, households have more recourse to the street (50.82%) for the evacuation of household waste. Household waste is generally evacuated in the streets (44.26%) and in nature (44.26%) in the Dioulabougou 2 sub-district. Households in the Dioulabugou 3 sub-district evacuate solid household waste in nature (55.74%) (Fig 12).

Cliché: *TRAORE D, Août 2021*

Fig 11: Un point d'incinération des ordures ménagères à Dioulabougou 1

Cliché: *TRAORE D, Août 2021*

Fig 12: Un dépotoir sauvage d'ordures ménagères rendant une rue insalubre à Dioulabougou 3

Frequency of household waste disposal in Dioulabougou

Most households (69 households, or 37.70%) in the Dioulabougou district get rid of household waste once a week. Those who evacuate household waste twice a week are 51 in number, or 27.87% of respondents. Households evacuating household waste every day are 48 in number, which corresponds to 26.23% of the sample.

Household waste deposits near homes, a source of nuisance

The management of household solid waste is an acute issue in Dioulabougou. Household waste evacuated in the street and in nature creates a situation of cohabitation between populations and solid waste (Table 6).

Table 6: Distance between households and household waste dumps

Sub-districts	Distance between dwellings and OM depots						Total	
	Less than 25 meters		25 to 50 meters		50 meters and more			
	CLEAR	%	CLEAR	%	CLEAR	%	CLEAR	%
Dioulabougou 1	40	65.57	09	14.75	12	19.67	61	100
Dioulabougou 2	40	65.57	15	24.59	06	09.84	61	100
Dioulabougou 3	43	70.49	09	14.75	09	14.75	61	100
Total	123	67.22	33	18.03	27	14.75	183	100

Source: *Field survey, August 2021*

The analysis of table 6 shows that 67.22% of households surveyed live less than 25 meters from household waste (Fig 13). There are 33 households living between 25 and 50 meters from the garbage dumps, which gives 18.03% of the total. We must add the 14.75% of respondents living more than 50 meters from household waste.

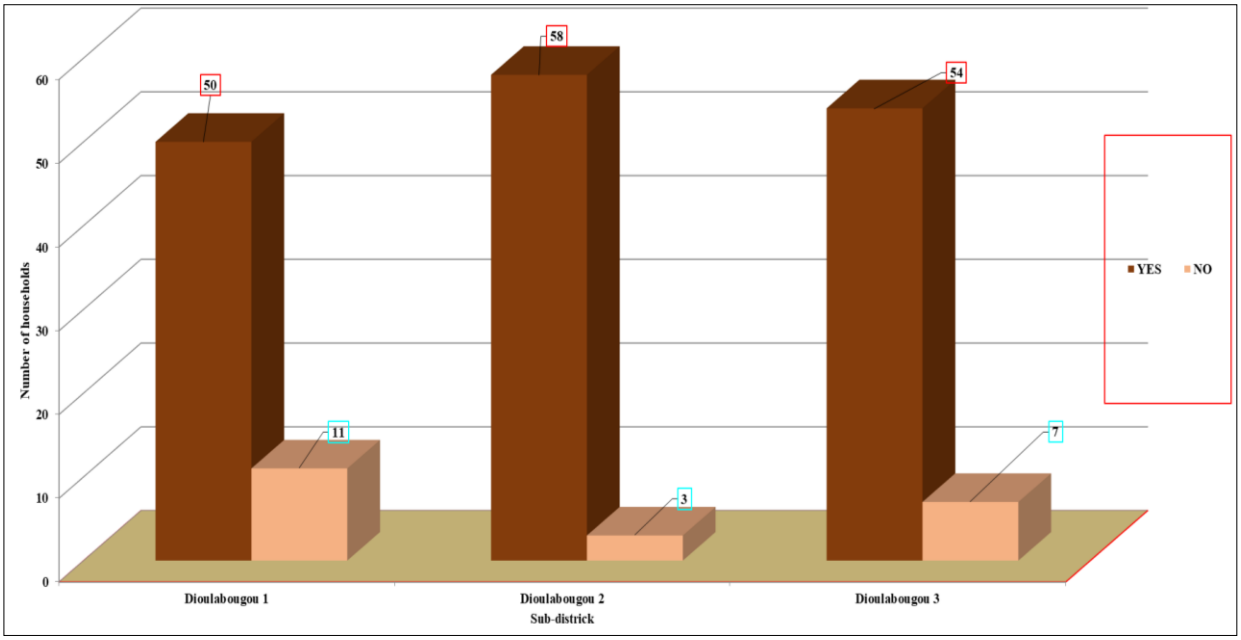
Photo: *TRAORE D, August 2021*

Fig 13: A household waste dump just next to a house in Dioulabougou 1

Proliferation of household waste, source of health nuisances in Dioulabougou

Households having recorded cases of disease in the Dioulabougou district

The proportion of households having recorded cases of disease during the three months preceding the day of the survey is highlighted in Figure 14.



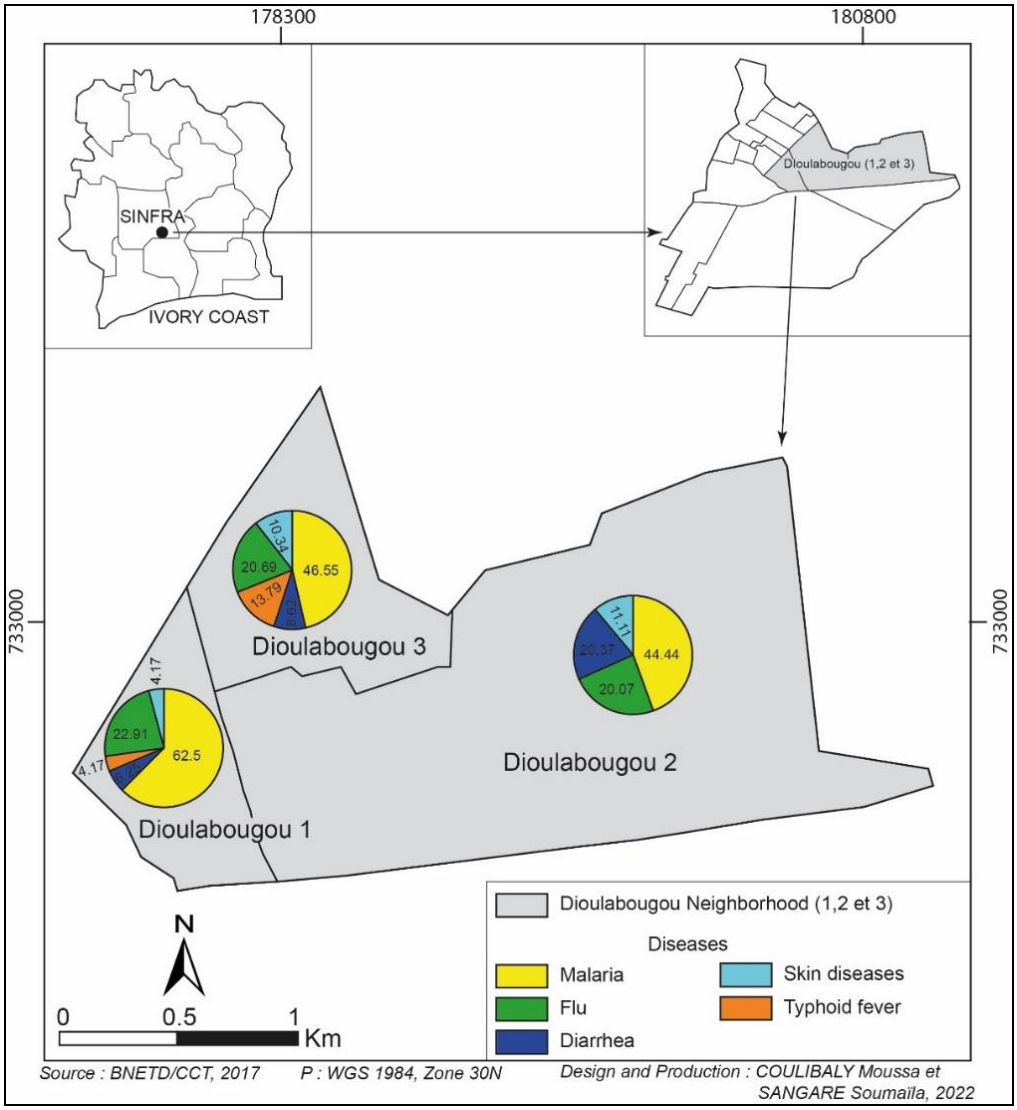
Source: *Field survey, August 2021*

Fig 14: Proportion of households having recorded cases of disease

It emerges from the analysis of figure 14 that 162 households, or 88.52% of the respondents recorded cases of disease during the three months preceding the day of the survey. Households that have not recorded cases of disease are 21 in number, which corresponds to 11.48% of the whole.

The main pathologies reported by households in the Dioulabougou district

The main pathologies reported by households are highlighted in Figure 15.



Source: *Field survey, August 2021*

Fig 15: Main pathologies reported by households in Dioulabougou

Of the 160 cases of illness declared by households, malaria represents 44% of cases (70 cases). It is followed by the flu which gives 28% of the cases of declared illnesses. Cases of diarrhea (24 cases) and dermatoses occupy significant places with shares of 15% and 11%. These same cases of illness were observed in the various consultation registers of the Sinfra health district. The evolution of the different disease cases is highlighted in Table 7.

Table 7: Evolution of disease cases in Sinfra from 2017 to 2020

Diseases	YEARS			
	2017	**2018**	**2019**	**2020**
Malaria	12715	10067	10168	6168
Diarrhea	278	293	394	171
IRA	132	270	201	103
Typhoid fever	108	104	133	133

Sinfra Health District, August 2021

The results contained in this table 6 show that the various diseases experienced a regression. The number of malaria cases increased from 12,715 cases in 2017 to 6,168 cases in 2020. As for diarrheal diseases, they have experienced an evolution from 2017 to 2019 through 2018. The number of cases has decreased from 2019 (394 cases) to 2020 (171 cases). ARI cases have remained almost constant from 2017 to 2020. This same trend is observed in the case of typhoid fever. Data collected from health facilities and households show that malaria is

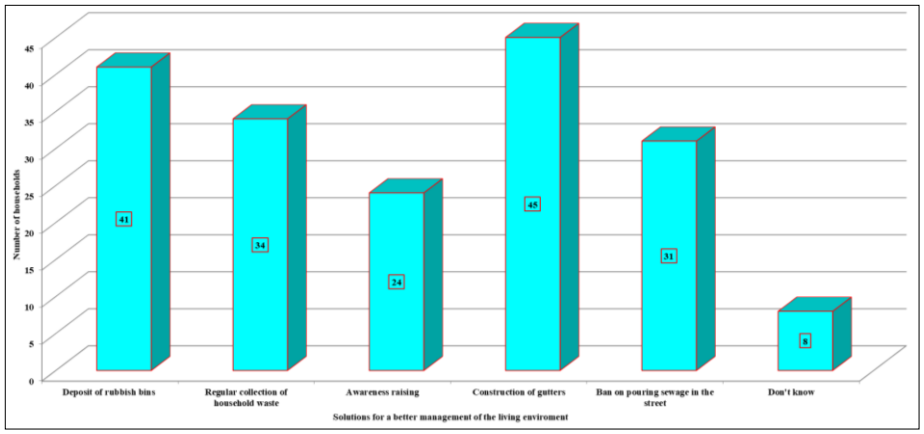
the most common pathology in the city of Vavoua. It represents the main reason for consultation recorded in health facilities from 2017 to 2020.

Populations vulnerable to declared diseases in the Dioulabougou district

Children under 5 are the most affected (61 households, or 33.33%) by diseases in the Dioulabougou district. This age group is followed by that of 5 to 15 years. Children aged 5 to 14 represent 31.69%. In the Dioulabougou 1 sub-district, children under 5 are the most affected by so-called environmental diseases. People aged 14 to 45 are the most vulnerable in the Dioulabougou 2 and Dioulabougou 3 sub-districts, it is children aged 5 to 14 who suffer most from environmental diseases.

Solutions proposed by households for good management of the living environment in the Dioulabougou district

Faced with a continuous deterioration of the living environment, households in the Dioulabougou district offer solutions (Figure 16).



Source: *Field survey, August 2021*

Fig 16: Solutions proposed by households

The analysis of Figure 7 shows that the construction of gutters (45 households, i.e. 24.60%), the deposit of garbage bins (22.40%), the irregular collection of household garbage (34 households, i.e. 18, 58%) and the ban on dumping wastewater on the tracks (31 households, or 16.94%) are the main solutions proposed by households in the Dioulabougou district.

Discussion

The Dioulabougou district in the city of Sinfra is faced with a real problem of household waste management. With regard to household waste disposal methods, the results show that 86.88% of respondents evacuate waste water from dishes and laundry in the streets. This situation is explained by the lack of collective and individual sanitation facilities. To this must be added the non-compliance with construction standards. The owners of the houses do not provide soak pits or septic tanks for the evacuation of domestic waste water. These results are similar to those obtained by I. Sy (2006, p. 237) in his study on sanitation management in Rufisque in Senegal. For him, in Gouye In Aldiana, a Rufisque district, household wastewater is discharged either into a vacant lot or into the street by 81.1% of households, while 18.9% use either the canal or a channel.

The poor evacuation of domestic wastewater characterized by the discharge of wastewater in the street promotes the cohabitation of households with the points of wastewater discharge. In the Dioulabougou district, 67.21% of the households surveyed live less than 25 meters from domestic wastewater. This behavior reflects the incivility and ignorance of the populations. This results in the exposure of householders to foul odors across the neighborhood. The same observation was made in the precarious neighborhoods of Jude, Mondon and Ayakro in Yopougnon by M. COULIBALY *et al*., (2018, p. 57) [4]. For these authors, 48.57% of respondents live less than 5 meters from waste water from showers, dishes, laundry and septic tanks.

In addition to the poor disposal of liquid household waste, households in Dioulabougou are faced with the problem of collecting household waste. This problem which is the origin of the proliferation of waste in the streets and nature. The streets (44.81%), nature (39.89%) are the main places for the disposal of household waste. This practice is justified by the absence of garbage bins but also by the fact that certain neighborhoods are not taken into account in the waste management system by the public authorities. These results are similar to those obtained by AC BOKO *et al*., (2020, p. 64). Their study showed that in the Anono Extension district in the municipality of Cocody, wild deposits constitute the most important rejection system. They represent more than half of the respondents, or 58% of households. For RJA Assako *et al*., (2010, p. 267) [2] in their study on the health risks and management of wastewater and waste in Kribi, the presence of numerous piles of garbage, abandoned collection half-barrels is a good illustration the difficulty of managing household waste in Kribi.

All these poor household waste management practices have contributed to the deterioration of the neighborhood, and expose the population to health risks.

The main diseases reported by households are malaria (44%), influenza (28%) and diarrheal diseases (18%). The high rate of malaria is due to the proliferation of wastewater discharge points throughout the district. These wastewater discharge points become places of reproduction and development of mosquitoes which are vectors of malaria. These results can be explained by the cohabitation of households with wastewater and household waste. Our results are similar to those of B. KAMBIRE *et al*., (2021, p. 86) [6]. For them, the proliferation of household waste deposits, the invasion of neighborhoods by waste water contribute enormously to the degradation of the environment and cause many health risks to the population. According to their field survey, the main environmental diseases declared by heads of households are malaria (55.3%), infections, diarrhea (9.6%) and dermatoses (7.6%).

In the event of illnesses in the Dioulabougou district, the therapeutic itinerary adopted is dominated by the pharmacy (36.61%), traditional medicine (26.78%) and health centers (24.59%). The choice of these therapeutic remedies is correlated to the standard of living of the populations. Households go directly to pharmacies to avoid the costs of consultations in health centers. Some householders turn to traditional medicine for several reasons. The affordable cost of treatments, an effective treatment for certain diseases, medicine with fewer side effects than pharmaceutical products. Contrary to our results, EH KAHONOU, (2020, p. 226) [7] shows that in the city of Agboville in Côte d'Ivoire, 93.2% of the households he surveyed go to public and private health facilities. They choose modern medicine to diagnose the ailments from which they suffer. They therefore seek the contribution of doctors or nurses in the consultation in order to identify the exact disease from which they suffer. After identifying the disease, in addition to modern care, people resort to traditional healers or traditional healers.

Conclusion

Characterized by a glaring lack of environmental management infrastructure, the Dioulabougou district in the town of Sinfra is confronted with traditional management of household waste. A management that is manifested by the use of streets as places for the disposal of household waste and domestic wastewater. A common practice that contributes to the disfigurement of the living environment of the populations and exposes the populations to nuisances and health risks. The main pathologies reported by households are malaria, influenza, diarrhoea, typhoid fever and dermatoses.

Improving the living environment and raising public awareness could also contribute to reducing environmental and health risks.

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