ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

Sanitation Practices in the Precarious Neighborhoods of the City of Douala: Case of the Makepe Missoke Precarious Neighborhood

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Publication Date: 2025/07/12

Abstract: The issue of sanitation remains a topical issue in every society, particularly in cities. Sanitation practices are increasingly poor in Cameroon's major cities. It is in this context that our article on: "Sanitation practices in the precarious neighborhoods of the city of Douala: The case of the Makepe Missoke precarious neighborhood". Wastewater, household waste and excreta sanitation facilities are still poor in urban African environments and particularly in urban Cameroon, resulting in environmental contamination (air, soil, resources, etc.). These unhealthy sanitation practices are poorly controlled and generate numerous water-related and unsanitary diseases. It is in light of this observation that we focused our problem on sanitation in the Makepe Missoke precarious neighborhood.

The objective is to take stock of sanitation practices and their effects on the environment and population health. We certainly relied on documents to approach this study. But the bulk of the work was done in the field, where direct observation, household surveys, health surveys, etc. were used to complete the research.

It emerges from all our field investigations that the sanitation of wastewater, excreta and household waste is still precarious. 93.76% of the households surveyed evacuate excreta via latrines (latrines on stilts, barrel latrines, latrines with a lost bottom, etc.) most of which are basic. 6.24% of households use septic tanks. The precariousness of latrines is due to certain socio-economic factors such as the low financial means of the populations, the overcrowding of houses, etc. The situation is even more deplorable in the lowlands where barrel latrines predominate, discharging their contents directly into watercourses and gutters. Wastewater is dumped on the ground, in rivers, etc. Household waste is dumped in unauthorized places (guts, rivers, etc.).

Water resources (well water, spring water, etc.), air, soil, etc. are contaminated by solid and liquid waste. The most common diseases (malaria, diarrhea, etc.) in health centers are linked to sanitation practices. We have proposed alternative responses to improve sanitation practices such as the development of construction routes, maintenance of gutters and channels, human investment sessions, etc.

Despite the unhealthy nature of sanitation, some households have adopted good practices. Therefore, much remains to be done to ensure that populations in the study area benefit from effective sanitation. People must make their own efforts to improve their sanitation conditions. If nothing is done by the various stakeholders involved, sanitation-related diseases will persist and the local living environment will become increasingly degraded.

Keywords: *Slum, Sanitation, Latrines, Wastewater, Household Waste, Garbage, Etc.*

How to Cite: Emmanuel Kengmoe Tchouongsi (2025). Sanitation Practices in the Precarious Neighborhoods of the City of Douala: Case of the Makepe Missoke Precarious Neighborhood. *International Journal of Innovative Science and Research Technology*, 10(7), 471-489. https://doi.org/10.38124/ijisrt/25jul384

I. INTRODUCTION

In Africa in general, urban growth is spectacular. Urbanization in this continent, which is caused by rural exodus, natural increase, etc., is marked by slum development, promiscuity, etc. In Cameroon in particular, the urbanization rate fluctuates around 48.8% (RGPH, 2005). Nowadays, approximately 6 out of 10 people live in cities and in the year 2025, this will be the home of nearly 75% of humanity (Keyétat M.L., 2014). The consequences of urbanization on populations include pollution (solid and liquid waste, etc.), problems of access to drinking water, etc. In Africa, for nearly half a century, researchers have been trying to find ways and means to reduce the risks associated with urbanization. In this regard, there has been a proliferation of work on urban problems. The expansion of

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

urban research into areas such as hygiene, and especially sanitation, is no accident. Improving sanitation conditions could play an important role in reducing the morbidity and mortality rates experienced by many developing countries.

In Cameroon, due to a galloping population, limited financial and material resources, and difficulties in controlling urban growth, Cameroonian urban municipalities are finding it increasingly difficult to provide adequate sanitation conditions to their city dwellers. The sanitation sector is dominated by autonomous structures. These include latrines and septic tanks for the evacuation of excreta, most of which are roughly constructed and are sources of contamination of the water table and the living environment of city dwellers. The latter use bare soil, gutters, rivers, etc. for the evacuation of wastewater. The gutters built and developed by the authorities are insufficient in number. Widespread insalubrity is observed in many precarious neighborhoods.

For decades, sanitation has been the poor relation of urban development policies in many African countries, particularly in Cameroon. With the advent of the International Drinking Water Supply and Sanitation Decade (DIEPA-1981-1990) and the Millennium Development Goals (MDGs-2000-2015), the issue of urban sanitation has resurfaced and is of vital interest. It reflects a growing awareness that has led to the establishment of sanitation plans and programs in many African countries. To this end, the Cameroonian government developed a Yaoundé Sanitation Master Plan (PDA) in 1996, funded by the African Development Bank (AfDB). This plan, which aims to combat recurring flooding in the capital, gave rise in 2002 to the Yaoundé Sanitation Project (PADY), funded by the AfDB. Alongside this large-scale project, sanitation in the city's deprived neighborhoods poses problems of control. It involves several actors including NGOs, associations, researchers, elites, local institutions, etc. In their daily lives, the inhabitants of precarious neighborhoods live in deplorable sanitation conditions, which exposes them to diseases and other waterborne infections. The most common method of sanitation in these neighborhoods remains individual sanitation (septic tanks, latrines). Indeed, in Douala, 85% (Djiomo C., 2006) of sanitation facilities consist of unhygienic latrines. Basic hygiene rules are flouted and the consequences are serious for the environment and human health. The situation is truly worrying in the deprived neighborhoods of the city of Douala, particularly in the of the Makepe Missoke precarious neighborhood and attracts the attention of any observer.

II. MATERIALS AND METHODS

➢ *Geographical Framework of the Study Area*

Located in the District of Douala Vth the, the Makepe Missoke precarious neighborhood in which more than 27,508 people live is limited to (See. Figure 1):

- North-west through the Makepe II and Cité SIC neighborhoods,
- Northeast by the Makepe II and Mbeedi neighborhoods ,
- Southwest through the Cité SIC and Beedi neighborhoods
- Southeast through the Beedi neighborhoods .

The study area has the same climatic characteristics as the entire city of Douala. It is subject to the equatorial climate of the " Cameroonian " type due to the proximity of the Atlantic Ocean, which subjects it to the influence of humid winds (monsoons) from the Saint Helena anticyclone (Suchel., 1988). The name " Cameroonian " results from the abundance of precipitation which falls almost all year round. The monthly and annual averages of rainfall, temperatures, and relative humidity recorded there are generally high. The climate of the city of Douala is characterized by two seasons, namely a rainy season and a dry season. The rainy season extends over 9 months from March to November. This season is very rainy with approximately 63.8% of precipitation for only a third of the year (Suchel ., 1988). The months of July, August, and September record the maximum rainfall; respectively 718 mm, 730 mm and 593 mm (See. Figure 2). During the rainy season, the living environment of the the Makepe Missoke precarious neighborhood is severely degraded by various solid and liquid waste. Rainfall, accompanied by flooding, carries the contents of makeshift latrines, household waste, and waste from economic activities into homes.

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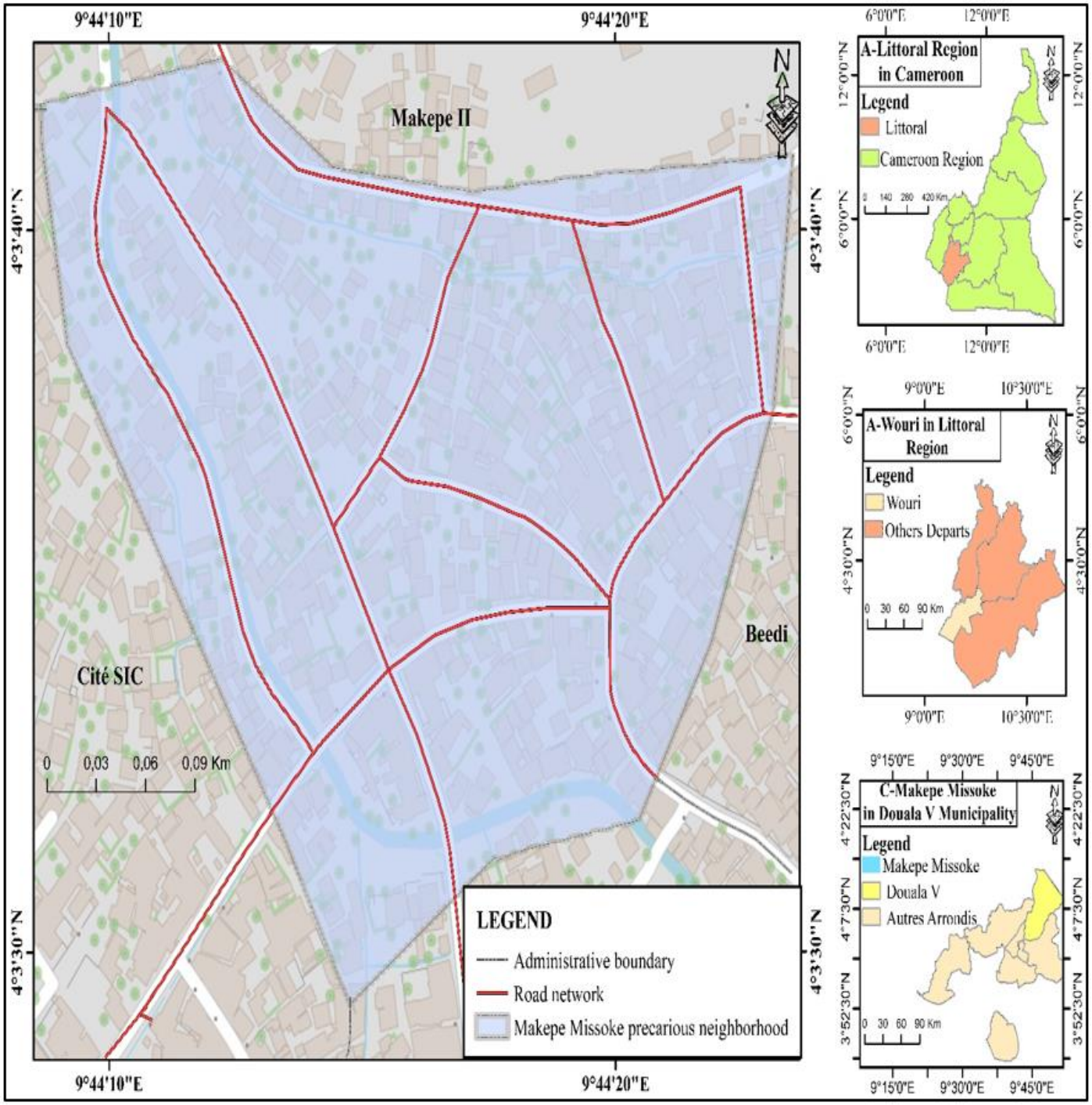

Fig 1 Location of the Makepe Missoke Precarious Neighborhood
Source: Shapefile INC 2020 and Google Earth Pro 2025

The dry season runs from December to February. This season would rather deserve the description of "less humid season", because the relative humidity and the water vapor tension are always very high[1]. In addition, this season records monthly rainfall heights above 50 mm. The driest months are January and December (See Figure 12). During the season dry, the living environment of the populations is less degraded.

[1]Explanation by Frédéric T. (2014), in his dissertation on: Contribution to the improvement of sanitation in unorganized housing districts, case of the New-Bell Bassa and New-Bell Funkel districts in Douala, dissertation presented for partial evaluation with a view to obtaining the professional master's degree in urban planning, development and urban development, University of Yaoundé I, Department of Geography, p48.

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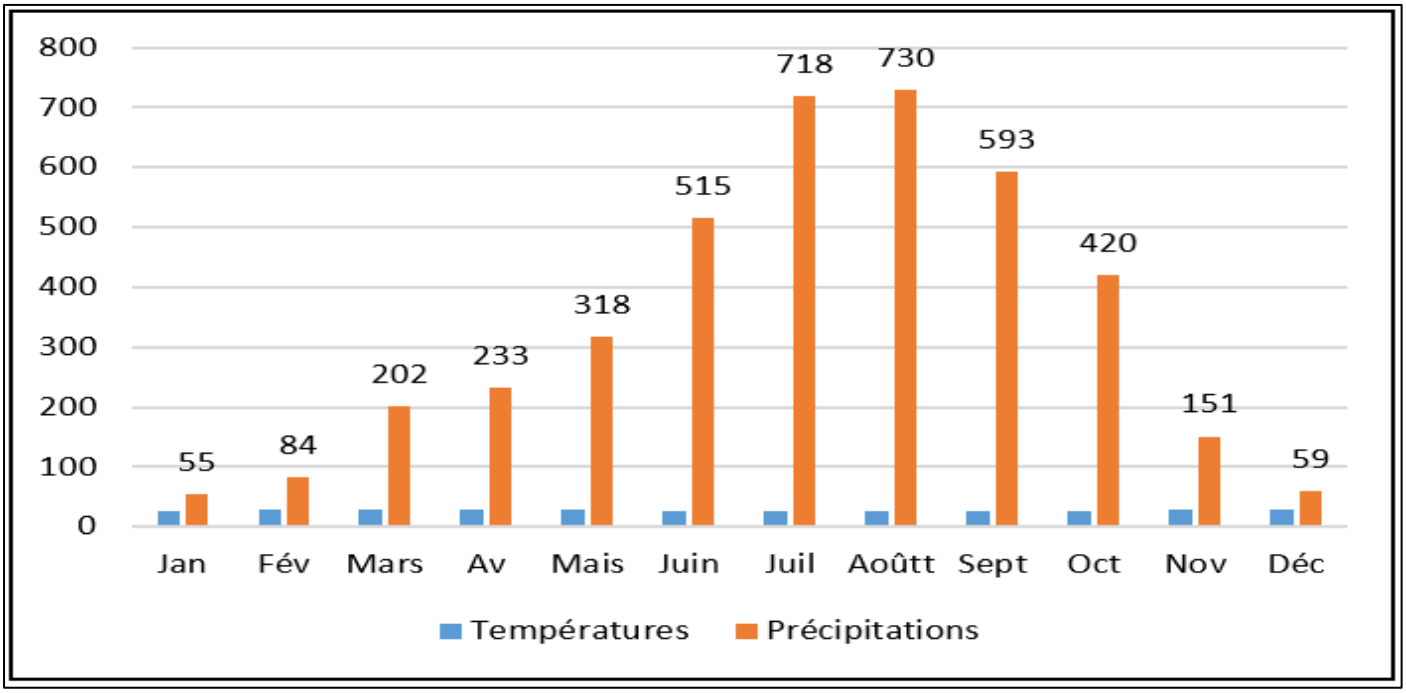

Fig 2 Ombrothermal Diagram of the City of Douala 2017
Source: ASECNA, 2017

From the analysis of Figure 2, we can conclude that there is an uneven distribution of rainfall in the city of Douala. The wettest months are July, August and September. The least wet months are November, December, January and February.

The climate of the city of Douala is characterized by relatively high temperatures all year round. The average temperature is 27.41°C per year. The hottest months are February, November, and December, with temperatures of (29°C), (28°C), and (28°C), respectively. This is followed by March (27.9°C), May (27.9°C), and April (27.8°C). July and August are the least hot months, with temperatures of 26.2°C each (see Figure 2). These high temperatures make Douala hot almost all year round.

Nowadays, in the Makepe Missoke precarious neighborhood, as everywhere else in the Douala ^{Vth} District, the vegetation is severely degraded due to the densification of buildings (See Figure 2) linked to urbanization. There is sparse, poor vegetation, consisting mainly of fruit trees (oil palms, mango trees, guava trees, etc.), floral species and food crops, etc. These different trees are scattered throughout the study area. In the neighborhoods, there is the presence of several fruit trees. In the hydromorphic areas, there is the presence of market gardening crops, etc.

Fig 3 Land use in the precarious the Makepe Missoke precarious neighborhood
Source: Google Earth Pro, 2025

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Most of the vegetation is concentrated in the lowlands, consisting of sissongo , imperata, etc. The Hydrography Network of the the Makepe Missoke precarious neighborhood, waste outlet various is moderately dense. The hydrographic network collects runoff water to ensure the site's sanitation. These watercourses have cleared deep valleys where streams flow. The environment of populations living in hydromorphic areas is severely degraded.

The study area is dominated by rivers such as Tongo Bassa, Bésseké and Mbanya. They cross neighborhoods such as Makèpè Maturité, Makèpè Missokè, Ndobatti, Ndog Hem 1 and Cité SIC, etc. These rivers are joined by several streams usually used as drains. These rivers flow almost all year round and their flow rates increase during the rainy season (between June and October). These rivers are the outlets for all urban solid and liquid waste. Most of the latrines that have been built near these rivers discharge their contents into them. These are particularly barrel and stilt latrines. During periods of flooding, this waste is carried into homes, thus degrading the living environment.

In the study area, the relief is flat and the slopes are gentle. Altitudes are between 40 and 145 m. Overall, the Makepe Missoke precarious neighborhood developed on floodplain sites. The relief of these neighborhoods is not very heterogeneous. The topographical ensemble of this relief is made up of gentle slopes between 3 and 11%. These are the areas most affected by flooding. In these areas, the living environment is significantly degraded, particularly during the rainy season, by various solid and liquid waste.

Generally speaking, the physical environment of the study area is very rugged and its consequences on the living environment are undeniable.

III. METHODOLOGY

The study was based on the collection of qualitative data, namely documentary, cartographic and quantitative data such as field observations (during this phase, we observed piles of garbage in gutters, gutters, watercourses and empty spaces. We also observed a predominance of basic latrines with lost bottom, barrel and stagnant water within the neighborhoods, etc.), interviews with local actors (Development Animation Committee, Association of men and women and questionnaire surveys. During this field observation phase, we carried out GPS surveys of garbage bins, piles of garbage, latrines, etc. The documentary research focused on the sanitation of solid and liquid waste, the degradation of the living environment, and the consequences of unhealthy sanitation practices in cities in developing countries. The documentary research also focused on the solution strategies implemented by the populations and local actors to improve the living environment in urban areas. Interviews with resource persons and focus groups with local populations made it possible to assess their perception of sanitation in the study area. The cartographic data used to produce the maps include GPS surveys, administrative shapefiles, the road network, the hydrographic network and the toponymy of the Makepe Missoke precarious neighborhood. These data were supplemented by a survey of 225 households across the study area.

IV. RESULTS

The results relate to the sanitation practices of various waste in the study area and the health consequences in the Makepe Missoke precarious neighborhood.

- *Sanitation Practices in the Study Area*

The treatment and disposal of wastewater and excreta, provided by both collective and individual sanitation systems, have the essential objective of eliminating any health risk due to the spread of pathogenic germs in the vicinity of homes while protecting the quality of receiving environments. That being said, we note that wastewater, excreta and solid waste in our study area are sources of environmental contamination. Of course, there are nuances within neighborhoods regarding the types of sanitation works used. These works are linked to the social status of households and the types of site (lowland, slope, etc.) where households are located.

- *A precarious Wastewater Disposal System*

In our study area, apart from households with a septic tank (modern management), all wastewater from almost all households is evacuated into gutters, rivers, the yard, etc. The water discharged into the yard is then channeled into the lowlands through earthen gutters shaped by erosion or by the inhabitants themselves. The major problem lies mainly in the fact that the evacuation of household wastewater is carried out here only individually, according to the perception of the nuisances specific to each home. These waters cause serious nuisances for neighbors to the extent that everyone channels them and directs them away from their plot, without worrying about their place of fall which may be the neighbor's land.

In the lowlands and relatively flat areas of the study area, these waters have difficulty draining, which causes them to stagnate in stinking puddles where flies, mosquitoes, and various rodents swarm. In the majority of cases, their flow is low. Thus, the slightest ravine in the land is a place of permanent stagnation of dirty water. The same scenario occurs when household wastewater is evacuated into gutters. In both the dry and rainy seasons, stagnation is perpetual because these gutters are often clogged with household waste.

Water and garbage mix together (See Photo 1), which clogs the gutters. It will take heavy rain to ensure the drainage of this waste into the watercourse. In the Makepe Missoke precarious neighborhood, people live with their wastewater both in the dry season and in the rainy season. They are found almost everywhere, making their way where the configuration of the terrain allows it, stagnating here. For the visitor, this situation is unbearable, but it is the harsh reality of city dwellers who, despite their problems, desperately seek to integrate into the urban space.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

Photo 1: Wastewater and Household Waste
Photo Kengmoé T Emmanuel, 2024

From all the above, we can conclude that, due to the lack of sewer systems, drainage channels or even cesspools, household wastewater is directly discharged into gutters, rivers, septic tanks, etc.

The results of our surveys (See Figure 4) show that 58.54% of households discharge their wastewater into their yards and bare soil. Before reaching waterways, the wastewater flows below the concessions. There is no doubt that, along the way, a large portion of this dirty water seeps in and contributes to the contamination of well water and natural springs. Rainwater also follows this same path. In reality, gutters are very ineffective channels because they are made of earth, and as a result, they are quickly destroyed on slopes by erosion or blocked in lowlands by flooding.

In our study area, we can also see that 35.01% of households discharge their wastewater into the gutter. 0.84% discharge it directly into rivers. This method of disposal concerns populations living in lowlands. Overall, 2.24% of households discharge their wastewater into latrines and 1.12% into septic tanks and cesspools. 2. 24% of households use networks as a method of wastewater disposal. These are households located along the main roads (See Figure 4).

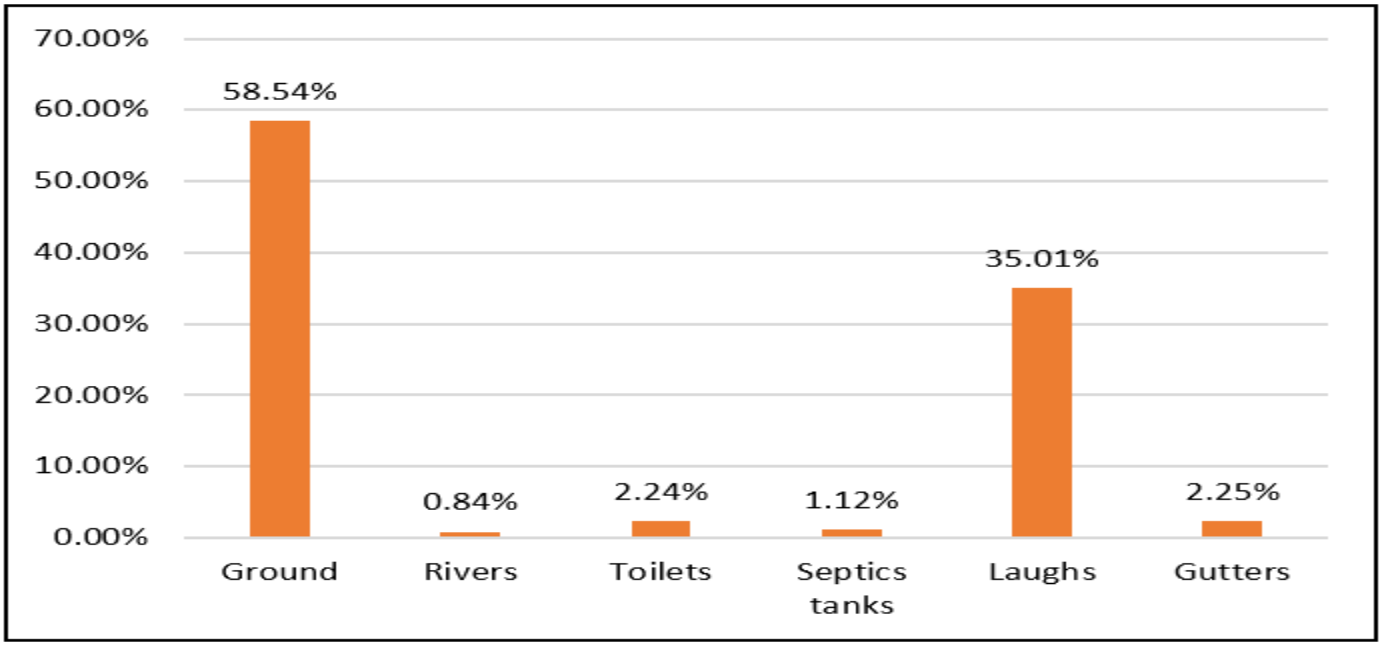

Fig 4 Wastewater Disposal Method in the Study Area
Source: Field surveys, 2024

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

➢ *A Poor Excreta Sanitation System*

Generally speaking, individual sanitation solutions are adopted by almost all households in the Makepe Missoke precarious neighborhood. Thus, excreta are evacuated either into septic tanks emptied periodically, or into latrines, etc. (See. Figure 5).

- *The Omnipresence of Latrines in the Makepe Missoke Precarious Neighborhood*

The most common method of excreta disposal in our study area is latrines. Overall, this system concerns 93.76% of the households surveyed (See Figure 5).

Generally, the latrine superstructure is a small, isolated building. It is composed of either a single compartment or two or more compartments, one serving as a shower, the other as a toilet, all placed on a pit. Some latrines serve as both a shower and a place of defecation. In all cases, the water from the shower flows either into the plot or into the pit located under the toilet. The latrines are outside the house, and are generally close to wells. Most of these latrines are basic. Only medium- and high-end buildings have improved latrines and septic tanks.

➢ *The Basic Latrines*

Rough latrines are the most widespread excrement management system in our study area. This type of latrine is a simple, quick to implement, and economical system. The level of development and the quality of construction materials are poor. The rough latrine consists of a single pit, generally rectangular in shape, where excrement accumulates. The pit is covered by a poured concrete slab, protected by a superstructure that can be made of concrete blocks or recycled materials (sheet metal, stakes, tarpaulins, plastic). Regardless of the nature of the materials used for the slab and the superstructure, the rough latrine is generally without a roof. This type of structure is used throughout the study area.

In our study area, we find three categories of basic latrines: basic latrines with a lost bottom, basic barrel latrines, basic latrines without pit (latrine on stilts) and tire latrines. These latrines have common characteristics for the slab and the superstructure (walls, roofs, doors, etc.).

➢ *The Basic Latrine with no Bottom Loss*

The basic latrines with a lost bottom consist of an excavation (or pit) in the ground. The walls can be stabilized using concrete blocks or not. It is covered with a slab having an orifice without a seat to allow excreta to pass through. The covered assembly is a superstructure whose characteristics of the walls, doors and roof are those of the basic latrines. This is the most used type of latrine in our study area. It represents 52.51% of the latrines studied (See Figure 5). The bottomless pits are dug deep (because they are rarely emptied), which increases the risk of excreta coming into contact with the water table. These bottomless latrines are found in almost all of our study area (See Plate 1).

- *Plate 1: Basic Latrine and Pit in the Study Area*

Photo 2: Latrine Made of Sheet Metal, Plastic, etc.

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Photo 3 Non-Masonry Septic Tank
Photos Kengmoé T Emmanuel, 2024

➢ *The Basic Cannon Latrine*

The basic barrel latrine has the characteristics of a basic latrine in terms of the superstructure (walls, slab, roof, seat and door). It represents 7.26% of the latrines studied (See Figure 5) . The basic barrel latrine has a concrete block pit, equipped with a PVC pipe (See Plate 2) which is used to empty the pit directly into the environment. This type of latrine is found along the banks of watercourses and gutters in the Makepe Missoke precarious neighborhood.

- *Plate 2 Basic Latrine and Pit in the Study Area*

Photo 4 and 5: PVC Gun Pit on the Edge of a Ditch and a River
Photos Kengmoé T Emmanuel, 2024

The barrel pit poses a danger to the health of the population and water resources. Indeed, the sludge from the pit is dumped into the environment without any treatment. It is used in the marshy area where the outcrop of the water table does not allow for deep digging. The barrel allows the pit to be emptied, which fills up quickly. It should be noted here that apart from the pit, the basic latrines with a lost bottom and barrel latrines have practically identical characteristics in terms of the slab, walls, doors, roof and seats. All basic barrel latrines are used as toilets and bathing water goes into the pit. Indeed, the contents of the pit must be liquid to be easily emptied.

➢ *The Basic Latrine without a Pit or Latrine on Stilts*

Also called a latrine on stilts, the basic latrine without a pit is the most basic form of latrine encountered in our study area. It represents 6.81% of the latrines studied (see Figure 5). It is located in the marshy area (regularly flooded) and near

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watercourses. It is composed of a cabin whose walls are made of recycled materials (wooden or sheet metal floor). The slab, made of untreated recycled wood, rests on wooden piles. It has no roof, door, or seat. The particularity of this latrine (apart from its lack of layout) compared to the two previous ones, comes from the fact that it does not have a pit. The excreta fall directly into the water (See Plate 3) or onto the ground and are evacuated each time the water rises.

- *Plate 3 Basic Latrine on Stilts in the Study Area*

Photo 6 and 7 Physiognomy of the Latrines on Stilts in the Study Area
Photos Kengmoé T Emmanuel, 2024

This type of latrine, similar to open defecation, is very common in our study area. Construction costs are low due to the obsolescence of the materials used for the cabin and the absence of a pit. These cabins are located far from homes because of the unpleasant odors they emit during the dry season. These latrines are found in the marshy area where there is a very low population density. The environmental and health risks are significant, as the excreta fall directly into the watercourse.

➢ *Tire Latrine*

The tire latrine, used by 3% of households (See Figure 5), owes its name to the tires used for its construction. Like the stilt latrine, it is not listed anywhere in the existing latrine nomenclature. Its presence reflects the ingenuity of the populations who compete in imagination to solve the problem of excrement disposal. Notably simple, the construction of tire latrines requires a few recycled materials such as old vehicle tires, planks, stakes, old metal sheets and tarpaulins (See Photo 6).

Photo 8 Tire Latrines in the Study Area
Photos Kengmoé T Emmanuel, 2024

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Tires, used for the construction of the pit, are of great importance. The process involves digging a few centimeters, enough to bury two to three tires. Depending on the case, three to four more are stacked above the ground. This increases the pit's storage capacity. The slab is made of planks and the superstructure of sheets or tarpaulins. For residents, tire latrines offer many advantages. Indeed, they do not need to be emptied. This task is accomplished by the movement of the tides or during heavy downpours. This explains their successful spread in the marshy areas of the study area. Tire latrines are the cause of the massive spread of pathogenic germs into the environment. Automatic emptying during tides or heavy downpours, for example, can lead to the deposit of excrement in homes. Whatever the case, the excrement ends up in the environment without prior treatment. Similarly, the materials used to build tire latrines make their maintenance particularly difficult. The excreta from these tire latrines contaminates the water that feeds wells and springs.

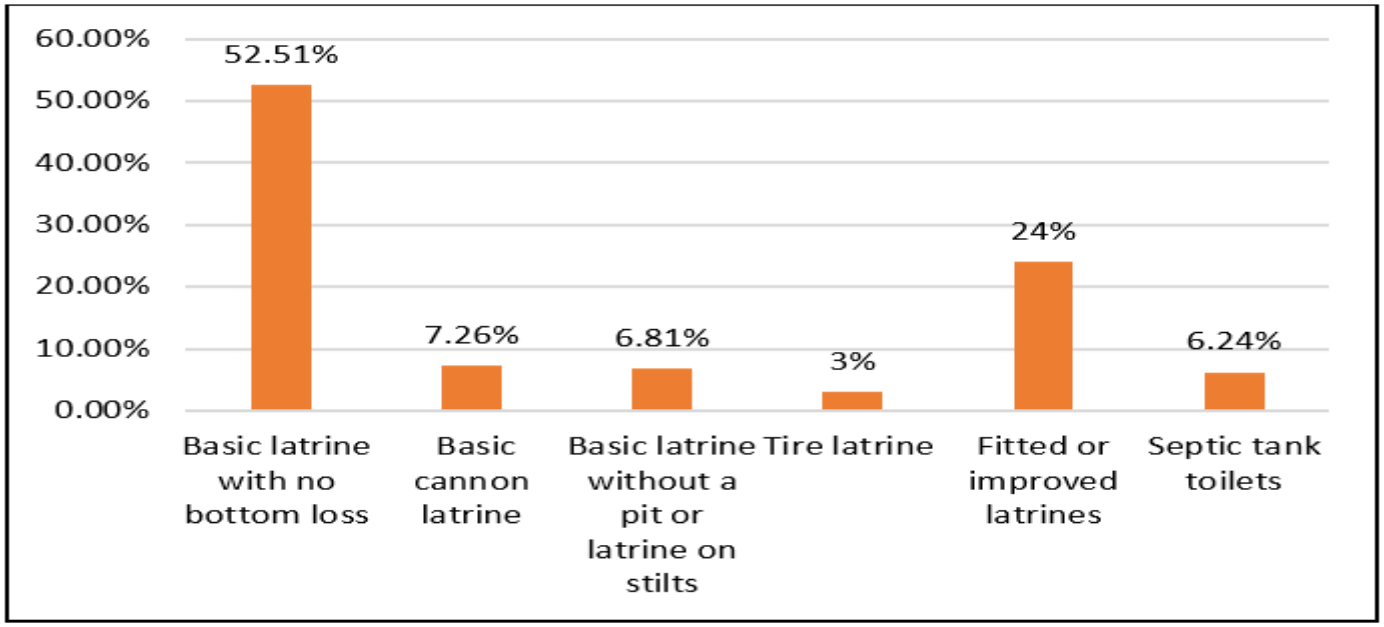

Fig 5 Typology of Latrines and Septic Tanks in the Study Area
Source: Field surveys, 2024

➢ *Fitted or Improved Latrines*

In our study area, there are improved latrines (See Figure 5). Unlike basic latrines, improved latrines are those that provide users with privacy, security, and comfort. Three families of improved latrines are found in the field: improved latrines with a lost bottom, improved barrel latrines, and emptyable latrines with a ventilated pit. These variants (see Photo 9) have common characteristics for the slab and the superstructure (walls, roof, door, etc.):

Photo 9 Improved latrines in the study area
Photos Kengmoé T Emmanuel, 2024

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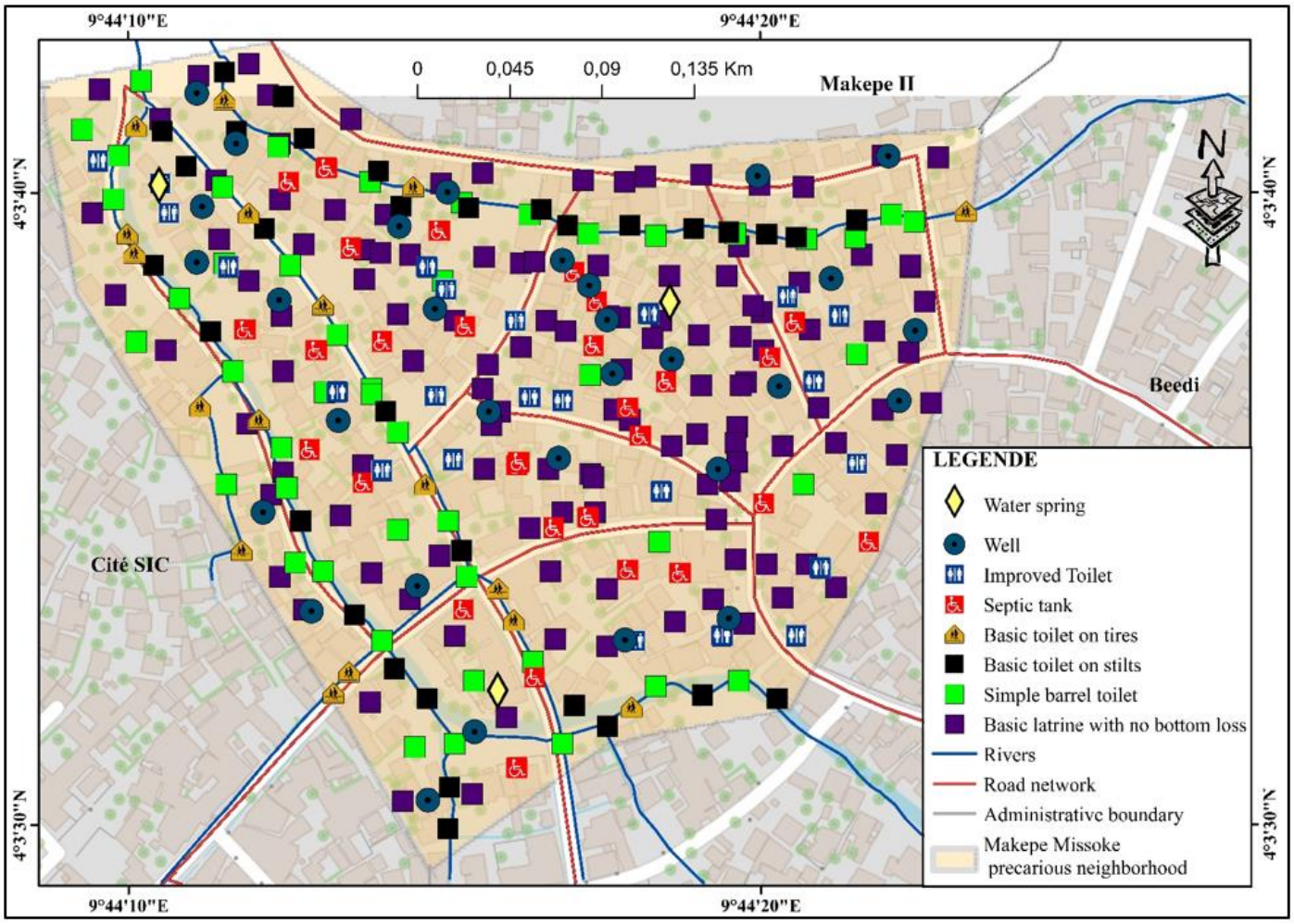

Fig 6 Typology of Latrines and Septic Tanks in the Study Area
Source: Field Surveys, 2024

➢ *Septic Tank Toilets*

This type of sanitation facility is used by 6.24% of households in the study area (See Figure 5). Septic tank toilets generally consist of a modern room connected to a septic tank via PVC pipes. The tank must then be connected to a cesspool, but this is not always the case.

Septic tanks (See Plate 4) are found in a few high-end buildings in our study area. They are generally the preserve of households with relatively high financial means and a water supply. All liquid waste (household wastewater) from the home is discharged into the septic tank. The collected wastewater passes through a series of tanks before being discharged into the sump.

- *Plate 4 Septic Tank Toilets in the Study Area*

Photo 10 and 11: Septic Tank and Septic Tank Toilet in the Study Area
Photos Kengmoé T Emmanuel, 2024

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

The operation of these septic tanks remains somewhat questionable. First, there is a lack of maintenance, which leads to deterioration, compounded by olfactory pollution. In many other cases, these tanks were built by contractors who ignored the requirements of the law.

In our study area, septic tanks account for 6.24% of the waste disposal methods. Most of the tanks do not have cesspools. In this case, the effluent seeps into the soil, contaminating the water table.

Generally, when the pit is full or is about to overflow, various means are used to restore it. 90.70% of households opt for emptying. 3.60% choose to rebuild a new latrine (See Figure 7). Some households (5.70%) use other means. They introduce quicklime or sulfuric acid into the pits to lower the level of excreta. In our study area, emptying is very difficult because of the overcrowding of houses, the high cost of the operation and the lack of financial means. Emptying is mechanical and manual. Only households located along roads or in serviced areas have the possibility of mechanically emptying their latrines. 71.12% of households use the mechanical method of emptying (See Table 1).

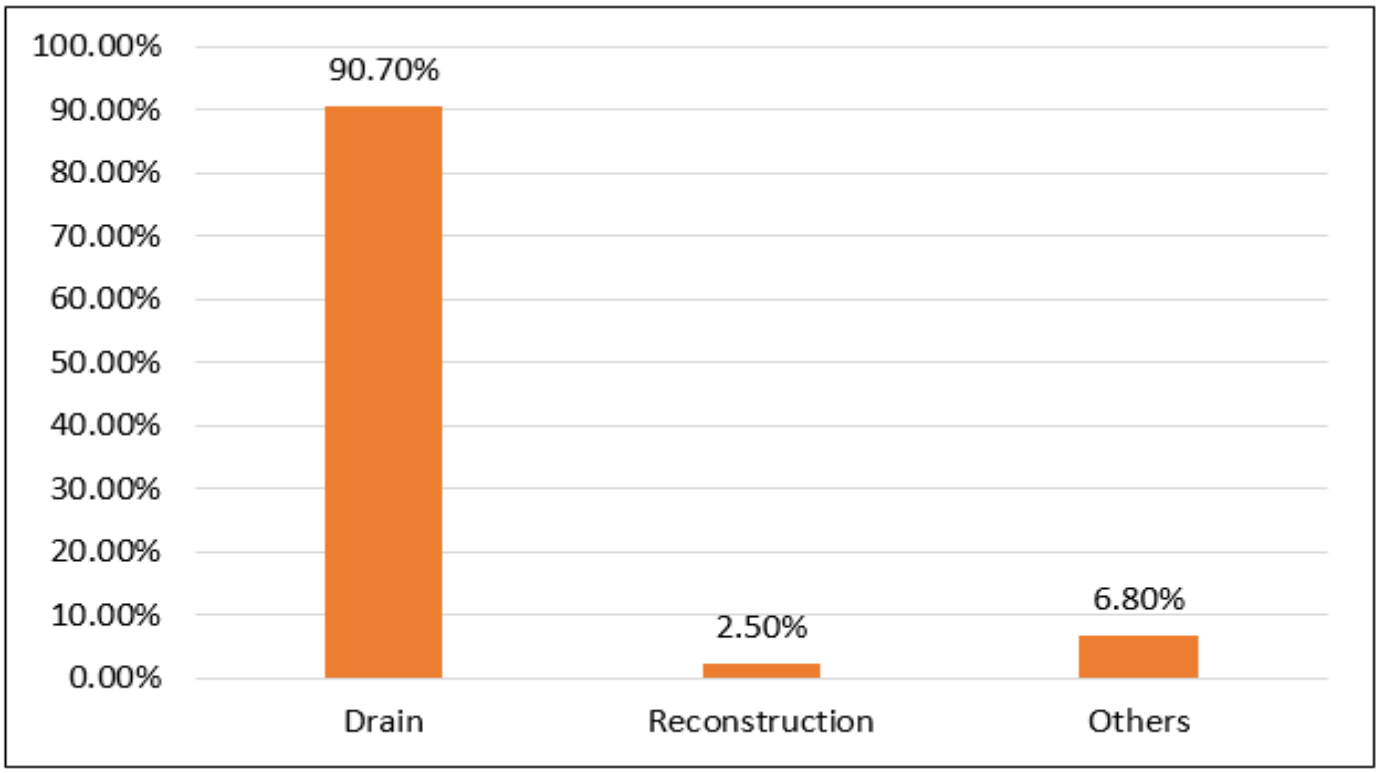

Fig 7 The Fate of Excreta in the Pits after Filling
Source: Field surveys, 2024

In poorly serviced neighborhoods, the emptying system is manual. Resident households use buckets, bags, etc. to empty their pits. 28. 88% of households do so manually and 71.12% mechanically. Obviously, the level of the pit is linked to that of the water table. This is why, in lowland areas, pits fill up quickly during the rainy season.

Table 1 Types of Drainage in the Study Area

Drain type	Staff	Percentages (%)
Manual draining	65	28.88%
Mechanical oil change	160	71.12%
Total	225	100%

Source: Field surveys, 2024

Latrine maintenance is carried out by people from the house. This maintenance is ensured by heads of household, spouses, elders in the family, etc. Toilet maintenance by households is daily or weekly. According to the results of our surveys, 56 % of households invest less than 1,000 FCFA per month for the maintenance of their toilet or latrine regardless of their income. Middle-income households spend between 1,000 and 3,000 FCFA for the maintenance of their latrines (19 %), while high-income households spend more than 2,000 - 3,000 FCFA and more for maintenance (See Figure 8).

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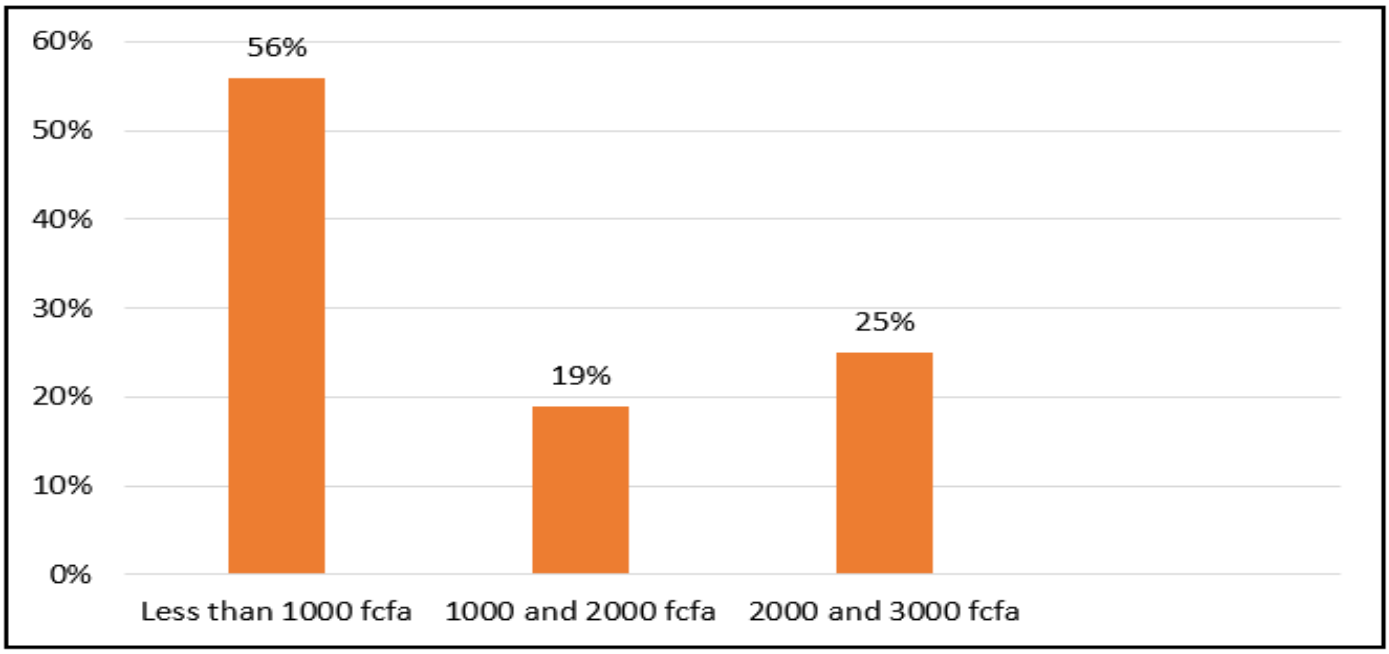

Fig 8 Distribution of Households According to the Amount Allocated for the Maintenance of Sanitation Works
Source: Field surveys, 2024

Despite maintenance, a large proportion of the latrines in our study area remain uninhabitable due to the negligence of their owners. These latrines, most of which are located near wells, pollute the latter through communicating vessels. It should be noted that in the study area, most households use decentralized water supply points such as wells, springs, boreholes, etc., which are previously polluted. More than half of the households surveyed use well water (See Figure 9).

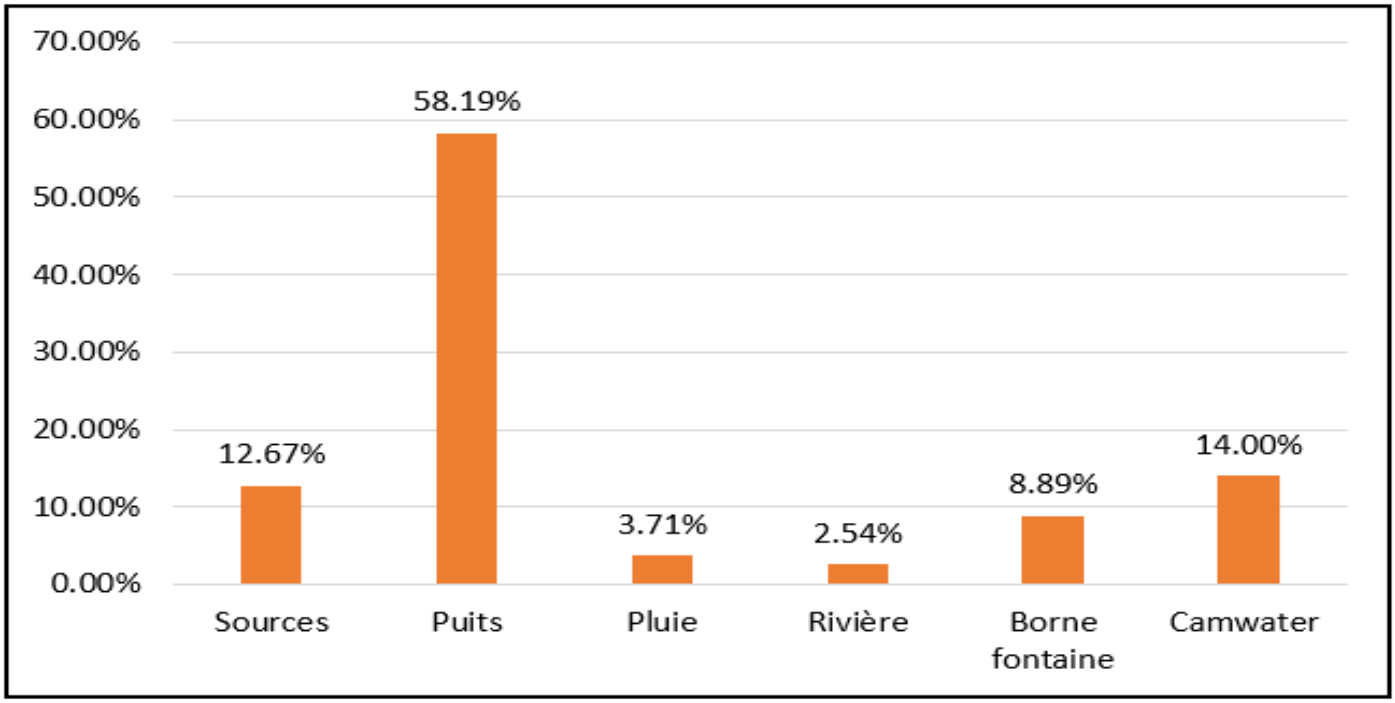

Fig 9 Water Supply in the Precarious Makepe Neighborhood Missoke
Source: Field surveys, 2024

- *Household Waste and Garbage Management, a Game of Chess*

The populations of the Makepe Missoke precarious neighborhood dump a large portion of their waste in unauthorized locations. Here, waste management is the responsibility of each household. In the empty spaces of our study area, piles of garbage pile up and sometimes even block traffic lanes, while in the lowlands, rivers are the main medium used to evacuate all waste (wastewater, household waste, etc.). We have thus observed that garbage is the main cause of flooding that occurs in the lowlands during each downpour.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

Throughout the study area, illegal dumping of solid waste proliferates along roadsides, in areas with gullies or floodplains, in riverbeds, and just about everywhere. HYSACAM's garbage bins are nonexistent or very few in number compared to the number of households served. Households that are fortunate enough to have bins at their disposal fill them in record time.

- *Plate 5 Anarchic Waste Management in the Study Area*

Photo 12 and 13: Pile of Rubbish in an Empty Space and in a Watercourse
Photos Kengmoé T Emmanuel, 2024

Looking at the diagram below, 49.55% of households dispose of their waste in Hysacam garbage bins. 17% dispose of their waste directly into Hysacam trucks and 17.11% on illegal garbage heaps. A large proportion of households dispose of their waste by unorthodox means. They deposit it in gutters, illegal heaps, waterways and along paved roads (See Figure 10). The pre-collection or door-to-door collection service ensures the collection of household waste from 8.15% of households in our study area. In addition, irregularities in the passage of Hysacam collection trucks contribute to visual pollution (See photos 12 and 13).

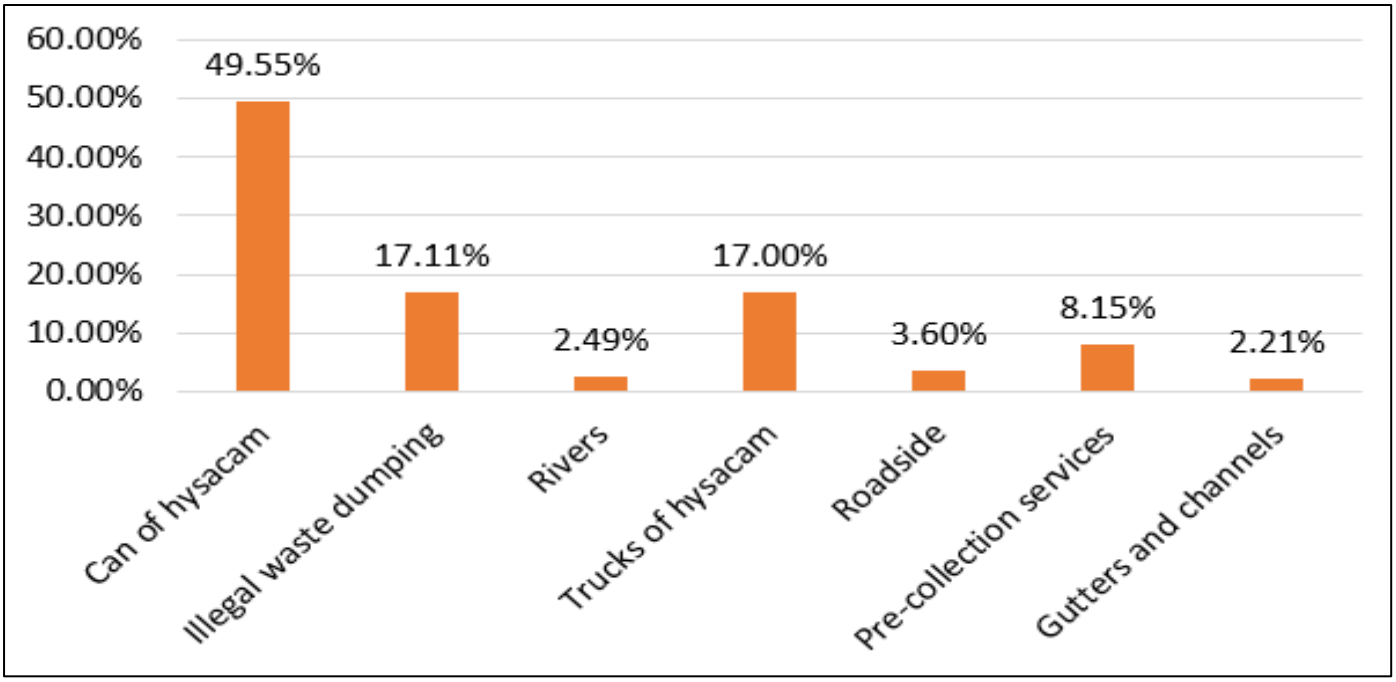

Fig 10 Main Methods of Household Waste Management in Our Study Area
Source: Field surveys, 2024

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

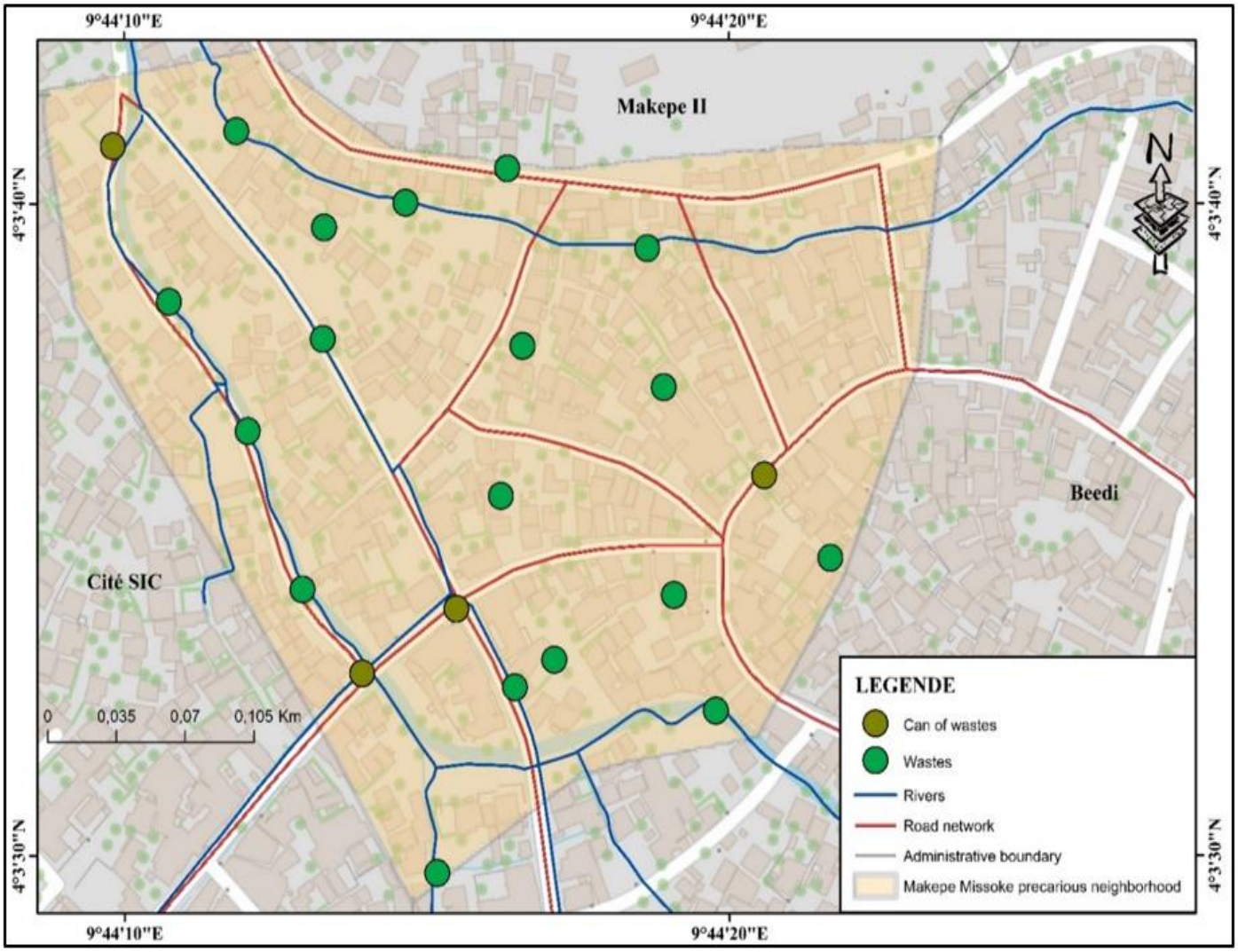

Fig 11 Bins and Garbage Piles in the Study Area
Source : Enquête de terrain, plus levées GPS, 2024

The structures responsible for pre-collection services or door-to-door collection are AJEM, ITA ASADJA, etc. Pre-collectors use in particular the main and secondary roads because they have rickshaws and motorcycles. Bins exist only along the edge of the main road (See Figure 11).

Sanitation practices in the Makepe Missoke precarious neighborhood are unhealthy and these have effects on the health of local population

➢ *Health Effects of Sanitation Practices in the Study Area*

Environmental degradation by latrines, septic tanks, wastewater and household waste affects the health of populations through several pathologies identified in our study area.

- *Pathologies linked to water and unsanitary conditions in our study area*

Poor management of household waste (liquid and solid) is the dominant factor in creating breeding grounds for health threat vectors such as mosquitoes, flies, cockroaches, mice, etc. This results in numerous waterborne diseases and those linked to unsanitary conditions.

➢ *Typology of Waterborne Diseases*

Waterborne diseases in our study area have several causes:

- *Amoebas:*

These are protozoa whose pathogen is *Entamoeba histolytica* , which affects 10% of the world's population. In nature, the amoeba lives in water and contaminated food with a high water content. They are transmitted when hygiene conditions and rules are not observed. Factors that favor the adaptation and multiplication of amoebas in running water are poor sanitary conditions, namely:

✓ wells (exposed to the elements), created without a development or safety plan. This is the example of certain wells that can be found behind (or next to) the toilets of certain houses, especially in the lowlands of the study area;
✓ wells, open to air movements and precipitation, located in lowlands in particular, close to toilets or undeveloped garbage bins, which receive household waste (liquid and solid) from houses located on slopes and interfluves during heavy rains.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

- *Bacilli*

Fecal bacilli are facultative anaerobic germs. In the human body, these parasites live in the small intestine. They are transmitted by fecal peril, poorly observed water hygiene conditions and the proximity of toilets or septic tanks to wells. Contaminated stools deposited in non-compliant places and drained by runoff water are also sources of contamination. There are several types of fecal bacilli including cholera vibrios, responsible for cholera, *salmonella typhi* , responsible for typhoid fever, which are fecal peril diseases and chlamydiae which is a disease linked to non-compliance with personal hygiene. The latter develops in dirty water (uncovered wells and springs). Amoebas are also responsible for bloody diarrhea.

- *Intestinal worms*

Intestinal worms affect more than 1.4 billion people worldwide, according to the WHO, and are responsible for high morbidity and mortality rates. In the human body, they are found in the small intestine. Eggs are laid under the intestinal lumen (entrance to the intestine) and are eliminated through feces. It is a fecal-borne disease of which humans are the primary host. Factors leading to intestinal worm contamination include: poor food hygiene (poorly washed raw vegetables), non-compliance with fecal hygiene rules (clean hands after bowel movements, unsanitary toilets).

➢ *Insects, Vectors of Transmissible Diseases*

These are mainly mosquitoes that can carry viral or parasitic diseases. There are three main types of mosquitoes:

- *The Aedes or Stegomyas*

Beetles are the *main* vectors of yellow fever in Africa and hemorrhagic fevers such as Dengue.

- *Anopheles:*

Anopheles mosquitoes are the only mosquitoes capable of transmitting *Plasmodium falciparum*, the protozoan responsible for malaria. Some species of Anopheles mosquitoes also carry lymphatic filariae (Viland et al, 2001) [2]. The female Anopheles mosquito injects the parasite into humans in the form of a " sporozoid ". When a mosquito bites an infected person, it becomes infected and can then transmit the parasite to another human.

With their biracial stinging and sucking parts, female Anopheles mosquitoes take blood from mammals (humans and animals) that they need to produce their eggs. Lavas develop in water. The mosquito season extends throughout the year in warm and humid regions. They are active all year round, especially where hygiene and sanitation problems arise. Yellow fever mosquitoes (*Aedes spp*) include a large number of species that are found mainly in urban areas. Lavas develop in slightly polluted water, in small ponds, old automobile tires, etc. In our study area, the female Anopheles mosquito develops in stagnant sewage and household waste, particularly in lowlands. It is the presence of the female Anopheles mosquito that explains the frequency of malaria in our study area.

➢ *Diseases Related to Unsanitary Conditions*

In the Makepe Missoke precarious neighborhood, household waste is disposed of without respecting hygiene rules. These bad practices plunge our study area into widespread insalubrity. The waste therefore becomes breeding grounds for flies, mice, cockroaches, etc. These harmful species cause many diseases. Among them we distinguish:

- *Flies*

The most important flies include the common housefly, the small housefly, the face fly, the fruit fly, the vinegar fly, the bluebottle fly, the grey blowfly, the stable fly, etc. They bite humans and animals to feed. They breed mainly in warm, dry places (household waste). Adult flies feed on plant and animal waste, but also on sweat and feces. They lay hundreds of eggs in rotting organic waste where the maggots live during all their stages of development.

- *Mice and Cockroaches*

Mice and cockroaches are harmful to the human environment. Unsanitary urban areas are conducive to their reproduction. They live off leftover kitchen food, feces, and organic waste in general. The Makepe Missoke precarious neighborhood, being an unplanned neighborhood, has become one of the biotopes of these species. Thus, in some households, people have difficulty keeping their food safe from mice and cockroaches.

Since our environment is unhealthy, flies carry thousands of micro-bacteria through their legs that can cause diseases such as diarrhea, cholera, etc. These insects contaminate us directly and/or by landing, for example, on fecal matter and then transmit the infectious agents through poorly protected food products. Thus, humans contract very dangerous and deadly diseases such as typhoid fever, amoebic dysentery, cholera. It is also believed that cockroaches, which thrive in dirt, mechanically transmit diseases. In our study area, the presence of garbage piles favors the proliferation of these harmful insects.

Of all the diseases mentioned, our study area only considered: diarrhea, typhoid, malaria, filariasis, etc. This choice responds to criteria of differentiation of modes of transmission. Finally, these diseases are the most known by the populations living in the Makepe Missoke precarious neighborhood. In our study area, several cases of recurrent diseases linked to water and unsanitary conditions are reported (See Table 2).

[2] Viland MC et al, (2001). Water and health, a practical guide for those working in rural African areas. GRET, Paris, 109 p.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

Table 2 Diseases Occurring Two Weeks before the Start of Field Surveys in 2024

Reported diseases	Number of patients	Percentages
Malaria	45	46.87%
Parasitosis	9	9.37%
Typhoid	8	8.33%
Cholera	5	5.20%
Diarrhea	3	3.12%
Amoebas	4	4.16%
Conjunctivitis	4	4.16%
Stomach ache	7	7.29%
Varicella	3	3.12%
Cough	7	7.29%
Urinary tract infection	1	1.04%
Total	96	100%

Source: Field surveys, 2024

Of the 96 reported cases of disease, malaria accounts for 45 cases, or 46.87 % of the patients. Parasite infections come in second with 9 cases, or 9.37%. Several cases of typhoid, cholera, diarrhea, etc., have been reported.

Diseases related to water and associated unsanitary conditions are the most common, accounting for a total of 81 reported cases. The highest number of malaria cases is found in the hydromorphic areas of our study area.

In the Makepe Missoke precarious neighborhood, the number of patients registered at the "Centre Médical Cabinet de Soins pour Tous Sarl" is fluctuating (See Table 3), but with a downward trend.

Table 3 Evolution of Cases of Sanitation-Related Diseases between 2022 and 2024 at the "Centre Médical Cabinet de Soins Pour Tous Sarl".

Years / Illnesses	2022	2023	2024	Total	T% = (BA)/A×100
Malaria	324	252	200	776	-38.25%
Typhoid fever	55	62	120	237	118.18%
Diarrhea	45	47	7	99	-84.44%
Intestinal worms	44	29	14	87	-68.18%
Amoebic dysentery	40	34	14	88	-65%
Dermatoses	34	41	12	87	-64.7%
Cough or pneumonia	12	34	0	46	-100%
Intestinal parasitoses	47	48	9	104	-80.85%
Filariasis	11	8	4	23	-63.63%
Total	612	555	380	1547	

Source: Health surveys, 2024

Table 3 shows the extent of disease evolution related to sanitation practices in our study area from 2022 to 2024. Malaria, typhoid fever and intestinal parasitosis are the most dominant.

- *Strategy of Solutions for Improving Sanitation Practices*

To improve sanitation practices in our study area, we recommend therapies, some of which have already proven effective in other areas. Regarding the sanitation of excreta, we propose the solutions of development which consist of repairing the latter but also the use of ventilated dry double pit latrines and ECOSAN latrines which are waterproof pits and therefore protect the water table. To facilitate the emptying of latrines, it will be necessary to create new roads and widen existing streets to install sewer systems, and facilitate the circulation of emptying trucks and hysacam.

Proper wastewater disposal will require the creation of gutters and the development of existing natural channels. Existing gutters will need to be maintained regularly.

Improving household waste sanitation practices will involve pre-collection and door-to-door collection of household waste to eradicate unsanitary conditions. Therefore, organizations can be set up to transport waste to transit points to be created. Promoting environmental education is a solution that will enable responsible behavior towards the environment (not throwing garbage in the environment, not using latrines that degrade the environment, etc.).

In the bus eradicates the insalubrity in the entire Makepe Missoke precarious neighborhood, the increase in human investment sessions will help restore cleanliness within the neighborhood. These operations concern all age groups of the population. People who refuse to participate in these neighborhood cleaning sessions will have to be sanctioned by the neighborhood leaders.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

V. DISCUSSION

This study showed that sanitation practices in the Makepe Missoke precarious neighborhood are unhealthy. Regarding wastewater management, city dwellers dump it, particularly into their yards, due to the lack of gutters or constructed channels. Some households dispose of it in septic tanks. Most of this wastewater stagnates in the Makepe Missoke precarious neighborhood are breeding grounds for mosquitoes and other harmful insects. In his work on waste management, Bangoura M.R., (2017) states that the proliferation of stagnant water in the city of Conakry is linked to the inadequacy of gutters and channels. This observation was also made by Kengmoe T. E., (2020) in the city of Bafoussam where the lack of gutters has caused water stagnation in certain precarious neighborhoods such as Ngoauche , Famla , Banengo , Tyo village, etc. In the Makepe Missoke precarious neighborhood, the excreta sanitation system is failing. Throughout the study area, latrines dominate to the detriment of septic tanks. The basic latrines with a lost bottom are very widespread and represent 52.51% of the latrines used by households. For the most part, they are precarious and are sources of environmental pollution, particularly the water tables feeding wells, springs and boreholes. These latrines made of precarious materials are sources of proliferation of nauseating odors. For the most part, the floors are not masonry, hence the absence of cleaning, and the doors, roofs and walls are absent. The barrel latrines, used by some city dwellers, particularly those living in hydromorphic areas, discharge their contents into streams and gutters, thus polluting groundwater and surface water. These latrines represent 93.76% of the toilets used by households. Latrines on stilts and tires are not left out. The latter are present in hydromorphic areas, used by the poor in particular. The contents of these latrines are sources of environmental pollution. According to Kengne F., et Mougoue B., (1997) in the city of Douala, the proximity between wells and latrines promotes the lateral and vertical transfer of coliforms and fecal streptococci polluting both the groundwater and surface water. Note that in the study area, waste management is the particular initiative of the local populations. The latter dump garbage in watercourses, along roads, in empty spaces, in gutters and gutters, garbage bins, etc. These solid wastes degrade the living environment of the populations not only because of the nauseating odors and leachate released, but also the proliferation of harmful insects (flies and cockroaches) and rodents (mice and ras). In parallel with the above, the study conducted by Mbiadjeu L.S.P., (2015) on the degradation of the living environment of the populations of Bafoussam showed that the presence of solid and liquid waste is the cause of the pollution of well and spring water. This author stated that the predominance of basic latrines with a lost bottom and their proximity to wells would be the main causes of groundwater pollution and waterborne diseases. The same observation was made by Djatcheu M.L., (2018) in the city of Yaoundé where in precarious neighborhoods and more precisely in the lowlands, latrines are the main causes of surface and groundwater pollution. The results of field investigations showed that the degradation of the living environment of the populations of the study area by various latrines has effects on the health of the populations. This situation is explained by the fact that city dwellers resort to decentralized water supply points such as wells, springs, etc. previously polluted by various waste. Field surveys showed that 58.19% of households surveyed use well water. The unsanitary conditions linked to the omnipresence of various waste are at the origin of the development of mosquitoes. In the study area, recurring diseases are linked to water and unsanitary conditions. Health surveys in the " Centre Médical Cabinet de Soins pour Tous Sarl" located in the study area showed that between 2022 and 2024, 776 patients from the study area suffered from malaria, 237 from typhoid fever, 104 from intestinal parasitosis, etc. It can be concluded that diseases related to water and unsanitary conditions dominate. The work carried out by Nya E. L., (2020) on diseases related to water and unsanitary conditions in the Ndé Division corroborates our results. Indeed, this author indicated that the most recurrent diseases in this Division are waterborne. This situation was also noted by Essomba M., (2021), who argues that populations in poor neighborhoods in the city of Yaoundé are exposed to waterborne diseases mainly linked to the high presence of fecal coliforms and streptococci in well and spring water. Points out that well and spring water in the Elig -Effa and Melen neighborhoods in Yaoundé have a high concentration of fecal coliforms and streptococci from latrines; thus vulnerabilizing the health of local populations.

VI. CONCLUSION

This work was aimed at examining the environmental impacts of sanitation in the Makepe Missoke precarious neighborhood. Our analysis shows that the study area has experienced dramatic spatial growth, coupled with the overcrowding of houses over the past several years. This surge has given rise to various problems, including sanitation.

Sanitation in our study area is still poor. The sanitation method is individual. Our investigations show that the physical environment (climate, vegetation and relief, etc.) influences sanitation practices. People dump wastewater in unauthorized areas (ground, latrines, etc.), this is explained by the fact that wastewater drainage gutters are insufficient. Wastewater is difficult to drain because natural gutters are blocked by household waste that stagnates around homes, and are the source of many health problems. It is in these puddles that mosquitoes develop.

The most widespread method of excreta sanitation in the study area is latrines. Some households use septic tanks. Due to limited financial resources and overcrowding of houses, the majority of the population in our study area has built basic sanitation works. These are latrines for which the level of development and the quality of construction materials are poor; which leads to deplorable conditions of use (insecurity, lack of privacy, presence of flies, cockroaches, mold, bad odors, etc.). These are barrel latrines, latrines on stilts, basic latrines with a lost bottom, etc. These latrines are sources of environmental pollution (pollution of the water table, water, air, etc.). Most basic latrines are devoid of at least one construction element (slab; roof, etc.). Despite the precariousness of excreta sanitation facilities, there are

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/25jul384

improved latrines in our study area that do not degrade the environment. They are the prerogative of people with high financial means. When these excreta sanitation facilities are full, most households empty them or rebuild them. Emptying is manual and mechanical. People dump their garbage in unorthodox places (rivers, stagnant puddles, gutters, etc.). Garbage bins exist only along the main axis that delimits the study area. This sad observation favors the emergence of diseases (malaria, pneumonia, amoebic dysentery, diarrhea, etc.) In order to achieve our objectives, we have proposed alternative solutions that can improve sanitation in our study area in the near or distant future. The adoption of these solutions by the populations will allow them to improve their behaviors in terms of hygiene and sanitation.

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