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Health risks and environmental impacts of domestic wastewater at Adétikopé (Togo, West Africa)

Efui Holaly Gbekley[1*], Kossi Komi[1,2], Sossawè Poli [3,4], Abla -Sika Hanou Gbekley[3,5], Pèssiezoum Adjoussi[1,2,6]
[1]Regional Center of Excellence on Sustainable Cities in Africa (CER-ViDA-Dounedon), University of Lomé, Lomé BP 1919, Togo; eg-bekley@gmail.com (E.H.G.).
[2]Research Laboratory on Spaces, Exchanges and Human Security (LaREESH), University of Lomé, Togo; kossi81@yahoo.fr (K.K.).
[3]African Institute of Biomedical, Agrifood, Societal and Environmental Sciences (IASBASE), Lomé, Togo; sosinhopoli@gmail.com (S.P.).
[4]Microbiology and Food Quality Control Laboratory (LAMICODA), University of Lomé, Togo.
[5]Biology Department, Universität Philipps Marburg, Marburg, Germany; vanakley_04@yahoo.fr (A.S.H.G.).
[6]Research Team on Geomorphology Heritage and Hydrosystems (ERHGH), University of Lomé, Togo; adjoussi@hotmail.com (P.A.).

Abstract: The demographic growth rate of the locality of Adétikopé causes a problem of management of waste water, sanitation, health and especially habitat. The densification of populations in these types of municipalities causes health problems linked to environmental degradation. The objective of this study is to identify the consequences (socio-sanitary and environmental impacts) caused by the poor management of wastewater in the peri-urban municipality of Adétikopé and to propose solutions. From August 2022 to July 2023, we undertook a socio-sanitary survey within the households of the commune using semi-structured questionnaires and interviews with health and communal officials. To this was added participant observation in the neighborhoods of the municipality. Thus, the frequencies of malaria and anemia are linked to poor management of water and household waste. Respiratory infections are due to unsanitary housing and air pollution. The populations of these generally deprived neighborhoods have little information on the relationship and the implication of the state of the environment on their health problems so that they are not very interested in the man-agement of their living environment. The recommended solutions in-clude, among other things, the use of impregnated mosquito nets and the use of hygiene and sanitary techniques.

Keywords: *Health and environmental risks; Wastewater; Autonomous sanitation system; Public health emergency diseases; Adétikopé (Togo, West Africa).*

1. Introduction

Humanity is in perpetual dynamism due to the growth of populations which transform territories [1]. Human societies, by perpetually modifying their environment, create conditions favoring the disappearance, maintenance or emergence of certain pathologies [2]. In the cities of developing countries, the effects of urbanization are more or less well controlled (spontaneous neighborhoods, degradation of housing, scarcity of services, etc.) create new health situations [3]. With this phenomenon causing high human concentrations in small spaces favoring the spread of multiple pathologies, health issues are becoming a central concern for both decision-makers and populations [2]. The Sustainable Development Goals (SDG) focused on urbanization and especially the evolution of multiple pathologies resulting from poor management of sanitation and public hygiene [2]. Today we see several pathologies linked to poor waste management in Africa south of the Sahara. These endemic diseases include malaria, dermatoses, acute respiratory infections and the diarrheal syndrome, which is very feared for children who are more

* Correspondence: egbekley@gmail.com

vulnerable to environmental pollution [2]. Since then, research work in public health and urban development has made it possible to make a link between the development of urban space and the health risks linked to sanitation [4, 5].

The approach consisted of describing the different modes of water and excreta management within populations and territories in order to identify any risks associated with this poor management. The disease therefore becomes an issue of the pathogenic system, the evolution of which depends on the health system put in place [6, 7].

Africa more particularly, that which is under-equipped, is more affected by the problems of sanitation and the effects on health. Indeed, African countries are experiencing urbanization without equal in the world and the harmful effects of this urbanization in African cities present a favorable context for analyzing the weight of sanitation on the development of diseases related to hygiene.

In the Maghreb for example, the accelerated development of Algerian cities has generated fragmentation and economic and social dysfunction resulting in the proliferation of slums [8]. Dating from the 1930s, these slums have proliferated due to the housing crisis and population growth. Cities with high potential like Skikda are not immune to this situation due to proliferation strongly linked to industrialization [8]. Generally, these shanty towns are located on peripheral and hilly areas. The materials used are mediocre, the sanitation, drinking water and electricity networks are lacking. These sites manifest themselves as places of precariousness incompatible with human development [8].

In West Africa, a study carried out in Rufisque, a city located 25 km from Dakar and populated by approximately 180,000 inhabitants for the year 2004 [2] shows that this city remains marked by high human [2] promiscuity, irregular installations, precarious housing, poor sanitation, insalubrity and the unfavorable physical environment linked to a specific urban configuration which puts waste management to the test [2]. In this city, insalubrity is the result of a long process of urbanization and development of a restrictive urban site, dotted with a very dense network of poorly maintained open-air canals from the 1960s until nowadays [2]. This situation creates a specific and dangerous epidemiological space which potentiates the pathologies linked to the lack of hygiene [2]. In this context favoring the development of pathogenic germs, fragile and vulnerable children expose themselves in a strong and permanent way to various health risks. According to Rufisque's study, the causes of deterioration in human health are to be found in the family environment and in general in the living environment. It is justified for this by the example of the role of the environment on infantile pathology. However, faced with the deterioration of the quality of the environment, the inhabitants of certain neighborhoods are getting organized by providing alternative solutions to mitigate the effects of the lack of sanitation. These realities must be taken into account: they may explain why neighborhoods with the same environmental landscapes are not found in the same epidemiological facies or the same levels of morbidity. The aim is to understand the social and cultural underpinnings of the differences in morbidity observed between areas with similar characteristics from the point of view of sanitation services.

Ultimately, diarrheal morbidity is a very illustrative example of the effects of sanitation on the development of pathologies in Rufisque. The neighborhoods observed are differently exposed to health risks, in light of the diversity of ecological conditions. The uneven distribution of diarrhea shows that health problems are individualized according to neighborhoods at the same time as these present environmental characteristics that are specific to them.

In Ivory Coast, scientific research was conducted to examine the relationship between certain household waste management practices and environmental diseases such as malaria, acute respiratory infections (ARI), and diarrhea. The results indicate that over half of household heads lack formal education (51%), and a substantial proportion of households improperly dispose of waste: 60% dump solid waste in the streets, while 48% dispose of wastewater in the same manner. The study also finds a high overall morbidity rate of 66%, with malaria being the most prevalent condition (48%), followed by ARI (28%) and diarrhea (9%). It reveals that both malaria and diarrhea are negatively correlated with educational level and positively correlated with poor waste management practices. The districts with the highest rates of illegal dumping are Derrière-Rails (43%) and Schneider (25%). These neighborhoods also show the highest prevalence of malaria, at 88% for Derrière-Rails and 82% for Schneider. The study highlights that

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when it comes to IRA, it seems to affect individuals with a university level more (77%) as well as residents of the Residential neighborhood (88%) [9].

In Cameroon, more precisely in the city of Yaoundé, the problem of wastewater sanitation, as it arises acutely, requires that appropriate solutions be taken. Statistics on the prevalence of diarrheal diseases highlight the impact of poor hygiene and sanitation, regardless of the urban fabric of the city. In Yaoundé, the prevalence of diarrheal diseases, particularly among children under five years old, is notably high at 14%. This statistic calls for immediate and appropriate interventions from relevant authorities [10]. A household survey involving 620 households in Yaoundé, complemented by an observation campaign on sanitation infrastructure, revealed several key findings regarding wastewater management. In neighborhoods with planned housing: (1) Individual Sanitation Systems: Septic tanks are the most common method, used by 30% of households, while 21% use latrines ; (2) Sewer Network: A sewer network with a treatment plant serves 46% of the households in the sample [10]. The study highlights significant dissatisfaction among households regarding these sanitation structures. For individual systems, 75% of households reported issues such as construction defects, inadequate maintenance, unpleasant odors, and cockroach infestations. For those connected to the collective sewer system, more than two-thirds of households experienced problems including insufficient wastewater treatment, system malfunctions, and complete abandonment of treatment plants. Consequently, households perceive various negative impacts due to poor wastewater management in their neighborhoods. These include pollution of natural resources (water and soil), the proliferation of water-borne disease vectors, unsanitary conditions, and the degradation of urban infrastructure such as drainage networks and roads [10].

In Togo, studies have been conducted on sanitation management in relation to environmental and health risks. The conclusions of these parcel data relate, a weakness of the system of management of waste water and excreta, present a correlation between the degree of sanitation and the health and environmental risks [11-14]. In addition to this situation, which is present in practically all urban municipalities, there are the obstacles of an educational nature [1]. These conclusions, although general in scope, point to the need to carry out specific studies for each territory subject to flagrant urbanization. The peri-urban commune of Agoè-Nyvé 6 is one of the most densely populated territories in Togo [15]. Indeed, the locality of Adétikopé has been marked by an exponential increase in its population since 2010. The significant population growth rate of Adétikopé (13% in 2017) and the various urban planning practices that are developing there are more revealing indicators than ever of urban problems in the future if urban planning is not rethought in public policies, and accompanied by a consequent investment plan. In reality, households experience difficulties in disposing of domestic wastewater. Vacant land, streets or gutters remain waste receptacles. Indeed, the treatment of domestic wastewater is very complex in this locality because there is no collective equipment for the disposal of domestic wastewater, jeopardizing the supply of drinking water [16, 17]. The health and environmental risks remain real in such circumstances, because the water table captured by most traditional wells is very close [18].

Through their actions and their strategy, several Togolese environmental actors demonstrate a clear desire to participate in the achievement of sustainable development. Nevertheless, the implementation of sustainable development comes up against various obstacles which, directly or indirectly, all refer to shortcomings of an economic nature. Admittedly, in Lomé and even in Adétikopé, various sustainable development initiatives have been undertaken by the authorities, non-governmental organizations and civil society, but these are running out of steam along the way, under the weight of the constraints that poses the vicious circle of underdevelopment. These obstacles are a serious impediment to realizing truly synergistic development. In order to contribute to a sustainable management of sanitation in the municipality of Agoè-Nyvé 6, it becomes necessary to conduct a contextualized study.

1.1. Research Questions, Objective and Approach Methodology

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The established observation forces us to question the feasibility of sustainable development in the context of a "developing" economy: What are the socio-sanitary and environmental risks resulting from this management of domestic wastewater?

The objective of this research is to identify the consequences generated (socio-sanitary and environmental impacts) by the poor management of wastewater and household waste in the peri-urban district of Adétikopé.

As a hypothesis, we formulate that the unsuitable behaviors, attitudes and practices of the populations in terms of domestic wastewater management lead to socio-sanitary and environmental impacts.

2. Materials and Methods

2.1. Study Framework

2.1.1. Geographic Study Framework

Adétikopé with its 12 peri-urban neighborhoods is the capital of commune 6 of the prefecture of Agoè-Nyvé in the autonomous district of greater Lomé, in the Maritime Region of Togo, a West African country with the code region (Africa/Middle East TO18). According to recent updates of municipal boundaries, the geographic coordinates are 6°19'23" N and 1°12'57" E in DMS (degrees, minutes, seconds) or 6.32306 and 1.21583 (in decimal degrees). The choice of Adétikopé is not accidental given the deterioration of the environment in this neighborhood which imposes negative impacts on the health situation. Added to this is the fact that Adétikopé reflects the image of a continuous peri-urban commune of the city of Lomé in the midst of an urbanization revolution. In total 4 criteria guided us : (1) the *geographical criterion* to ensure good spatial representation of the city with the presence of a maximum number of districts and urban fabrics; (2) the *socio-economic criterion* which is based on the necessary participation of beneficiaries in future projects; which assumes that the selected households have at least an average income; (3) the *urban planning criterion* characterizing the presence of a sufficient road grid, likely to constitute a support for the projected sewer networks and (4) the *technical criterion* makes it possible to focus on the main object of our study, to know the presence of household waste and irregularity in the management of liquid waste.

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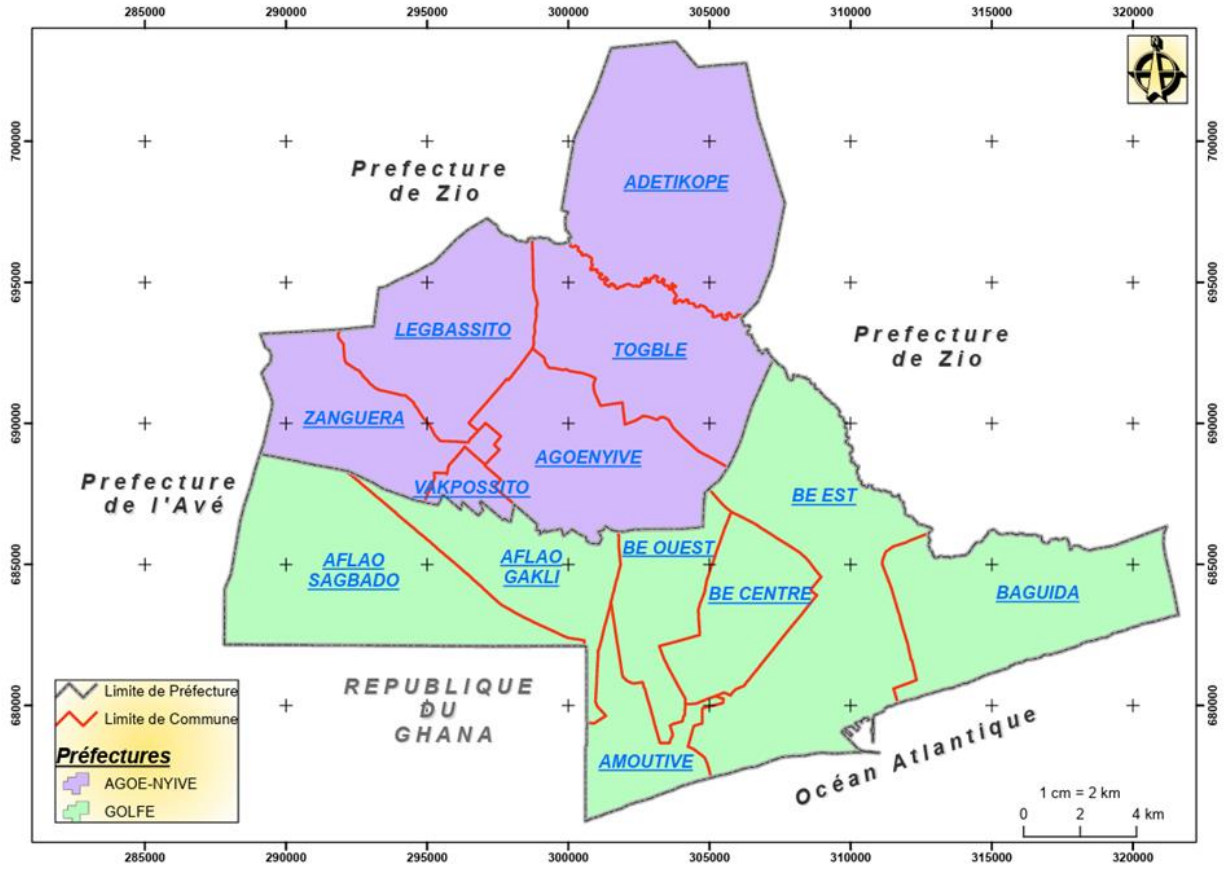

Figure 1.
Map of Togo with the geographical location of Adetikopé.
Source: Gbekley and Mouloungui Kussu).

The Figure 1 illustre the 13 communes of the autonomous district of Greater Lomé with the prefecture of the Gulf in green and the prefecture of Agoè-Nyvé in purple: the commune of Adétikopé being highlighted in the extreme north of the prefecture of Agoè-Nyvé.

2.1.2. Scientific Framework

The research project was initiated by the Regional Center of Excellence on Sustainable Cities (CERViDA-DOUNEDON). The Laboratory of Biomedical, Agrifood and Environmental Health Sciences (LaSBASE) of the University of Lomé served as the scientific framework for our study and we benefited from the advice and technical support of the "Clinique d' Expertise Educative, Sociétale , Politiques et Objectifs Développement (CEESPOD) of the African Institute of Biomedical, Agrifood, Societal and Environmental Sciences (IASBASE) for the development of our work.

2.2. Study Materials

2.2.1. Study Population

The study population is made up of the primary household managers in Adétikopé, those responsible for the health centers, the Marie and the neighborhood development committees (NDC).

2.2.2. Technical Material

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The technical material consists of data collection tools, namely the Observation Grid, the Interview Guide, the Questionnaire and the Counting sheet.

2.3. Study Methods

2.3.1. Type of Study

This was a cross-sectional and descriptive study on the knowledge, attitudes and practices of the population of the locality of Adétikopé in terms of household waste management which took place from August 2022 to August 2023, taking into account the preparatory phase, the collection and processing of data.

2.3.2. Method used for Data Collection

To carry out this work, we obtained all possible authorizations from the direction of CERViDA_DOUNEDON (University of Lomé), Adétikopé chief Canton secretary, health and municipal authorities (Adétikopé Town Hall). For data collection, we carried out our investigation with individual interviews, collective interviews and field observations. The recorded data was processed by the Epi Infos software and then illustrated by tables and figures.

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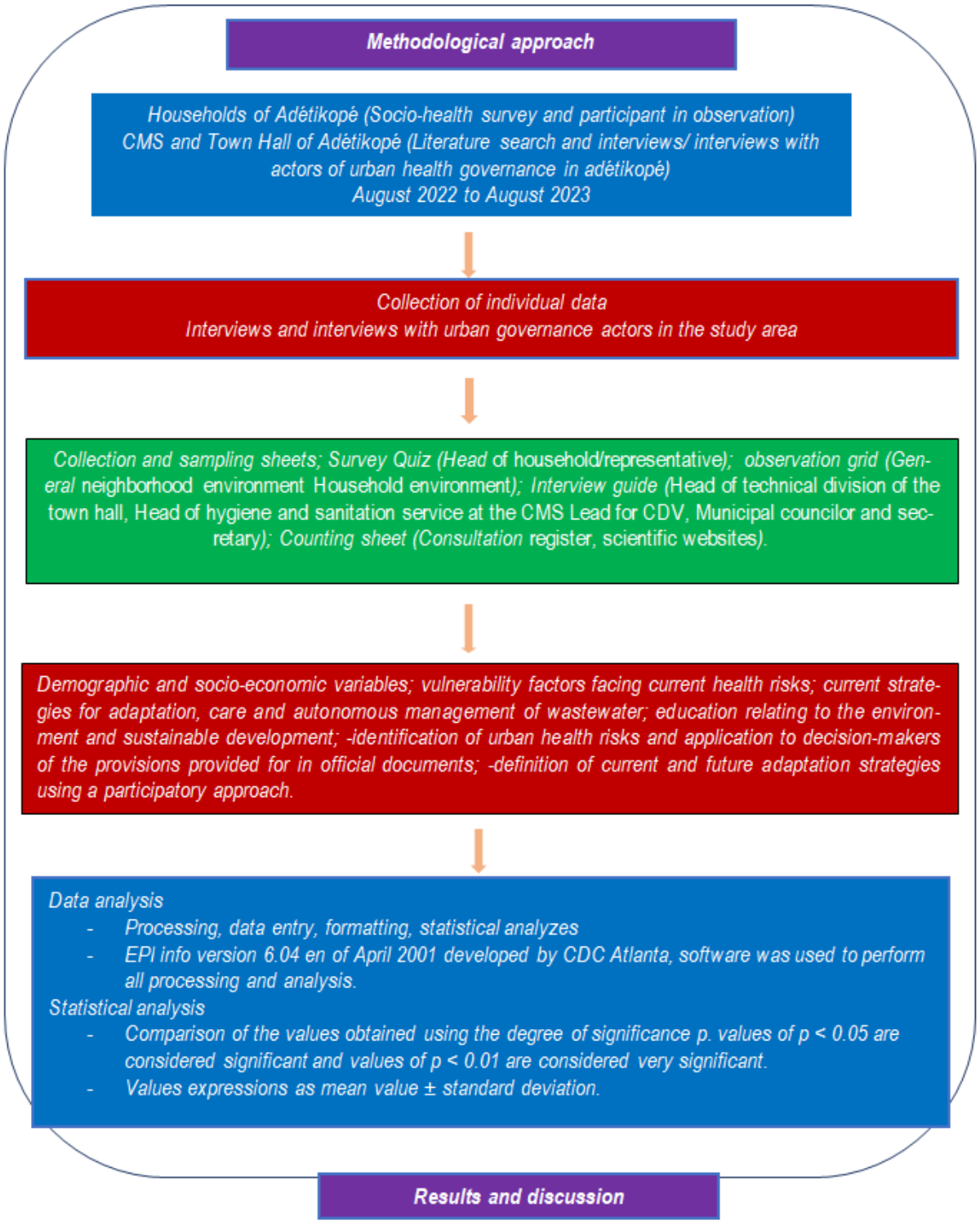

Figure 2.
Conceptual framework of the study.

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The Figure 2 here presents the general methodology of research of the work. This methodology goes from the period of the study to the analysis of the data by declining the tools and methods used

3. Results

3.1. Socio-Economic Characteristics of Households in Adétikopé Neighborhoods

Figures 3-5 shows the distribution of respondents according to neighborhood, gender, age, occupation status, religion and educational level.

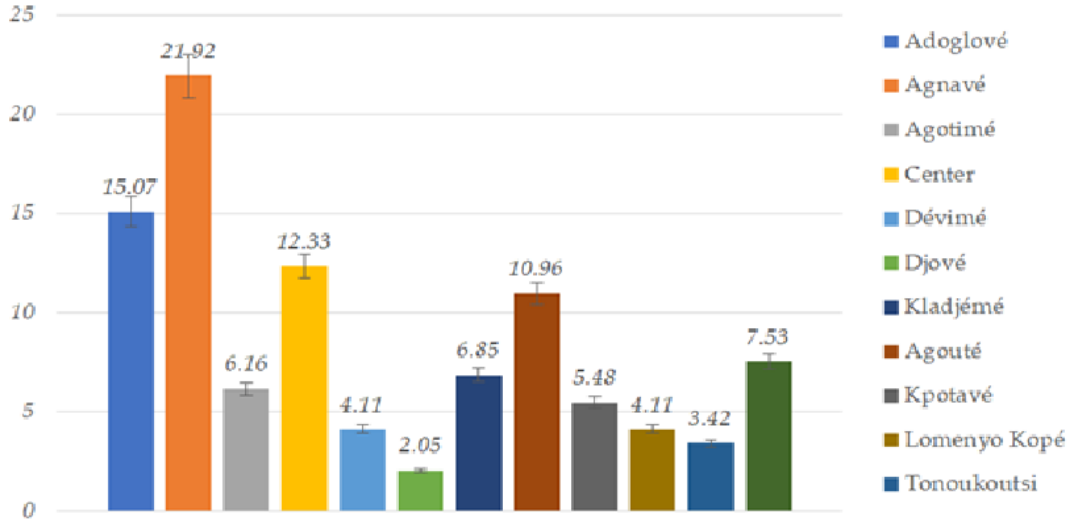

Figure 3.
Household heads surveyed in the 12 villages.

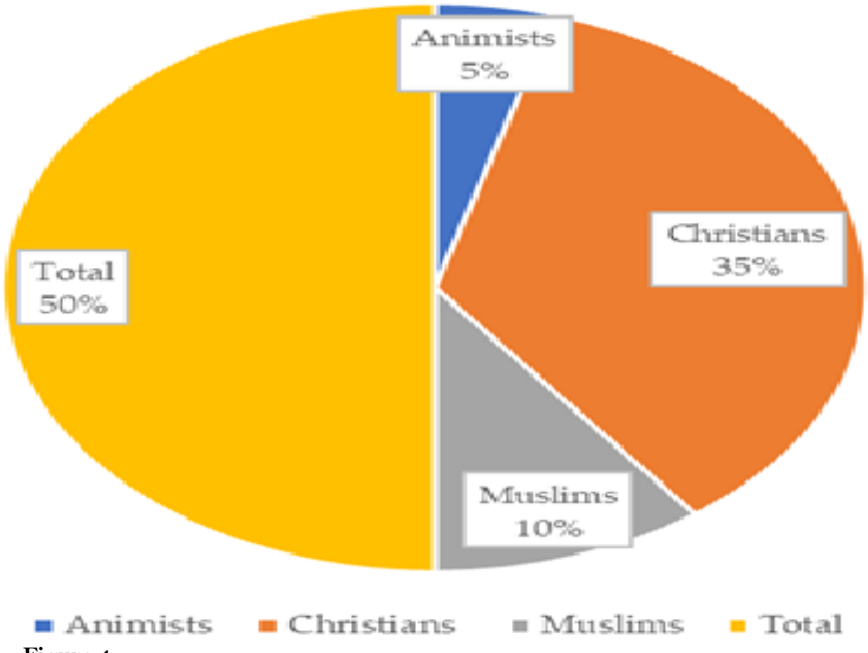

Figure 4.

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Household heads surveyed according to religions practiced.

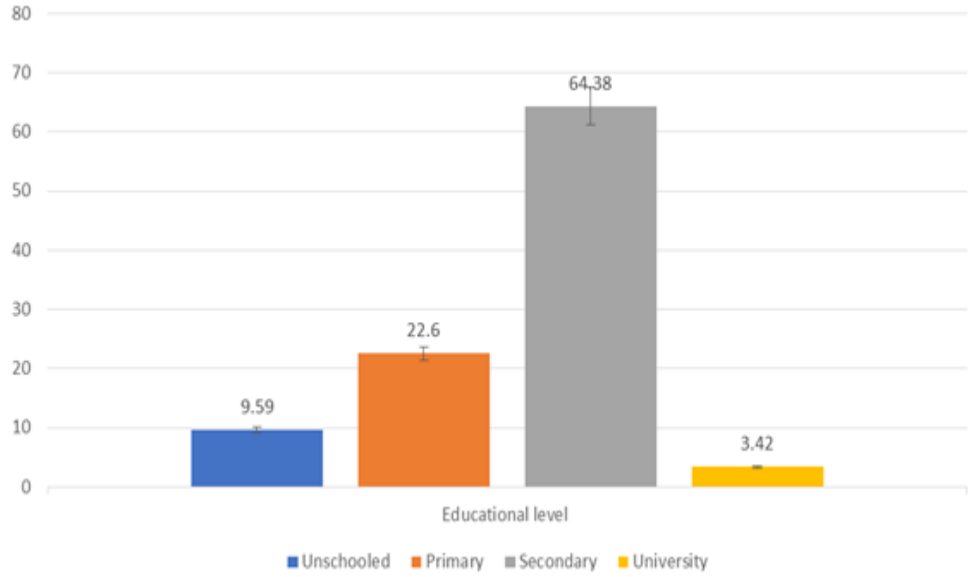

Figure 5.
Household heads surveyed according to educational levels.

Of the 100% households surveyed in the 12 villages of the peri-urban commune of Adétikopé, 27.40% are male household respondents and 72.60% are female. The ages of household respondents were divided into 6 age groups. The majority of respondents belong to the age group]30-40] with a percentage of 39.61%. The extreme brackets are poorly represented,]0-20] 0.68% and]60-70] 3.42%. A proportion of 20.55% are over 40 years old and less than or equal to 50 years old.

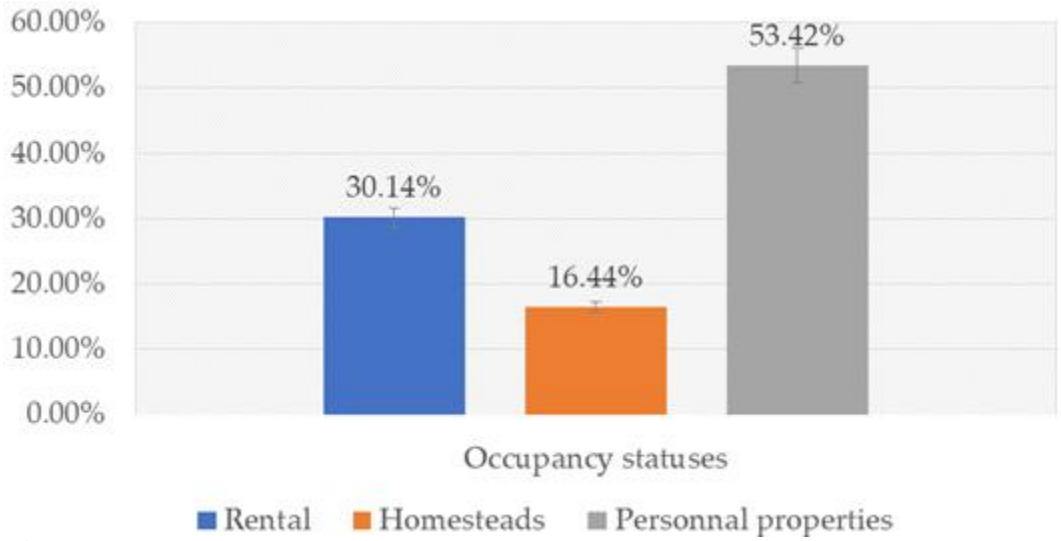

Figure 6.
Household heads surveyed according to occupation status.

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Figure 6 shows the types of occupations that we encounter in Adétikopé

Regarding the occupation status 53.42% have personal properties, 30.14% are rented and 16.44% are in family properties. The majority of respondents practice Christianity (70.55%), 8.90% are animists and 20.55% are Muslims. Concerning the level of study of the respondents, 64.38% have secondary level, 22.60% have done primary education, 3.42% have university level and 9.59% are uneducated.

3.2. Description of the Built and Inhabited Environment

Adétikopé is bounded to the north and west by the canton of Davié, to the south by the great Zio valley, to the east by the canton of Dalavé and to the southeast by Djagblé; and more precisely between 6°23'-6°35'N and 1°10'-1°37'E. The Habitat is built without any urban plan and the lack of sewage pipe systems makes sewage management quite a pain.

The spatial organization of housing highlights two collective forms of land use, namely, individual plots or individual housing units occupied by a single house (64% of the sample) and collective plots made up of several households (36% of the sample). In terms of concession, we distinguish rentals made up of several households (30.14%), family properties (16.44%) and personal properties mostly occupied by a single household (53.42%). The tenants with more than 60% of the sample are the majority in the dwellings of Adétikopé Centre. In the other neighborhoods of the 11 villages of Adétikopé, there are as many tenants and owners.

"Owner households" or "family households" represent 40% of our sample with, however, reversed rates in the previous districts. The responsibility of head of household falls in 80% of cases to the male gender against 20% held by women. Each head of household is responsible for 6 people on average.

The study area reveals three distinct types of housing, as detailed in Table 4: (1) Modern Housing (19.06% of the sample): This category includes housing equipped with most basic health and education infrastructure ; (2) Mixed Housing (60.39%): These plots are accessible via well-maintained roads and are served by urban technical networks such as electricity, communication, and drinking water, with coverage rates ranging from 30% to 80%. Basic urban services like education and health are available but not guaranteed; (3) Traditional Housing (20.55%): This type is characterized by plots with poor access (badly maintained roads) and limited or absent water and electricity networks, as well as basic urban services.

The built environment in the study area is quite diverse and can be classified into three main categories based on the level of standing, as shown in Table 4: (1) High Standing (7.48%): These houses are constructed with permanent materials such as brick, tiles, and plastered plywood ceilings. They feature a high level of finish and include amenities like gardens, fences, water, electricity, and telephone services. This type of standing is typically found in modern housing ; (2) Average Standing (71.97%): These houses have a lower level of finish compared to high-standing houses and are usually found in mixed or modern housing areas. They may show signs of improvement or change over time ; (3) Low Standing (20.55%): These houses are built with unplastered mud bricks or temporary materials like planks or cob. They generally have a lower level of finish and are characteristic of traditional housing.

Two forms of occupation of the plot coexist in the different neighborhoods studied: (1) "Tenants" with nearly 60% of the sample, particularly in the dwellings of "Adétikopé centre". There are as many tenants as owners in the other districts; (2) "Owner households" or "family" represent 40% of our sample, with however reversed rates in the previous neighborhoods.

This research intended to characterize the urban space of Adétikopé from a health perspective by defining sub-spaces at risk according to the levels of sanitation of the districts does indeed present, as illustrated in Figure 4 and 5, the open channels open which are the receptacles of rainwater but also of solid and liquid waste including faeces, constitute play areas for children and places of activity for adults.

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Figure 7.
Wastewater on the road to Adétikopé-Centre Town Hall (Photo Terrain, CEESPOD, December 2022).

This Figure 7 shows the presence of wastewater on the main road leading to the town hall of Adétikopé, almost preventing passage.

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Figure 8.
Wastewater on the road to Adétikopé Town Hall (Photo Terrain, CEESPOD, December 2022).

The Figure 8 show the presence of wastewater on the main road leading to the town hall of Adétikopé, almost preventing passage.

3.3. Employment Status of Household Heads and Household Income

Out of the sample as a whole, 76.1% of household heads have a "main or permanent" activity, of which 10.3% have a "secondary or temporary" activity (Figure 9).

The public sector is the largest employer of workers (with 63% of workers), compared to 37% for the private sector. The socio-professional categories are "senior executives" (12% of working people), "executives and similar" (34.2%), "middle executives/supervisors" (16%) and the other categories (with 1. 3% of cases). The spouse carries out an economic activity in 60% of the households in the sample. Working children still living in the family home are present in 16% of the households studied.

Table 1. Activity situation of heads of households.

Indicators	Terms	Workforce	%	P. values
Occupancy statuses	Rental	1584	30.14%	< 0.05
	Homesteads	864	16.44%	< 0.05
	Personal properties	2808	53.42%	**< 0.05**
	Total	5256	100%	-

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Types of habitats	Modern habitats	1002	19.06%	< 0.05
	Mixed habitats	3174	60.39%	-
	Traditional housing	1080	20.55%	< 0.05
	Total	5256	100.00%	
Standing of habitats	High standing	393	7.48%	< 0.05
	Average standing	3783	71.97%	< 0.05
	Low standing	1080	20.55%	-
	Total	5256	100.00%	-
Income / Monthly salary in CFA	[0-50000]	2160	41.10%	-
	[50000-100000]	951	18.09%	< 0.05
	[100000-300000]	1212	23.06%	< 0.05
	[300001-500000]	258	4.91%	< 0.05
	[500001-700000]	108	2.05%	<0.001
	[700001-900000]	270	5.14%	< 0.05
	[900001-1100000]	189	3.60%	< 0.05
	[1100001-1300000]	27	0.51%	<0.001
	[1300001-1500000]	27	0.51%	<0.001
	[1500001-1700000]	0	0.00%	<0.001
	[1700001-1900000]	0	0.00%	<0.001
	[1900001-2100000]	0	0.00%	<0.001
	[2100001-2300000]	0	0.00%	<0.001
	[2300001-2500000]	54	1.03%	<0.001
	Total	5256	100.00%	-

Table 1 presents the indicators of occupational activities of heads of households within the community surveyed. The CFA which is defined as the African financial community is the currency used in the West African monetary union in West Africa.

In Adétikopé, the majority of households earn less than 50,000 CFA francs per month.

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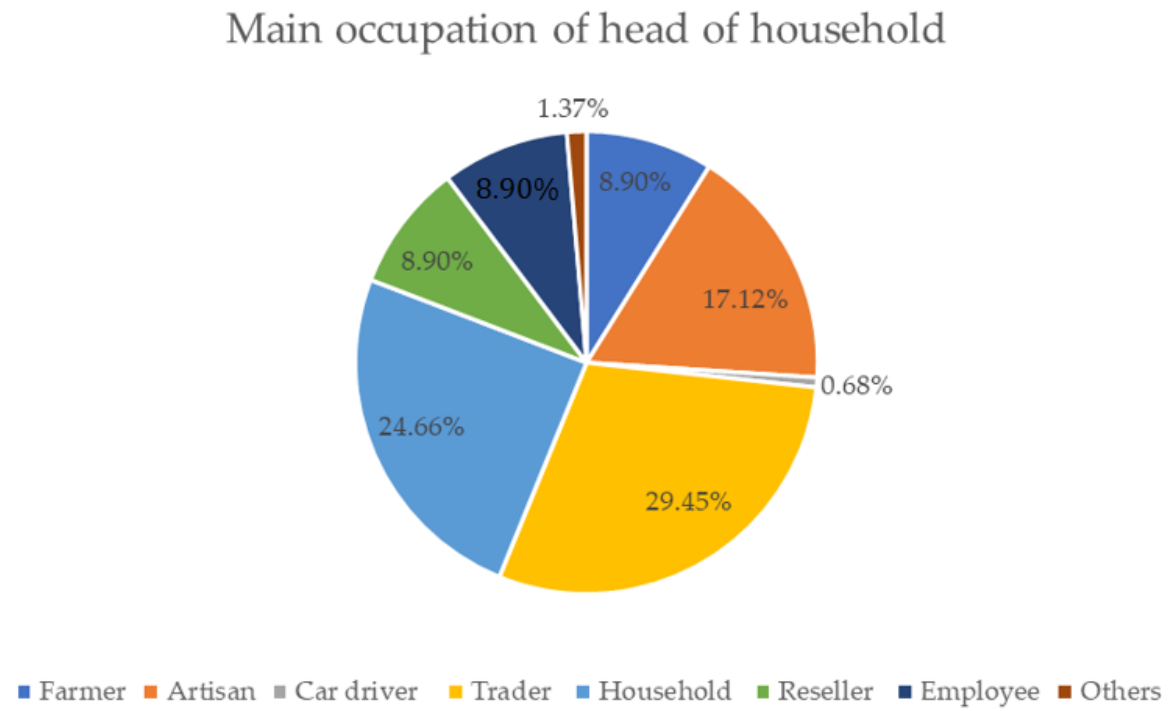

Figure 9.
Socio-demographic characteristics of the population.

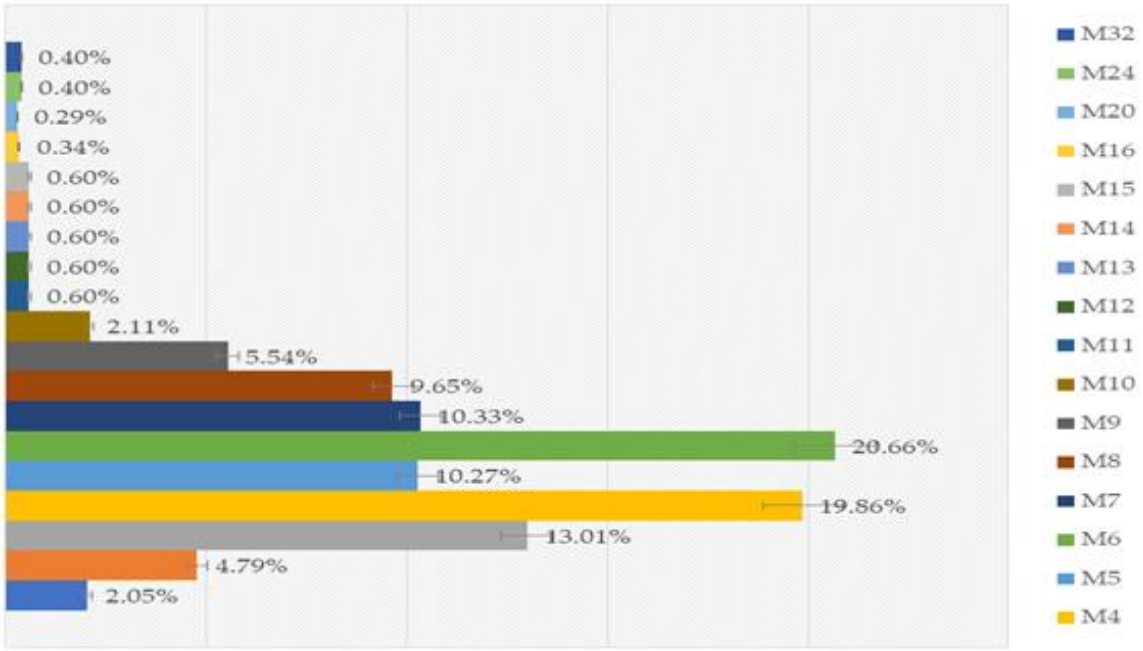

Figure 10.
Average household size fashion.

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Figure 10 presents the socio-demographic characteristics of the surveyed population according to household groupings.

The majority of respondents were traders in a proportion of 29.45%. Housewives and artisans represent respectively 24.66% and 17.12% of respondents. Farmers, employees, resellers each represent a proportion of 8.90%. Taxi-motorcycle drivers/drivers represent 0.68% and the others 1.37%. The average household size is 5.6 ± 3.2 (≈ 6) people and the maximum number of people per household is 32.

3.4. Sanitation within Households

3.4.1. Depth of Borehole Water and Well Water and the Distance from AE Sources to Sanitary Works

Regarding the depth of borehole water and well water, 37.15% of well water has a depth of 10 m, 41.75% a depth of 15 m and 21.09% a depth of 20 m. Regarding the distance between wells and sanitary structures, 48.96% are less than 5 m away, 26.04% are between 10 and 15 m, 19.36% are between 15 and 20 m, and only 65% are located more than 20 m away. Mr. 32.72% of boreholes have a depth of more than 20 m, 27.57% of boreholes have a depth of between 15 and 20 m, 25.71% have a depth of 5 m and 13.99% of boreholes have a depth of between 10 and 15 m. As for the distance from water sources to sanitary facilities, 41.90% have a distance between 15 and 20 m, 24.01% a distance located more than 10 and 15 m, 15.09% more than 20 m and 19.01% are located less than 5 m.

Table 2.
Depth of borehole water and well water and the distance from AE sources to sanitary works.

Terms	Terms	Workforce	%	P.values
Depth of well water/at ground surface	Less than 10 m	428	37.15%	< 0.05
	Less than 15 m	481	41.75%	-
	Less than 20 m	243	21.09%	< 0.05
	Total	1152	100.00%	-
Well-pit distance	Located less than 5 m	564	48.96%	-
	Located between 10-15 m	300	26.04%	< 0.05
	Located between 15-20 m	223	19.36%	< 0.05
	Located more than 20 m away	65	5.64%	< 0.05
	Total	1152	100.00%	-
Drilling depth	Located less than 5 m	1009	25.71%	< 0.05
	Located between 10-15 m	549	13.99%	< 0.05
	Located between 15-20 m	1082	27.57%	< 0.05
	Located more than 20 m	1284	32.72%	-
	Total	3924	100.00%	-
Borehole-pit distance	Located less than 5 m	746	19.01%	< 0.05
	Located more than 10-15 m	942	24.01%	< 0.05
	Located within 15-20 m	1644	41.90%	-
	Located more than 20 m	592	15.09%	< 0.05
	Total	3924	100.00%	-

Table 2 presents data on borehole water depth and distances between sanitation facilities and drinking water sources.

3.4.2. Distances Traveled to Access Water

The distances traveled to access water are summarized in Table 7.

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About 31.45% of households travel between 31 and 60 m to access water, 27.70% have to travel a distance between 61 and 100 m, 17.96% have to travel between 6 and 30 m before accessing water. have access to water, 11.34% travel a distance between 101 and 500 m, 10.31% a distance between 0 and 5 m, 1.03% a distance between 501 and 1000 m and only 0, 21% cover more than 1000 m before having access to water.

Table 3.
Distances traveled to access water.

Terms	Indicators	N	(%)	P. values
Distances traveled to access water (Both within and outside the household)	0-5 meters	542	10.31%	< 0.05
	6-30 meters	944	17.96%	< 0.05
	31-60 meters	1653	31.45%	-
	61-100 meters	1456	27.70%	< 0.05
	101-500 meters	596	11.34%	< 0.05
	501-1000 meters	54	1.03%	< 0.05
	>1000 meters	11	0.21%	<0.001
	Total	5256	100.00%	-

The Table 3 presents the distances traveled by the household and neighbor to access water.

3.5. Individual Wastewater and Excreta Sanitation Works in Adétikopé

According to the survey data, the public road is the most favored place by respondents for discharging cooking and laundry water. In fact, of the 5,256 respondents, 78.77% discharge cooking and laundry water onto public roads, while 12.33% and 8.90% discharge laundry water into unbuilt plots and house yards, respectively. Kitchen wastewater is discharged by 13.70%, 6.16%, and 1.37% of respondents into unbuilt plots, courtyards, and cesspools, respectively. Septic tanks and unbuilt plots are the places most used by households for discharging or draining wastewater. Indeed, 58.22% discharge this wastewater into septic tanks and 32.19% into unbuilt plots. Of the 5,256 respondents, 85.62% have a latrine, while 14.38% do not. The majority of respondents (54.40%) have traditional pits, 30.47% have VIP latrines (Ventilated Improved Pit), and 15.13% have manual flush latrines. Among the respondents with latrines, 93.60% have them in good condition, 4% have them in acceptable condition, and 2.40% have them in poor condition. According to the survey data, 68% maintain their toilets or latrines twice a month, 31.20% do so once a week, and 0.80% do so once a month. Regarding the frequency of latrine emptying, 2.40% empty their latrine pits every three years, 3.20% every two years, 66.40% have never done it, and 26.40% are unaware of the frequency. The majority of respondents (80.14%) believe that the pits of their latrines are never emptied or do not know if the pits are emptied; 5.48% of respondents said that the pits are emptied by truck. The final treatment of the emptied waste is unknown to 99.20% of respondents. The places of defecation for respondents without latrines vary: 14.28% defecate with neighbors, 66.67% in nature, and 19.05% in public latrines. Households with children dispose of their stools in various places: 85.62% dispose of children's stools in nature, and 14.38% dispose of them in a WC. Floods occur in the concession of 12.33% of respondents and in the neighborhood of 11.64% of respondents. A proportion of 87.67% said they did not experience any flooding in their concession, and 88.36% said there is no flooding in their neighborhood. A proportion of 67.12% of respondents claim to know the place of dumping of the trucks and the future of the emptied waste, while 32.88% have no idea about the place of dumping or the future of the emptied waste.

3.5.1. Latrines

Most latrines are structures, two-thirds of which are 10 to 20 years old. They do not have a quality sanitation system and are made, in more than 70% of cases, by unqualified well diggers and jobbers,

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against 22% built by masons. Thus, the majority of latrines are poorly built and the construction costs are relatively low: on average 70,000 FCFA with a cost range varying from 10,000 to 450,000 FCFA, depending on the degree of completion of the works. Half of the latrines have been emptied only once and a quarter have been emptied at least 3 times since their construction, this against payment of a sum of 35,000 to 75,000 FCFA/emptying. The places where fecal sludge is deposited are the surrounding bush and the marshy areas located on the outskirts of the peri-urban commune of Agoè-Nyvé 6. More than 4/5ths of households with latrines are not satisfied with the functioning of these structures. due to the constant presence of flies, mosquitoes, cockroaches and mice, the release of foul odours, construction defects and insufficient maintenance. To solve these problems, nearly 3/4 of the households considered want to build "modern" structures (improved latrines of the Ventilated type Improved Pit latrines - VIP, septic tanks and sewer system) and use deodorants.

3.5.2. Septic Tanks

The septic tanks, about 22% of which are less than 10 years old, were 88% made by unskilled labor at an average cost of 400,000 FCFA, varying from 140,000 to 1 million FCFA. Draining, using specialized trucks, was carried out in only 35% of the structures identified against payment of approximately 52,000 FCFA/drainage. The fecal sludge deposit sites are the same as before. Nearly three-fifths of septic tank owners are not satisfied with the performance and operation of their facilities due to malfunctioning of internal sanitary equipment (62%), maintenance faults (14%), construction faults (10% of cases) and the presence of cockroaches and odors in 8% of septic tanks. The recommended solutions range from the rehabilitation or reconstruction of new septic tanks (60%) to the restarting of municipal hygiene services (8%) via sewer networks with treatment plants.

3.6. Perceptions and Knowledge of Households on the Harmful Effects of Poor Management of Household Waste and Wastewater on Health and the Environment

Wastewater is considered by households surveyed as a source of environmental and health problems.

3.6.1. Conditions Caused by the Poor Management of Wastewater and Household Waste

Poor wastewater management has an impact on the health of populations because it is the basis of many public health emergency diseases.

Table 4.
Causes of the most frequent diseases.

Indicators	Terms	Workforce	%	P. values
Causes of the most common diseases	Bad condition of sumps	75	1.43%	< 0.05
	Traditional dry pit	373	7.10%	< 0.05
	Open defecation	89	1.69%	< 0.05
	Stagnant Wastewater	3579	68.09%	-
	Pollution of wild dumps	919	17.48%	< 0.05
	Poor maintenance of sanitary facilities	221	4.20%	< 0.05
	Total	5256	100.00%	

Stagnant sewage is the cause of 68.09% of disease cases. Pollution from wild dumps represents 17.48% of the causes of disease, traditional dry pits 7.10%, poor maintenance of sanitary facilities represents 4.20%. Open defecation and the poor condition of cesspools are respectively the basis of 1.69% and 1.43% of cases of illnesses caused by poor management of sewage and household waste. The diseases caused by this mismanagement are summarized in Table 5. Malaria, anemia and metabolic diseases are

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the most frequent diseases with 31.39%, 23.40% and 13.41% respectively. Insect stings and bites from reptiles, scorpions, bees are the least common with 1.26%.

Table 5.
Most frequent consultation conditions in households.

Indicators	Terms	Workforce	Percentage %	%
	Malaria	1650	31.39%	-
Main illnesses reported by households	Digestive parasites	467	8.89%	< 0.05
	Diarrheal diseases	200	3.81%	< 0.05
	Food poisoning (Poisoning)	205	3.90%	< 0.05
	Food poisoning (Intoxination)	87	1.66%	< 0.05
	Insect stings, reptile bites scorpion's bees	66	1.26%	< 0.001
	Dermatoses	351	6.68%	< 0.05
	Anemia	1230	23.40%	0.16
	Metabolic diseases	705	13.41%	< 0.05
	Respiratory diseases	295	5.61%	< 0.05
	Total	5256	100.00%	-

3.6.2. Frequencies and Types of Illnesses According to the Level of Education of Households

The level of studies is an important element in the management of wastewater. Thus, the frequency and types of diseases according to the level of education of the households are summarized in Table 5. Apart from malaria, which is more frequent in households with the primary level, all the other diseases are more frequent in households not schooled. Dermatosis, digestive parasitosis and food poisoning are the most common with 65.53%, 64.45% and 64.39% respectively.

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Table 6.
Frequency and types of diseases according to level of household education.

Indicators	Malaria	Digestive parasites	Diarrheal diseases/ Typhoid fever	Food poisoning	Food poisoning	Insect bites, reptile bites scorpions bees	dermatoses	Anemia	Metabolic diseases	Respiratory diseases	Respiratory diseases
No schooling	11.39%	64.45%	60.00%	64.39%	58.62%	59.70%	65.53%	50.24%	23.69%	129	43.73%
Primary	64.42%	22.70%	23.00%	22.44%	22.99%	19.40%	23.08%	30.65%	23.40%	57	19.32%
Secondary	22.61%	9.42%	13.50%	9.76%	14.94%	14.93%	6.84%	15.61%	49.65%	91	30.85%
University	1.58%	3.43%	3.50%	3.41%	3.45%	5.97%	4.56%	3.50%	3.26%	18	6.10%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	295	100.00%

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Table 6 presents the indicators of the different diseases contracted by the surveyed households following poor environmental health management and according to the levels of education.

3.6.3. Environmental Issues

Based on the opinions of the populations, it can be estimated that the environmental problems, caused by heavily loaded wastewater, are of concern in the study area since they are cited by households who perceive them in terms of: (1) Presence of macro-waste cited by 23.52%, (2) Air pollution seen by 23.21% of the sample, (3) Bad odors cited by 25.13%, (4) The presence of wild dumps cited by 19.43% of households, (5) Flood seen by 3.42%, (6) Insalubrity cited by 3.33% of households, (7) Stagnation of wastewater by 1.96%.

3.6.4. Health Issues

Health problems due to the non-treatment of wastewater and its stagnation in drains and open spaces are reported by households surveyed in terms of: (1) Proliferation of disease-carrying insects perceived by 40%. Insects are responsible for several nuisances. Mosquitoes are the most cited in particular in 85.92% of households. Flies are cited in 11.86% of cases while cockroaches and ants are respectively cited in 1.52% and 0.80% of households; (2) Proliferation of diseases seen by 31.81%; (3) Frequent injuries reported by 15.01%; (4) Breathing problems cited by 10.22%; (5) Proliferation of reptiles seen by 2.93% of households. Scorpions, centipedes, the Lezard / Gêko / cinque group, and snakes are mentioned respectively in 42.12%, 40.81%, 12.44% and 4.62% as responsible for nuisances.

3.6.5. Issues Affecting Urban Technical Networks

The problems suffered by urban technical networks, due to poorly drained wastewater, are mentioned by 92% of the households interviewed in terms of clogging of the gutters (30% of households giving access to the gutters being concerned), obstruction of the drainage systems rainwater drainage (52% of households), broken pipes and wastewater rising on the road (17% of households in the sample). The consequences shared by all are the degradation of the environment and the health of populations.

Table 7. Household knowledge of the harmful effects of poor management of household waste and wastewater on health and the environment.

Indicators	Terms	Workforce	(%)	P.values
Environmental pollution	Presence of macro-waste	1236	23.52%	-
	Air pollution	1220	23.21%	< 0.05
	Flood	180	3.42%	< 0.05
	Presence of wild dumps	1021	19.43%	< 0.05
	Wastewater stagnation	103	1.96%	< 0.05
	Insalubrities	175	3.33%	< 0.05
	Bad smells	1321	25.13%	< 0.05
	Total	5256	**100.00 %**	-
Health impacts	Proliferation of disease-carrying insects	2104	40.03%	-
	Frequent injuries	789	15.01%	< 0.05
	Disease proliferation	1672	31.81%	< 0.05
	Reptile proliferation	154	2.93%	< 0.05
	breathing problems	537	10.22%	< 0.05
	Total	5256	100.00%	-
Order of insect nuisance	Mosquito	4516	85.92%	-
	Fly	618	11.76%	< 0.05
	Cockroach	80	1.52%	< 0.05

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	Ants	42	0.80%	< 0.001
	Total	5256	100.00%	-
Reptile nuisance order	Scorpios	2214	42.12%	-
	Centipede	2145	40.81%	0.64
	Lizard / Gêko / cinque group	654	12.44%	< 0.05
	Snakes	243	4.62%	< 0.05
	Total	5256	100.00%	-

3.6.6. Solutions Recommended for Participatory Management of Wastewater Treatment in the Structured Neighborhoods of Adétikopé

The problem of wastewater treatment, as it arises acutely in the locality of Adétikopé, requires that appropriate solutions be taken. The consequences on the environment are noticeable. The impact of wastewater on health is also perceptible. The opinions of households, through the survey conducted in structured neighborhoods, are signals of this. Health officials believe the risks are significant, even if the prevalences of diseases are relatively different. In general, the prevalence of malaria and anemia in the locality of Adétikopé, is significant (31.39% and 23.40%) (P<0.05) and challenges the competent actors for solutions of emergency and adapted. These solutions exist, are numerous and the households interviewed during the study are aware of them. All these forms of contribution can, according to the households, be improved if they are better informed about the costs of the works and the recommended management method.

3.6.7. Awareness and Information on Hygiene and Health Risks Due to Wastewater

Information, training, and awareness programs on waterborne diseases and environmental preservation are available to households and young schoolchildren through the media (recognized by 35% of households) and schools (21% of households). However, these households consider the programs "insufficient" and believe that it is necessary to refocus the content and adjust the television time slots to reach a larger audience. Additionally, the topics covered are viewed as "less adapted to the socio-cultural contexts of the city" and use a more specialized level of language. These themes include food and body hygiene, the healthiness of the living environment, human health, the causes of waterborne diseases, the means of prevention and control, and the quality of water and environmental degradation.

3.6.8. Means of Control and Prevention

The households interviewed are aware of the magnitude of the consequences on the environment, health and living conditions of the inhabitants, due to the poor management of the sanitation sector and the non-treatment of wastewater. The technical solutions they recommend range from the use of impregnated mosquito nets cited by 61.91% of households to the use of hygiene and sanitary techniques such as the construction of improved VIP-type latrines, septic tanks and a treatment cited by 38.09%. For the latter, natural wastewater treatment plants represent an appropriate alternative to wastewater treatment in the locality of Adétikopé. As regards the prevention of the most frequent diseases, 46.65% recommended the use of mosquito nets, 11.55% wanted subscription to pre-collection structures, 10.82% proposed the construction of cesspools to Wastewater. The development of household surroundings, the development of dumps, the destruction of illegal dumps and the maintenance of toilets were proposed in respectively 9.82%, 8.68%, 7.67% and 4.83% of the cases by households. In addition to these recommended solutions, information, training and awareness programs for households and young schoolchildren are needed in terms of hygiene and health risks due to the poor management of wastewater and domestic waste, the preservation of environment through the media and schools. The involvement of households in the implementation processes of living environment sanitation projects is important.

Table 8.

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Means of fighting and preventing the diseases caused by the poor management of wastewater and household waste.

Indicators	Terms	Workforce	Percentage (%)	P values
Means of struggle	Mosquito net uses	3254	61.91%	-
	Use of hygiene and sanitation techniques	2002	38.09%	< 0.05
	Total	5256	100.00%	-
Means of prevention	Use of mosquito nets	2452	46.65%	**< 0.05**
	Development of dumps	456	8.68%	< 0.05
	Subscriptions to pre-collection structures	607	11.55%	< 0.05
	Destruction of wild dumps	403	7.67%	< 0.05
	Development of household surroundings	516	9.82%	< 0.05
	Construction of sumps for waste water	568	10.81%	< 0.05
	Sanitary maintenance	254	4.83%	< 0.05
	Total	5256	100.00%	-

Table 8 presents the means of combating and preventing diseases caused by poor management of wastewater and household waste in Adétikopé.

4. Discussion

4.1. Socio-Economic Characteristics of Households in Adétikopé Neighborhoods

This study was conducted in the peri-urban commune of Adétikopé in the Autonomous District of Greater Lomé. Greater Lomé includes 13 municipalities grouped into two prefectures: The prefecture of the Gulf includes 7 municipalities and that of Agoè-Nyvé, 6 municipalities including that of Adétikopé. The Autonomous District of Greater Lomé is a special territorial entity with legal personality and financial autonomy. It is the local authority representing the city of Lomé as a whole [19, 20]. Lomé is a cosmopolitan capital where many languages and dialects are spoken. However, there is a vernacular language, Mina/Ewe (about 60% of the population). There is also a diversity of ethnic groups and populations [21]. With a large youthful population, Grand-Lomé faces many social problems including youth employment, urban management and the environment, resulting in serious housing problems and basic socio-collective infrastructure [22].

The sociodemographic characteristics presented during the survey reflect the characteristics of the territory of Greater Lomé and the Autonomous District of Greater Lomé. The disparity between the conditions of women and those of men in Togo concerns all socio-economic sectors. We note the imbalance in the economic power penalizing women, female employment remains low to the extent that it only concerns 7% of active women who are employed or have already worked. The unemployment rate for women stands at 6.5% and that of underemployment at 22.8% [23]. As for young people, the unemployment rate fell slightly between 2006 (9%) and 2011 (8.1%) while the level of underemployment remains high (20.5% in 2011). The incidence of poverty among women increased by 1.2 points, from 56.2% in 2006 to 57.4% in 2015, while that of men fell by 8.4 points, from 62 .9% to 54.5%. In addition, the incidence of poverty is lower in the category of households headed by men (54.6%) than in those headed by women (57.5%) (Poverty profile in Togo, National Institute of Statistics and Economic and Demographic Studies, 2016). Togolese women mainly work in the agricultural sector (51.1% in 2012), in commerce (24.2%) and, to a lesser extent, in public administration. According to the public administration workforce analysis report (2017), the body of civil servants is made up of 19.3% women compared to 80.7% men. carry out most of the tasks related to the pumping, transport, storage and use of water, as well as the maintenance of water points Women and young girls devote themselves essentially to all social and

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family functions related to water (domestic consumption, subsistence agriculture, sanitation and hygiene, education of children, family health, domestic tasks), functions that require daily use of water [24].

4.2. Description of the Built and Inhabited Environment

Adétikopé is bounded to the north and west by the canton of Davié, to the south by the great Zio valley , to the east by the canton of Dalavé and to the southeast by Djagblé; and more precisely between 6°23'-6°35'N and 1°10'-1°37'E [18]. Considered as a new urban center, Adétikopé is distinguished by the dynamism of a residential area and the attractiveness of an industrial facility. Located north of Lomé, this new urban center has undergone a spectacular spatial transformation and a dazzling administrative promotion, making it a municipality integrated into the metropolis of Lomé [18]. Remained for a long time a hamlet of the canton of Davié, Adétikopé experienced an unprecedented administrative promotion. First in 2013, it was erected as the capital of the canton of the same name. By this new statute, this locality becomes the chief town of the canton of the prefecture of Zio . A year later, Adétikopé is classified among the peripheral semi-urban centers of Lomé [25] and consequently benefits from the achievements of the emergency project for the rehabilitation of infrastructures and electrical services financed by the World Bank and the Global Environment Fund at around $55 million. As part of the creation of Communes to operationalize the decentralization process, Adétikopé was erected in 2017, as a Commune (officially called Agoè-Nyivé 6), attached to the prefecture of Agoè-Nyivé. This measure then makes Adétikopé a Commune in 2017 of the District of Lomé in the process of being created. In less than a decade, Adétikopé then went from a hamlet in the prefecture of Zio to a Commune in the prefecture of Agoè-Nyivé, and consequently became an urban center of the agglomeration of Lomé. This administrative promotion reinforces the attractive power of Adétikopé, without however removing it from the dependence of Lomé, in full metropolization [18]. The types of housing encountered in Adétikopé resemble those found in many cities undergoing urbanization in Africa south of the Sahara and in other developing countries. They are characterized in their economic structures, the spatial organization and the social fabric which is the immediate consequence of the unplanned and irrational urbanization of its formerly agricultural lands, today built territories.

A previous study in Togo shows that the outskirts of the city of Lomé are undergoing significant changes in their economic structure, spatial organization, and social fabric [26]. This transformation is part of a broader trend of strong demographic growth that began in the second half of the 20th century, marked by a rapid increase in the number of populated localities and the demographic growth of these localities [26] . Nearly 15 new localities appear each year in this small region, and the number of localities with more than 1,000 inhabitants increased from 80 to 168 between 1970 and 2010. The large population volume and rapid growth are essential aspects of development. This densification of settlement is both a cause and a consequence of the intense competition for land observed on the outskirts of Lomé [26]. According to the study, land acquisitions in these peripheral areas are primarily intended for urbanization (66%). Consequently, the rapid reduction in agricultural land poses a major challenge for peri-urban agriculture. Each year, a significant proportion of agricultural land is converted into buildings: 26% in the outskirts close to the city of Lomé and 7% in the more distant outskirts, especially beyond 25 km. The vast majority of buyers (93%) live in nearby urban centers, and many of these city dwellers are government executives (24%) [26].

A study conducted in Cameroon on wastewater treatment and the socio-sanitary and environmental risks in planned housing areas of Yaoundé identified three types of housing throughout the area studied: (1) "Modern" housing, comprising 78% of the sample, is equipped with essential urban technical networks and basic urban health and education services; (2) "Mixed" housing, comprising 16% of the sample, is characterized by plots accessible by a well-maintained road and served by urban technical networks at rates varying from 30% to 80%. The presence of other basic urban services (education and health) is optional; (3) "Traditional" housing, comprising less than 7% of the sample, is characterized by plots that

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are difficult to access (roads in poor condition) and the remoteness or absence of water and electricity networks as well as basic urban services [10].

In Yaoundé in the study area, the level of standing of the built environment is quite diversified in the study area and marked by four large complexes classified according to decreasing level of standing: (1) "very high standing" houses constructed of so-called permanent materials (blocks/bricks, tiling, sheet metal/tile, plywood/plastered ceiling, garden, fence, water, electricity and telephone). This type of standing is generally characteristic of modern habitats; (2) "high standard" houses, identical to the previous ones but with a lesser degree of finish. This type of standing is also characteristic of modern habitats; (3) "average standing" houses with lower levels of finish are characteristic of mixed or modern housing, if possible, changes over time are taken into account; (4) "low standing" houses built of unplastered concrete blocks/earth bricks or temporary materials (planks, cob more or less plastered).

4.3. Employment Status of Household Heads and Household Income

In Adétikopé, less than 5% of households surveyed earn more (900,000-2,500,000 CFAF) than 95% of households (0-900,000 CFAF). This situation would be identical in many African countries.

In Cameroon, according to Wéthé , in order of importance of permanent incomes in Yaoundé, we can have, according to the type of urban fabric, the following classification: (1) the households interviewed in modern residential areas have an average income relatively higher: 308,000 CFAF /month/household; (2) households in modest settlements have an average monthly income of about 233,200 CFAF /month/household; (3) the neighborhoods of communal housing estates come in third position with an average monthly permanent income of 220,500 CFA francs/month

4.4. Sanitation at Household Level

From the study in Adétikopé, it appears that households have sources of drinking water (TDE, wells and boreholes) accessible at reasonable distances for the majority (>75%). Most people have individual waste water and excreta disposal systems within the concessions for the most part (>64%).

This situation resembles that described in other studies such as the one conducted in Côte d'Ivoire on the health risks associated with household waste on the population of Anyama (Abidjan-Côte d'Ivoire) [9]. The main places of sewage disposal in Anyama are the streets, the gutters, the ravines and the backyards of dwellings. In fact, 48% of households declare that they discharge wastewater in the aforementioned places, compared to 37% and 16% who evacuate wastewater into septic tanks and the yard respectively [9, 27]. According to the same study, Koné presents in its results that the majority of the population reaching 65% in certain districts, of the respective households evacuating their waste water in the street. The septic tank is used by 80% of households [9].

4.5. Perception of Households in Structured Neighborhoods on Issues Related to Wastewater

Wastewater is considered by more than 63% of households surveyed as a source of environmental, health and degradation of urban heritage problems. These illnesses are likely to lead to disability, significant expense and even death.

4.5.1. Issues Focused on Environmental Problems

Concerning environmental problems, research work and previous and recent studies confirm the perception of the households surveyed [10, 27, 28]. From these studies, it appears that the impact of wastewater (and solid waste), domestic and industrial, is perceptible on the quality of water in rivers. These waters have a level of pollution higher than the guidelines of the World Health Organization (WHO): suspended solids (145 and 1900 mg/l), phosphorus (from 0.3 to 33mg/l), ammoniacal nitrogen (1.2 to 60 mg/l), nitrates (0.7 and 9 mg/l), iron (1.85 to 5.5 mg/l), dissolved oxygen (1.1 and 5mg/l), BOD5 (from 8 to 300mg/l), faecal coliforms and streptococci (from 10^3 to 10^7 Colony Format Unity /100ml) [28]. The same results note the presence of heavy metals: cadmium (5 to 21 µg/l), lead (14 to

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250 µg/l), zinc (28 to 300 µg/l) and copper from 16 to 1200 µg/l at the outlets wastewater from certain industries.

A more recent study in Cameroon shows, based on the opinions of the populations, that the environmental problems caused by heavily loaded wastewater are of concern in the study area and that they are cited by 75% of households who perceive them as term of: (1) pollution and degradation of the quality of water resources cited by 78% of households resulting in the disappearance of aquatic species (fish); (2) soil contamination mentioned by 63% of households resulting in the deterioration of soil quality, soil erosion and gullying; (3) deterioration of the living environment, destruction of urban heritage, unsightliness, insalubrity and inconvenience to neighbors mentioned by 40% of households surveyed; (4) risks of disease and other illnesses, the slowdown in socio-economic activities and the increased risk of accidents are recognized by 30.1% of the households surveyed; (5) air pollution with the release of foul odors, seen by 25% of the sample [10].

This situation is further aggravated in Cameroon by agricultural practices with the use of chemical fertilizers and pesticides in the marshy lowlands of the city. Added to these factors is the filling of lowlands for residential purposes due to the insufficient supply of serviced plots, the proliferation of informal socio-economic activities, etc. The consequences, already visible, are among others, the eutrophication and the filling of water bodies, the impoverishment, even the disappearance of the aquatic fauna and flora thus calling into question the ecological value of these environments, the and various nuisances (including mainly odors and mosquitoes) [10].

4.5.2. Issues Focused on Health Problems

The poor management of waste in Adétikopé leads to most households, illnesses for the populations with in record malaria and anemia. This situation is a problem of public health interest if we know the economic burden of the management of these two conditions. Adétikopé lives the same consequences of a lack of waste water and excreta management as all the cities of Togo and Africa.

Assessing the prevalence of environmental diseases in the population, 66% of people surveyed in Côte d'Ivoire in 2019 during research reported having contracted malaria, diarrhea, acute respiratory infection (ARI) at least once.) or other diseases. Among them, 73% had malaria against 43% for ARI and 13% for diarrhea. Among the other diseases, the most recurrent are abdominal pain, anemia, dermatosis, bloated bellies, chronic diseases such as arterial hypertension, sinusitis, rheumatism, ulcers and epilepsy. These diseases have a prevalence rate of 39% [9].

Moreover, it appears that whatever the disease, the rate is higher for women compared to that of men [9]. This rate exceeds 50% regardless of the age group. For example, the minimum prevalence rate of malaria for women is 50%, while it is 39% for men [9]. ARI has a minimum prevalence rate of 59% among women, while for men it is 33%. The under-five age group also has the highest rates compared to other age groups. Malaria has a morbidity rate of 40%, 19%, 8%, 5% for the respective age groups of less than five years, 5 to 14 years, 15 to 50 years and over 50 years. Concerning the ARI, the proportion of morbidities rises to 24%, 6% and 2% respectively for people under five years old, from 5 to 14 years old and over 15 years old. Diarrhea, on the other hand, has a morbidity rate of 6% for children under 5, 1% for people aged 5 to 50 and 0% for people over 50 [9].

A study conducted in Rufisque, Senegal, on the management of urban space and the morbidity of sanitation-related pathologies concluded that diarrheal morbidity is a very illustrative example of the effects of sanitation on the development of pathologies [2]. According to the same study, health risks are functions of the diversity of ecological conditions of households and territories at the same time as these present environmental characteristics that are specific to them [2]. Indeed, the variability of diarrheal pathology is explained by the unequal distribution of risk factors, especially those relating to the sanitation of the domestic and peri-domestic space, as well as the weak foundation of hygienic behavior [2].

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In terms of health consequences, a study in Cameroon details that health problems due to the non-treatment of wastewater and its stagnation in drains and open spaces are reported by 56% of the households questioned in terms of: (1) proliferation of breeding grounds for disease vectors (mosquitoes, flies, cockroaches and rodents) as well as foul odors (cited by 60% of households in the area); (2) presence, in wastewater, of pathogenic germs and microbes, perceived by 30% of households as factors causing illness among local residents; (3) contamination of water, soil and food with health risks: 67% of these households fear amoebic dysentery, typhoid and diarrhea while 17% mention malaria caused by mosquitoes (female Anopheles type). According to the results of this study in the opinion of these households, these diseases are likely to lead to disabilities, significant expenses and even death. Cross-referencing the previous data with illnesses that occurred in households during the last three months preceding the survey shows that the latter are mostly of water origin and can be summarized as: (1) malaria which affects average 35% of households in the study area; (2) diarrhea and dysentery suffered by 11% of the households in the sample; (3) typhoid which affects nearly 10% of the households studied; in addition to these illnesses, the study reveals cough in 17% of households in the sample.

The study in Cameroon did not identify a group particularly vulnerable to these diseases in the households surveyed. The proportion of people affected by these conditions is 12% in children under 4 years old, 18% in young people under 15 years old and finally 20% in adults. Moreover, the link between these diseases and the defects of wastewater treatment is not clearly defined at the end of this study. However, there is a link between the diseases perceived by households and those actually declared at the level of the city's health centers. Indeed, an analysis of data from the epidemiology and endemo-epidemics service of the Ministry of Health (Community Health Department) shows that the risks of waterborne diseases are high throughout the city, without distinction of urban fabric, particularly in the households bordering watercourses and areas of wastewater stagnation. From these data it appears that these diseases are the cause of nearly 15% of ailments in households in the city of Yaoundé. Children under the age of 5 are the most affected and represent 30% of the cases declared in all the hospitals of the city. This situation evolved in sawtooth between 1996 and 2002: 21,000 in 1996 (with 15 deaths recorded), 11,025 cases in 1999 (with 20 deaths), 19,000 cases in 2000 (including 10 deaths), 13,000 cases in 2001 (including 31 deaths) and finally 19,500 cases of diarrhea in 2002 (including 15 deaths) [10].

4.5.3. Issues Focused on Problems Affecting Urban Technical Networks

Although this study does not focus on collective systems, the populations of Adétikopé and other large African cities such as Yaoundé share the same realities in terms of the consequences mentioned by the households in the sample, which are among others: (1) the destruction of urban infrastructure, the reduction in the lifespan of urban networks, particularly roads that have become impassable and slow down economic activities. In Cameroon, the study on collective systems reveals that the problems suffered by urban technical networks, due to poorly drained wastewater, are mentioned by 52% of households interviewed in terms of sewer blockage (50% of households connected), obstruction of rainwater drainage systems (23% of households), breakage of pipes and wastewater rising on the road (7% of households in the sample) [9, 10]. However, as in our study, the same consequence is mentioned by 70% of the households in the sample who also think that rehabilitation expenditure is significant; (2) the pollution of the urban environment generates insalubrity, nauseating odours, unsightly and inconveniences for 24% of the sample [10].

4.6. Therapeutic Itinerary and Health Care Costs

4.6.1. Therapeutic Itinerary in the Population

In Adétikopé, less than 50% of the population systematically seek treatment spontaneously. Residents equate their state of health with fatigue and feel that they do not need local health services. If for some, the evidence of an emerging disease is real because of poor management of the immediate environment, they resort to self-medication and street drugs.

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In Côte d'Ivoire, 96% of individuals who fell ill during the survey period sought immediate treatment. Four (4)% of sick individuals did not seek care for various reasons: lack of resources, low severity of the disease or recent onset of the condition. In addition, for treatment, households most often resort to public health centers (52%), then to self-medication (34%) and private healthcare facilities (15%) [9].

4.6.2. Population Health Care Cost

The majority of households affected by diseases of environmental origin spend an average of 20,150 CFA francs per month with an average income of less than 50,000 CFA francs per month.

Koné- Bodou reveals that health care costs reported by households have an average of 16,035 F CFA over the study period. The average daily consumption expenditure is 2,861 F CFA, which amounts to 42,915 F CFA over this same period. Thus, the cost of health care is more than one-third of consumer spending. Furthermore, we note that private health structures are the structures where care is higher for households (22,508.33 F CFA). They are immediately followed by public health structures where health costs in terms of average daily consumption expenditure are just as high (2,146.25 F CFA) [9].

4.7. Raising Awareness and Information on Hygiene and Health Risks Due to Wastewater

The households interviewed are aware of the scale of the consequences on the environment, health and the living environment of city dwellers, due to the poor management of the sanitation sector and the non-treatment of wastewater. The technical solutions that they advocate range from "modern" stand-alone structures such as improved VIP-type latrines, septic tanks to wastewater treatment plants. These proposals are to be considered because they testify to the awareness of the real stakes of sanitation by the populations and the way of sustainable management of waste water and excreta [29]. Good sanitation management would benefit community health and sustainable health [10]. Similar proposals have been made in studies in Burkina [30] Côte d'Ivoire [9] and Senegal [2].

As an example, in Cameroon, treatment plants by natural means represent an alternative adapted to the treatment of wastewater in the neighborhoods with structured housing in Yaoundé, dispersed in the urban perimeter. These systems are indeed flexible and inexpensive in their design, implementation and management [10]. However, as recommended by the methodology of the Hierarchical Mosaic of Artificial Ecosystems (HMAE), the choice of the "best station" requires knowledge of the socio-cultural, economic, technical, urban planning and environmental parameters of the context in which it will be installed [10].

The participation of households, the main beneficiaries, is a necessity. The study revealed their real willingness to join and to contribute financially, materially, in manpower and in advisory support to the implementation of new, more efficient systems, provided they are convinced of their effectiveness. The capitalization of endogenous human, material and financial resources is therefore possible in the neighborhoods studied, provided that: (1) information, training and household awareness campaigns on hygiene and health risks due to water worn out; one could benefit from channels such as television, radio, schools and high schools; (2) the involvement of households in the entire process of implementing sanitation projects in the living environment; (3) taking into account their opinions on the form of organization of the management of the systems envisaged in the neighborhoods in order to ensure the efficiency and sustainability of the sanitation systems [10].

4.8. Information and Training of Households on Appropriate Sanitation Techniques

Information, training and awareness programs for households and young schoolchildren on waterborne diseases and environmental preservation exist through the media (recognized by 35% of households) and schools (21% of households). The choice of individual wastewater treatment systems (septic tanks and latrines) is motivated on the one hand, "by their management autonomy (case of households already connected to the sewer network with treatment plant)" and on the other hand, "by their relatively low production and operating cost as well as the better settling of solid matter". The

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unfavorable position taken for the individual systems lies in "their unsuitability for structured neighborhoods with small plots, the diffuse pollution of the aquatic environment, the requirement for regular and costly emptying, the limits of yields and the low purification capacities.

The desire of the populations of Adétikopé for the appropriation of collective systems (coming mainly from households with individual structures) is argued by "their adaptation to structured neighborhoods, the presence of marshy lowlands that can serve as sites for the establishment of stations and outlet for treated effluents. The stations are also safer, more reliable and more efficient for the living environment and the environment if the operating equipment and the related human resources are adapted. They do not require regular emptying at the expense of the household. In addition, their design meets scientific rules for certain households. They offer very good settling and participate effectively in the depollution of chemical and organic elements. They carry less risk of disease and contamination of the natural environment. Modern and efficient systems, wastewater treatment plants ensure the hygiene and aesthetics of the living environment because they completely treat wastewater before it is discharged into nature".

The survey in Cameroon reveals that less than 18% of households are informed of the existence of sanitation systems other than those they use: sewer networks coupled with treatment plants or with underground spreading, septic tanks and VIP latrines. However, more than 80% of these households have no idea about the performance of these new systems [10]. It should be noted that the collective systems and particularly on the activated sludge treatment plants have shown their limits for decades in Yaoundé: "the regular breakdowns and the abandonment of the stations built by the SIC, the lack of mastery of this technique by the operators" [10]. According to these households, considering such systems amounts "to running the risk of seeing the sites become uncontrolled dumping grounds for untreated wastewater and household waste or shelters for disease vectors in the absence of control and maintenance. of the system ". In addition, "the maintenance of such installations is costly" [10].

4.9. Recommended Solutions for Participatory Management of Wastewater Treatment in the Structured Neighborhoods of Adétikopé

The study in Adétikopé was able to show the interest of more than 90% of households in seeking new techniques for managing wastewater and excreta to improve the level of sanitation in the town. While hoping for better results, the actors point to the difficulty of the public authorities in the capitalization of endogenous human, material and financial resources, which resources are important for the good margin of management and whose insufficiency tests the patience and the desire populations of Adétikopé.

In the other studies, the desire for improvement is always of great interest. In Cameroon, the malfunctions observed and the inconvenience caused by untreated wastewater on the environment, health and urban heritage are such that 75% of the households questioned are of the opinion to acquire new evacuation and treatment systems. wastewater if it is proven that these are more efficient. Four forms of contribution are recommended by these households with the aim of improving wastewater treatment in their respective neighborhoods: (1) financial contribution, considered by 60% of the sample, at an average rate of about 3,000 fCFA per month and per household; (2) the contribution in the form of labor recommended by 22% of the sample who agree to devote an average of 3 days of work per week to the construction of new waste water disposal and treatment systems; (3) the contribution in the form of equipment (wheelbarrows, shovels, etc.) and construction materials (cement, steel, concrete blocks, sand and gravel) is envisaged by 11% of the sample; (4) the other types of contributions relate to technical support and advice during the studies, monitoring of implementation, participation in information campaigns, animation and household awareness and training of jobbers.

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5. Conclusion

The objective of this research is to identify the consequences generated (socio-sanitary and environmental impacts) by the poor management of wastewater and household waste in the peri-urban district of Adétikopé.

In Adétikopé, capital, our scientific research has made it possible to describe the socio-economic and health situation of households in the Agoè-Nyvé 6 commune of the autonomous district of greater Lomé in the face of an environment marked by insalubrity. The results lead to the conclusion that the insalubrity linked to the insufficiency in the management of waste water and excreta is quite accentuated in this commune and affects the health of households, especially those whose heads do not have a level of health. education. Thus, acting on environmental variables could improve the health of populations. This sanitation of the physical environment of the populations must take into account, among other things, the wastewater and excreta management circuit, the epidemiological surveillance of diseases of public health significance (Malaria, Infections, Anemia, Diarrhea, etc.). Our adopted methodology allowed us to collect most of the data to verify our hypothesis: The inappropriate behaviors, attitudes and practices of populations in terms of domestic wastewater management lead to socio-health and environmental impacts.

For sustainable management of sanitation in Adétikopé, it will be necessary to focus on education relating to eco-citizenship and the environment which will make it possible to reinforce upstream the level of education which is closely linked to the choice of living environment by the household and make the latter aware of the rules of hygiene for the well-being of all. The essential provisions for the adoption of inclusive policies that take into account the proposals of the populations would be one of the best options to achieve innovative and sustainable results as advocated by the Eco-Health approaches. In Adétikopé, an important industrial and economic center, managers had to act quickly to find suitable solutions for the current and future urban situation. This intervention must affect several aspects such as the renovation of the common center (Adétikopé Centre), the treatment of outdoor spaces in peripheral districts, the application of town planning regulations, the creation of harmony in the urban fabric, the fight against "popularization" of the town and the dilapidated state of the built environment in order to make Adétikopé a sustainable city capable of fulfilling its current role and ensuring a better life for future generations.

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The Ethical Committee of the [CERViDA-Dounedon/ University of Lomé], Togo has granted approval for this study on June 2022 (Ref. No. Autorisation N° 45/AT/D/CERViDA-UL/2022).

Authors' Contributions:
Conceptualization, GBEH; Methodology, GBEH, K K , PA ; Software, GBEH ; Validation, PA ; Formal analysis, GBEH, SP, GASH ; Survey, GBEH, YSM, AN ; Resources, AN, TT, SDK ; Data curation, GBEH, GASH . ; Writing—original draft, GBEH ; Writing—editing and editing, GBEH, PA ; Visualization, KZH , YA ; Oversight, PA, SDK . All authors have read and accepted the published version of the manuscript.

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