Global Scientific JOURNALS

GSJ: Volume 10, Issue 9, September 2022, Online: ISSN 2320-9186

www.globalscientificjournal.com

POPULATION GROWTH AND SOLID WASTE GENERATION IN THE URBAN MUNICIPALITY OF GAO, MALI

Dr. ABDOULKADRI OUMAROU TOURE [(1) *], Dr. FATOUMATA MAIGA [(1)], Dr. ISSA OUATTARA[(2)]

(1) Faculty of History and Geography of the University of Social Sciences and Management of Bamako, Mali
(2) Institute of Economic and Social Development of Bamako, Mali

Author respondent : Tel : 00223 66 84 59 23, Email : toureabdoulkadri@gmail.com*

Abstract

The urban municipality of Gao, located in the North-East of Mali, has been booming since the 2012 security crisis due to the fact that it is welcoming more and more refugees, displaced persons but also candidates for migration to Europe, artisanal gold miners and civil servants/soldiers who come there to work. This phenomenon has caused an unprecedented population growth. As a result, the quantities of waste have become larger and more difficult to manage. The objective of this study is to analyze the relationship between population growth and the production of solid waste in the urban municipality of Gao and the implications of this correlation. The methodology adopted consisted of a bibliographical analysis, field surveys of actors in the waste sector and surveys of the GPS points of the main dumps (official and anarchic). The results show that the quantity of waste produced per person per day has increased from 0.5 kg in 2009 to 0.9 kg in 2020. Thus, the total production of solid waste in the urban municipality of Gao has respectively increased from 43.17 tons at 109.85 tons per day. As the community is not prepared to receive such a human wave, the waste has become more cumbersome and the infrastructure, equipment and appropriate storage areas are lacking. This results in a deterioration of the living environment of the populations and the increase in diseases such as malaria, typhoid fever and respiratory infections, which constitutes a significant health risk. Waste is more of a problem for the urban environment and contributes to the mortality of livestock and the degradation of soils and waterways. To meet this challenge, it is important to adopt concerted waste management between the players.

Keywords: *Population growth, solid waste, Gao.*

Introduction

Waste management is nowadays one of the major challenges of urban development. It is a major issue in developing countries, especially because of the accelerated growth of the urban population and the emergence of new modes of production and consumption that generate more waste (Ouattara et al, 2019).

Like other urban municipalities in Mali, solid waste management remains a real headache in the urban municipality of Gao. The municipality is not immune to the problems posed by the ever-increasing production of solid waste and the consequences that this has in a context of demographic growth.

The urban municipality of Gao is currently facing a worrying situation of insalubrity. Out of an annual production of solid waste estimated in 2018 at 21,013 tons (all categories of household waste combined), an estimated 10% of solid waste is transported to transit and informal dumps (CEFAD, 2018). The rest accumulates here and there (clogged sidewalks, blocked gutters and collectors, waste piled up on the sides of houses) or is used for other purposes: backfilling of building bases, backfilling of gaping pits dug by brick makers. Apart

from the health problems (foul odors, disease vectors) caused by the waste, its accumulation strongly degrades the aesthetic environment. There are about twenty major dumps (all categories) in the city of Gao and its periphery (CEFAD, 2018). While some dumps are formal (these dumps are undeveloped), most are informal dumps (people create their garbage dumps without authorization from the municipality). The lack of official dumpsites leads to the proliferation of anarchic dumpsites throughout the municipality.

The mass production of waste caused by the massive arrival of populations accentuates the difficulties and challenges of the urban municipality of Gao with respect to the collection, disposal, treatment and recovery of waste, as well as the organization of the actors in the sector. The issue of solid waste in this municipality arises in terms of the imbalance between the management of the quantities of waste produced by an exponentially growing population and the resources and strategies put in place by the local authorities. Waste production seems to have exceeded the level of available sanitation infrastructure and the capacity of the authorities to evacuate and treat the waste.

In Mali, several studies have examined the solid waste management system, particularly in the District of Bamako. However, very few have established a correlation between demographic change and solid waste generation, particularly in the regions (inland). This article is written with this in mind, and its main objective is to analyze the relationship between population growth and solid waste generation in the urban municipality of Gao and the implications of this correlation.

2. Materials and Methods

2.1. Presentation of the Urban Municipality of Gao

The municipality of Gao was established as a medium-sized municipality in 1958 and recognized as a urban municipality by Law No. 66-9/AN-RM of March 2, 1966, with the powers stipulated in Law No. 96-059 of November 4, 1996, on the creation of decentralized territorial communities in the Republic of Mali. It is one of the seven municipalities in the Gao circle (PDSEC Commune urbaine de Gao 2021-2025).

Today, the municipality of Gao has the status of an urban municipality. It is composed of 09 districts which are: Gadeye, Farandjiré, Aljanabanbia, Djoulabougou, Saneye, Sosso-koïra, Boulgoundjé, Château and Djidara (see Figure 1) and has a municipal council of 33 members elected in the 2016 municipal elections. With an area of 38.5 km², the municipality is bounded to the north by the rural municipality of Sonni Ali Ber, to the south by the rural municipality of Gounzoureye, to the east by the rural municipality of Anchawadj, and to the west by the rural municipality of Gounzoureye (Idem). The municipality remains the nerve center of the region in terms of trade between the south and north of the country and between the region and neighboring countries (Algeria, Niger, etc.).

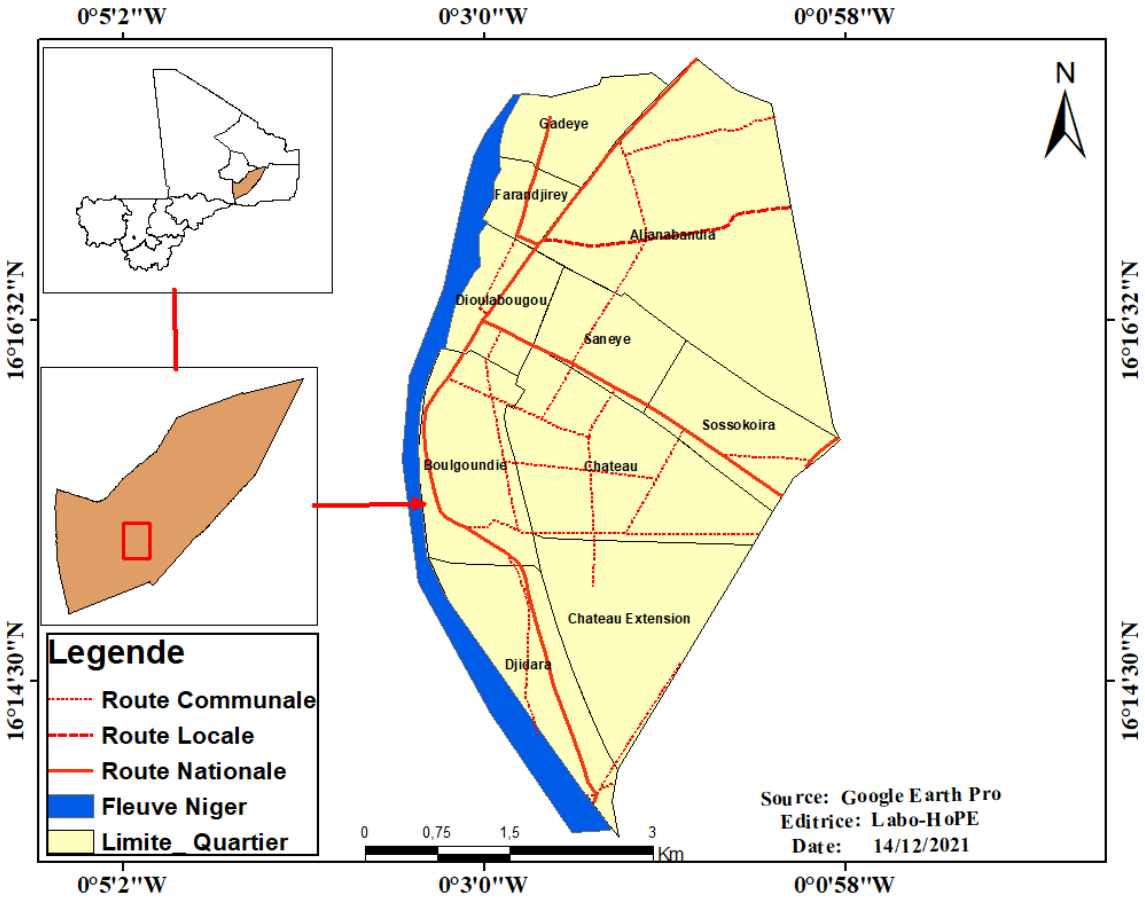

Figure 1: Map of the urban municipality of Gao

The relief of the urban municipality reflects the character of the Niger River coastline. It is very monotonous and dominated by the presence of plains, especially in the river valley. The municipality has two main seasons (a rainy season, from June to October with a rainfall of 200 to 250 mm per year, and a dry season, from October to May with an intermediate (cold) season from November to February). The Niger River crosses the municipality from north to south over a distance of about 15 km.

The urban municipality of Gao has an estimated population of 122,064, distributed as follows: 61,621 men and 60,443 women (based on projections by the Direction Régionale de la Planification, de la Statistique, de l'Informatique, de l'Aménagement du Territoire et de la Population - Regional Directorate of Planning, Statistics, Informatics, Land Management and Population - DRPSIAP of Gao, 2020). It is composed of the Songhoy, Arma, Tamasheq, Arab, Peulh, Malinké, Dogon, Sarakolé ethnic groups and several other nationalities since 2012, etc. The dominant religion is Islam, but there are also Catholic and Protestant Christians who live together in perfect social cohesion. There is a strong concentration of populations on the banks of the river over a distance of nearly 15 km, thanks to agriculture, livestock, fishing, market gardening and small-scale trade.

The city, which took off well before the security crisis of 2012, has seen its population increase due to this crisis and its collateral effects (inter-community violence, inter-militia, terrorists, intervention of humanitarian organizations). Indeed, it has served as a refuge for many displaced populations from the interior of the region and from other regions, and even

for refugees from Niger and Burkina Faso. There are also a significant number of returnees, many of whom have come from neighboring countries. In 2020 alone, the Gao circle recorded 47,692 displaced persons (Direction Régionale du Développement Social et de l'Economie Solidaire - Regional Directorate of Social Development and Solidarity Economy). Also, since 2013 with the intervention of the French military operation Serval, now Barkhane, MINUSMA and humanitarian organizations, the city's population has experienced an unprecedented increase. Also, since 2017, the discovery of gold panning sites in the region has caused a massive flow of people from all over (inside the country as well as from abroad). As a result, the quantities of waste have become larger and more difficult to manage, leading to an increase in the number of uncontrolled dumpsites throughout the urban municipality of Gao. The municipality is not prepared to receive such a large number of people in such a short period of time, so the waste has become more cumbersome and the infrastructure, equipment and appropriate areas for disposal are lacking.

In terms of tourism, the urban municipality of Gao is home to the site of the Askias' tomb (photo 1), an archaeological site in the Gao region that was inscribed on the UNESCO World Heritage List in 2004. The site covers an area of 4.24 ha. The spectacular pyramidal structure of the tomb of Askia, built by Askia Mohamed, Emperor of Songhai, in 1495 in his capital Gao, bears witness to the power and wealth of the empire that flourished in the 15th and 16th centuries thanks to the control of trans-Saharan trade, especially in salt and gold. The complex, including the pyramidal tomb, the two flat-roofed mosques, the mosque cemetery, and the open-air assembly area, was built when Gao became the capital of the Songhai Empire and after Askia Mohamed made Islam the official religion of the Empire on his return from Mecca. The site of the Askias' tomb was, along with the pink dune of Koïma (photo 2) located on the right bank of the river in the village of Koïma (municipality of Gounzourèye), one of the biggest tourist attractions in the region before 2012. However, the outbreak of the conflict in 2012 put a stop to tourism, with tourist sites being visited by only a few locals. Moreover, in 2012, with the occupation of the city of Gao by jihadist movements, the site was placed on the emergency list of sites in danger on June 28, 2012, due to the site's exposure to jihadist threats. Indeed, according to the interpretation given by Ançar Dine, places of worship should only be dedicated to God and to no "saint", and tombs or shrines should not be erected as monuments above ground...

Photo 1: Site of the Askias' tomb in Gao

Photo 2: The pink dune of Koïma

2.2 Data Collection, processing and analysis

The population of the urban municipality of Gao is estimated at 122,064 inhabitants in 2020 (DRPSIAP Gao), distributed among 09 neighborhoods. For the sampling, we opted for the stratified method. This was done through:

- **The choice of neighborhoods**: 03 neighborhoods were chosen based on the number of households (one sparsely populated neighborhood, one moderately populated neighborhood and one heavily populated neighborhood). Within these three neighborhoods (Farandjirèye, Djoulabougou and Sossokoïra), the various socio-professional categories of the municipality are also represented.
- **The choice of households**: within the selected neighborhoods, 10% of households were targeted, i.e. 333 households with whom the surveys took place.

The field surveys took place from August 28 to September 16, 2021 in the targeted neighborhoods. Prior to the field surveys, the questionnaire was designed on the Kobocollect software and installed on smartphones to facilitate the conduct of the surveys and the analysis of the collected data. At the end of the surveys, the collected data was analyzed via Excel to highlight trends on graphs. The GPS was used to record the geographical coordinates of the garbage dumps while the digital camera was used to take images in the field. The GPS data was then processed to create the thematic maps.

3. Results and Discussion

3.1 Results

3.1.1. Socio-economic and demographic characteristics of respondents

The analysis of the results shows that the majority of the people surveyed are less than 50 years old. They are in the age range of 23 to 46 years, or 69%. Those under 40 years of age represent 44% of the sample and those over 45 years of age represent 31%. Women represent 51% of those interviewed and men 49%. Of these, 59% are heads of household and 41% are housewives (who responded on behalf of the head of household). With regard to the level of education of the respondents, 26% were not literate, 2% had attended Koranic school, 23% had attended elementary school, 36% secondary school and only 14% higher education. This shows that the majority of respondents (72%) can read and write (see figure 2). With regard to the occupation of our respondents, the surveys reveal that 59% have a job (of which 20% are civil servants), 31% do housework, 3% are retired and 7% are unemployed. With regard to the occupation status, 49% of the people surveyed are owners of the houses they occupy while 51% are tenants. With regard to the length of residence in the municipality, 6% have lived there for less than a year, 59% have lived there for between 1 and 10 years, 17% have lived there for between 11 and 20 years, and 18% have lived there for more than 20 years (Figure 3). This shows that the city has registered more than 50% of the people interviewed in the last 10 years.

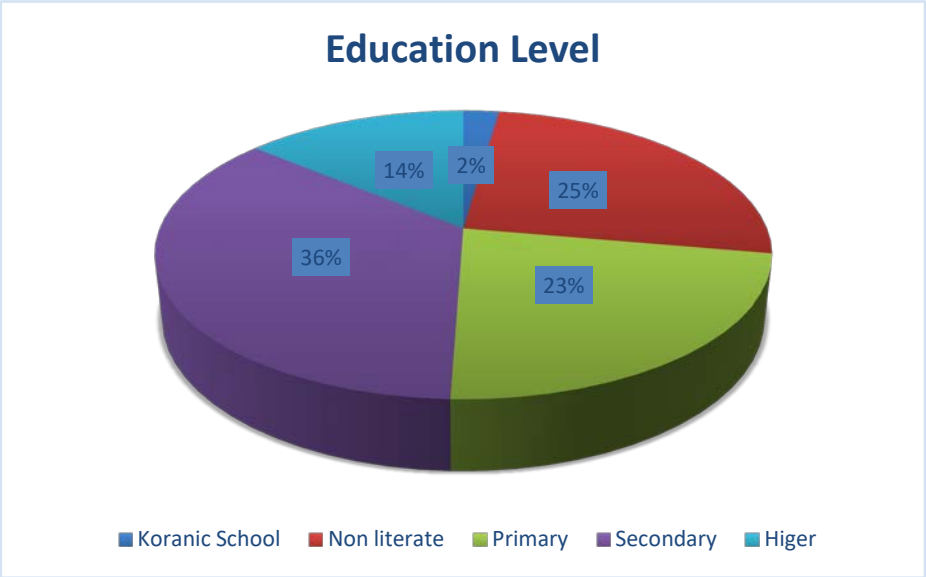

Figure 2: Educational level of respondents

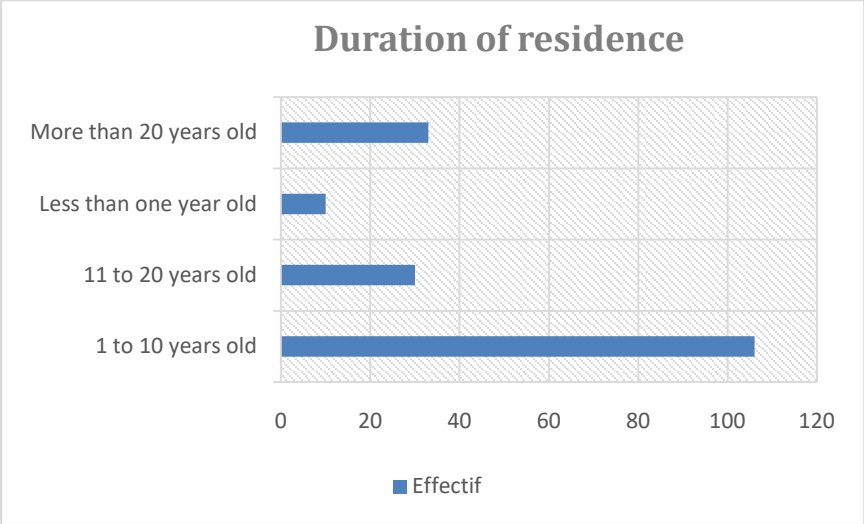

Figure 3: Length of residence of respondents in the municipality

The analysis of the results shows that 80% of households consist of 2 to 10 people, with a large proportion of households of 6 to 10 people (50% of the total number of households surveyed). Households made up of more than 11 to 25 persons represent 20% of the total households surveyed. Based on this assumption, an average household can produce 5.4 kg of waste per day.

3.1.2. Population growth and soaring solid waste generation

The analysis of the results of our investigations indicates that there is a link between population growth and increased solid waste generation in the urban municipality of Gao. Indeed, from 2009 to 2020, the population of the urban municipality of Gao increased from 86,353 inhabitants to 122,064 inhabitants according to the DRPSIAP of Gao (2020). In the last general population and housing census (RGPH) of 2009, the average annual population

growth rate in the urban municipality of Gao was 4.7%, exceeding the national average of 3.6%, which is itself increasing.

The corollary of such a demographic explosion is the constant increase in the production of waste, particularly solid waste. According to data obtained from the Direction Régionale de l'Assainissement et du Contrôle des Pollutions et des Nuisances - Regional Directorate of Sanitation and Control of Pollution and Nuisance (DRACPN) in Gao, the production of solid waste in Gao was estimated at 0.5 kg/person/day in 2009. According to the same source, this production has increased to 0.9 kg/person/day in 2020. Based on these estimates and population numbers, our calculations show that total solid waste generation per day in the urban municipality of Gao increased from 43.17 tons to 109.85 tons (all household waste categories combined) from 2009 to 2020. Based on the 2021 population and a standard of 0.9 kg/person/day, the municipality's solid waste production is estimated at 112,947.3 kg/day in 2021, or 112.94 tons. These figures reveal the urgency of ensuring an effective organization and adequate infrastructure that is not found in the urban municipality of Gao insofar as the production of waste has multiplied by 2.5 in a decade!

3.1.3. Organization and dysfunction of the waste management system

Several actors are involved in solid waste management in the urban municipality of Gao. These include the municipality's City hall, the du Service de l'Assainissement et de Contrôle des Pollutions et des Nuisances - Sanitation and Pollution Control Department (SACPN), Economic Interest Groups (EIGs), technical and financial partners, and households.

The two main actors in the sector are the municipality (mayor) and private operators, particularly the EIGs. Private operators are responsible for providing quality service to subscribers and for meeting their commitments to the population and the mayor. In this respect, they must ensure pre-collection from homes and evacuation of waste to transit depots. They must also actively participate in the implementation of the sanitation plan drawn up by the city hall.

Pre-collection in the municipality of Gao is carried out by households within the compounds, economic interest groups (EIGs), and individuals. However, not all households subscribe to the collection EIGs. Of the households surveyed, 35% are subscribers and 65% are not. The minimum subscription period is 2 months, while the maximum is 5 years. Some households close to the depots or without sufficient financial means prefer to pre-collect the waste themselves and deposit it at the anarchic depots in general. The two other categories in charge of pre-collection are the EIGs and private individuals. They are service providers. EIGs are formal organizations involved in the pre-collection of waste. Individuals are people who go from door to door with human-drawn carts commonly called "rickshaws" or tricycles to collect waste and deposit it at dumpsites. The people in charge of this transport are generally children and adolescents under 15 years of age. The use of these informal workers to remove household waste is widespread. The EIGs are generally paid at the end of the month (1,000 to 1,500 FCFA/month), while the individuals are paid by the spot between 100 FCFA and more depending on the volume of solid waste to be collected.

As for the City Hall, it is responsible for the collection and evacuation of waste to the final dump located 15 km northeast of the city (on the road to Kidal), and for the management of this infrastructure.

The majority of households interviewed (94%) have a waste disposal container, while 6% do not. The latter point to the high cost and poor quality of pre-collection services, a nearby anarchic dump, poverty, burning of waste, and a nearby gutter into which garbage is thrown (see photo 3). As for the containers used to store garbage, their quality varies from one household to another, ranging from half barrels (62.7%) to baskets made of *doum palm tree* leaves (7.77%) to old buckets (22.77%) and plastic bags (6.66%). In households that do not have a container, waste is thrown on the ground in the yard or outside (often in front or behind). This waste is burned in the corners of the yard and especially in the street early in the morning or in the early evening, which is likely to cause other nuisances that can degrade the quality of the air that people around breathe or cause burns to children who play around. It is estimated that approximately 15-20% of solid waste is burned in the yards and streets of the city of Gao by households (EJOM project study, 2018). This is an occasional activity depending on the positioning of compounds or neighborhoods. The burning of waste occurs every 2 to 3 days when waste accumulates in the compounds.

In addition to the burning of waste, there is also the creation of micro-deposits of waste by houses. This practice is observed in almost all households on the outskirts of Gao. In some cases, these small dumps overflow and become huge piles of garbage that are nearly 50 m long in the streets (Photo 4).

Photo 3: Main drainage ditch filled with garbage

Photo 4: Overflowing garbage dump

Households use the waste for other purposes, such as backfilling the base of their houses. It is common for formal actors, notably the Economic Interest Groups (EIGs) for waste collection, or informal actors (individuals or private individuals) to contract (make agreements) with landowners for backfilling (Photo 5). Another point of backfill is the gaping pits left by local manufacturers of mud bricks. Households and pre-collectors also dump waste in these pits. This dumping continues even when the land is filled in (photo 6).

Photo 5: Land filled with garbage

Photo 6: Garbage dumping in the street

Nowadays, the main dumps used by the population are the anarchic ones that have developed over time. Field surveys conducted using GPS identified 32 dumpsites ranging in size from 0.5 to 04 hectares and 07 waste disposal caissons (Figure 4). The results show that 7% of the people surveyed said they were very far from the dump sites, 37% were far away, while 56% were close. In the center of town and in the market of Gao, the caissons made available to the population by the municipality are overflowing due to a lack of timely waste disposal by the municipal services. Worse, waste is deposited on the ground near the caissons (see photo 7), causing the proliferation of insects and foul odors. The current image of Gao contrasts with that of 30 or 40 years ago. BHT, a man in his sixties, put it this way: "*During independence and even the two decades that followed, the city of Gao was the cleanest city in Mali and one of the cleanest in the sub-region. In addition to cleanliness days, each compound was responsible for keeping the front of its house clean. Nowadays, it is deplorable to see that even the inside of the courtyards are dirty, not to mention the streets which have practically become dumping grounds.*

Photo 7: An overflowing box leading to an anarchic dumping ground at the big market.

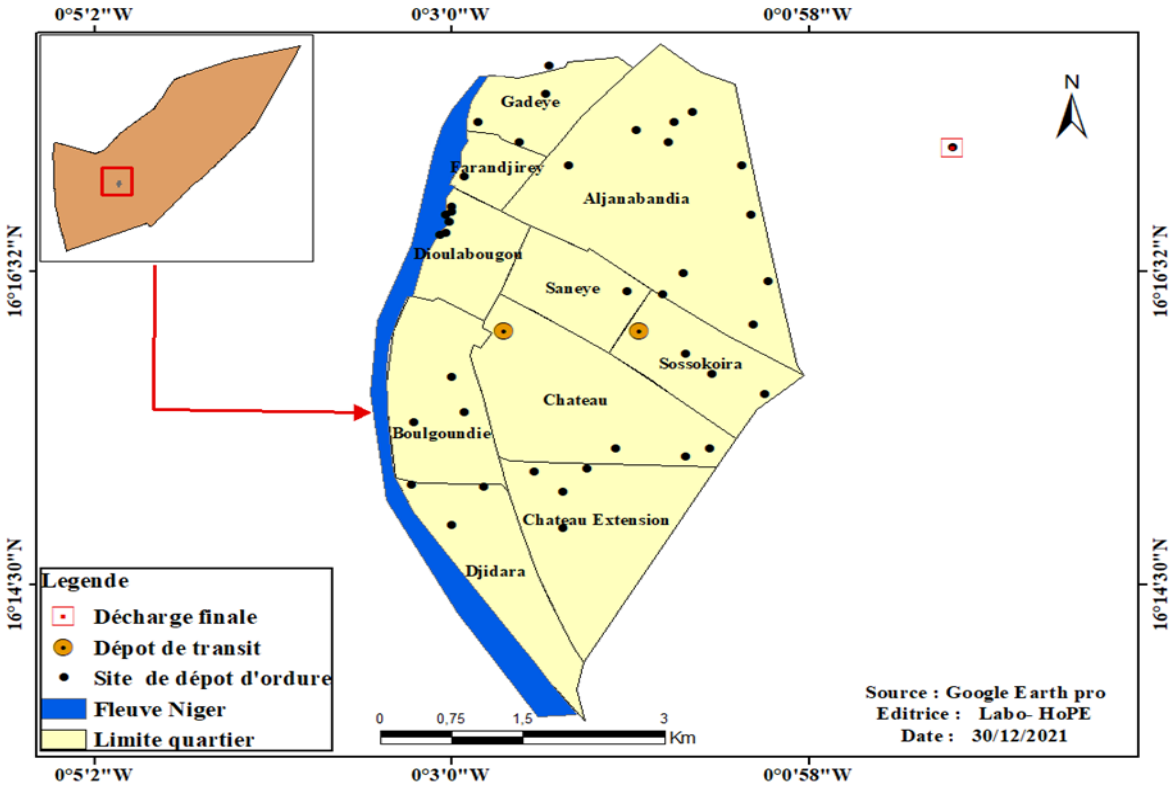

Figure 4: Location of the main dumpsites in the city of Gao (official and anarchic).

3.1.4. Poor waste management, a vector of disease and environmental impact

The constraints linked to waste management (difficulty for the IEGs to ensure pre-collection, assumption of responsibility for pre-collection by households, and the limited resources of the mayor's office) encourage the proliferation of illegal dumping and unauthorized dumping of waste in the canals. The dumping of waste in waterways (particularly the Niger River) deteriorates the quality of the water that is used for washing clothes, dishes and even baths by a segment of the population, especially those living along the river. This situation poses a real public health problem. A famous pond called *Aljannabandia* (the pond of paradise) which gave its name to the district of the same name is nowadays invaded by waste degrading the quality of its water unfit for drinking and the air in its surroundings (see photo 8). This pond used to be a place of refuge for local biodiversity, a watering place for animals, and was used by men in their daily activities (taking water for domestic work) before the installation of the city's water network. AM, a sixty-year-old native who lives near the pond, confided to us that: *"When we were kids, the water in the pond was clear and limpid, and we used to go swimming there. Nowadays, it is really deplorable to see that the pond has become a garbage dump, so much so that its water is unfit for consumption."* In view of the ecological role played by this pond, it must be cleared of all garbage and developed so that the local populations can live in a healthy environment and that the local biodiversity around the pond can be reborn.

There has also been a resurgence of illnesses related to insalubrity. Of all the people interviewed, 79% said they had contracted at least one case of a disease related to poor sanitation in the past two years, compared to 21% who said they had not contracted any disease (Figure 5). Among the diseases cited, malaria is in first place (62%), followed by

diarrhea (21%), skin diseases (9%) and then acute respiratory infections (ARI) (8%) (figure 6).

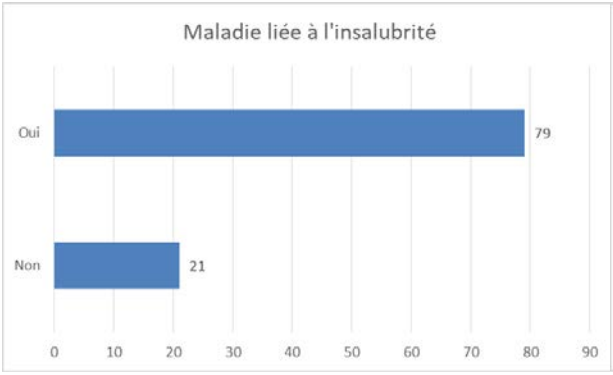

Figure 5: Cases of illness contracted

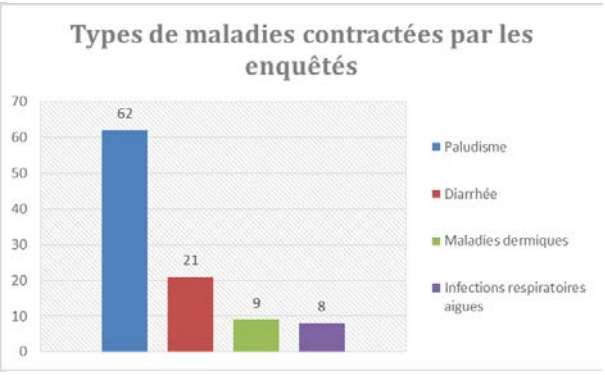

Figure 6: Types of illness contracted

In addition, the proliferation of waste in the municipality causes illnesses and even deaths among livestock through the consumption of plastic waste (photo 9) and other dangerous chemical elements (battery debris, caustic soda, sulphur or potassium rejected by artisans ...). Also, from an environmental point of view, the Niger River bed is cluttered with plastic waste (photo 10). This can have harmful effects on fishery resources, particularly those of fish. The trees and shrubs in the area, mostly made up of thorny trees, are almost covered with plastic (photo 11), which the swirling wind causes to stick to the trees (either to the roots or branches), thus contributing to the degradation of visual aesthetics and also threatening the survival of the host trees.

Photo 8: The "pond of paradise" transformed into the "pond of hell

Photo 9: Animals feeding on waste

Photo 10: The riverbed overgrown with garbage, here near the boat dock

Photo 11: Plastic waste hanging from trees and swirling around plants

3.2. Discussion

The results of the study show that over the past ten years, the urban municipality of Gao has experienced a dramatic increase in solid waste production. Indeed, the amount of waste produced per day and per person increased from 0.5 kg in 2009 to 0.9 kg in 2020. This production extrapolated on the whole population of the municipality gives between 43.17 tons/day and 109.85 tons of solid waste. This increase is explained by the growth of the population of the municipality during the same period. It would have a link with the political and security crisis in which Mali has been immersed since 2012. Indeed, this crisis has led to the intervention of several peacekeeping operations and non-governmental organizations, particularly in the northern regions, most of which have bases in Gao. This situation has led to a massive influx of people seeking opportunities related to the presence of these missions and organizations in the urban municipality of Gao.

These results converge with those obtained by many studies conducted in recent years, particularly in African cities where there has been a sharp increase in the production of solid waste. For example, in Bamako, the quantity of household waste produced daily was about 600 tons in 1998 (Coulibaly, 1999). It increased to 1,543.50 tons/day in 2017 (DSUVA, 2017). In Yaoundé, Cameroon, the amount of household waste produced increased from 795 tons/day in 1995 to 934 tons/day in 2000 and to 1000 tons/day in 2003 (Epoh-Mvaboum and Moussinga, 2003). Our results are corroborated by Beede and Bloom (1995) cited by Bras (2010) who showed that for every 1% increase in per capita income, there is a 0.34% increase in waste generation; for every 1% increase in population, there is a 1.04% increase in waste generation. These results converge with those of Ouattara (2019), who in his work has shown that as the population increases, the waste generation stream becomes increasingly important. However, this author adds that the current change in the consumption habits of populations, coupled with the demographic growth of cities explains the increasing production of urban solid waste. In 2017, a World Bank report on urbanization in Africa showed that Africa's high population growth and rapid urbanization (40%) not only create pressure on the environment, but also generate sanitation problems, including waste. These results reveal the urgent need to ensure effective organization and adequate management infrastructure, which is generally lacking in Malian cities.

The results of the study reveal a dysfunction of the solid waste system in the municipality. Nowadays, in view of the invasion of the city by garbage, it is clear that the waste management system in Gao is "dying" because of the low investment capacity of the IEGs and the meagre means of the mayor's office to finance solid waste disposal activities in the municipality. The pre-collection of the city's waste, which in principle should be provided by the IEGs, is no longer functioning. The low rate of collection of monthly subscriptions and the low level of participation by households mean that the IEGs are unable to make their investment profitable and always end up losing out, which leads most of them to give up if they do not have a palliative activity for the pre-collection of waste. For this reason, most households deposit their waste in the growing number of illegal dumpsites (see Map 2) or simply in the street or gutters near their compounds. The transit depots and the final dumping site built within the framework of decentralized cooperation have never been used, despite the support of the city of Nancy, which supported the implementation of the municipality's sanitation plan through the construction in 2010 of three transit depots in the city: two in the Château district and one in the Sossokoira district. These findings on urban waste management failures are supported by the work of several authors in many African cities (Onibokun, 2001; Tini, 2003; Yao-Kouassi, 2010; Ngambi, 2015; Ouattara, 2019; Keita, 2020).

It also shows that poor solid waste management is a source of disease and environmental pollution. These results are consistent with several studies conducted on the issue. Thus, surveys conducted by Cointreau (1997), confirmed this trend by highlighting the direct link between the diseases observed and the activity of waste collectors/recyclers. In fact, the presence of unauthorized dumps all over the municipality represents a favorable environment for the multiplication of transmission vectors such as arthropods (flies, mosquitoes) and rodents, as well as for the proliferation of germs responsible for all kinds of diseases and infections. A study conducted by Chofqi et al (2010) highlighted the impacts of solid waste on the health of the population surrounding the old landfill of the city of El Jadida in Morocco. Our results are also confirmed by the work of Ouattara (2019) who showed that activities related to the presence of landfills cause immediate or delayed, mostly long-lasting impacts on the natural environment, especially on water and air quality. These impacts are mainly induced by the degradation of waste causing the formation of leachates and biogas. Another nuisance from waste that has a no lesser environmental impact and whose consequences are more easily perceived is the visual impact of waste deposits coupled with the problem of foul odors.

Conclusion

At the end of this study, it appears that the problem of solid waste management is acute in the urban municipality of Gao because of the demographic explosion. The dysfunction of the sector can be explained by the low level of investment by private operators (especially IEGs) and the low financial and organizational capacity of the city hall. In addition, the limited financial means of a large segment of the population coupled with lack of civic virtue make it difficult for them to pay the costs related to the evacuation of household waste. The result is the piling up of garbage in the city and in the suburbs, which degrades the living environment of the population and has a corollary effect on human health (diarrhoea, malaria, acute respiratory infections, etc.) and animal health (consumption of certain toxic or unfit-for-consumption waste). To address these problems, it is important to involve all actors in the

management of solid waste in the municipality, train and sensitize households. In addition, the city hall, with the support of the technical services in the field, must provide itself with the technical and financial means to develop and make the transit and final dumps functional. To date, the final dump, which has been summarily fitted out, is not used at all and the waste recovery activity that should be carried out there has not yet taken place. This is a loss of earnings for the city council and hundreds of young people who could invest in the sorting, recovery and sale of waste at the multiple transit dumps and the final dump. In the future, we will look more closely at the interactions between the actors and the strategies needed for sustainable waste management. We will also be interested in deepening the environmental impact of waste and the role that waste recovery can play in reducing unemployment, especially in young people.

References

- BRAS Anie (2010) : *Eléments pour une définition de la problématique de la propreté urbaine en Haïti : le cas de Port-au-Prince*. Thèse de doctorat en cotutelle en Géographie, Aménagement et Urbanisme, Institut National des Sciences Appliquées de Lyon (France) et Université Quisqueya (Haïti), 213 p.
- Centre d'Expertise, d'Etudes, de Formation et d'Accompagnement en Développement- CEFAD, (2018) : *Etat des lieux de la situation de la gestion des déchets dans la ville de Gao*, Projet EJOM (L'emploi des jeunes crée des opportunités, ici au Mali), Union Européenne, 60 p
- CHOFQI Amina, YOUNSI Abdelkader, ELLHADI Kbir, MANIA Jacky, VERON Alain, (2010) : « *Incidences environnementales d'une décharge publique non contrôlée sur la population et les eaux souterraines : cas d'El Jadida (Maroc) »*. Actes du Colloque Eau, Déchets et Développement Durable, Alexandrie, 28-31 mars 2010, pp. 89-95.
- COINTREAU Sandra, (1997): «*Occupational and Environmental Health Issues of Solid Waste Management. International Occupational and Environmental Medicine*». Saint-Louis (USA), 25p.
- COULIBALY Yaranga (1999) : *La gestion de l'environnement urbain à Bamako*. Thèse de doctorat en Population-Environnement, Institut Supérieur de Formation et de Recherche Appliquée (ISFRA), Bamako, 330 p.
- Direction des Services Urbains de Voirie et d'Assainissement, (2018) : *Rapport annuel 2017*, Bamako, 44 p
- Direction Régionale de l'Assainissement et du contrôle des pollutions et des nuisances de Gao (2020) : *Rapport de bilan d'exercice de l'année 2020 et perspectives de l'année 2021*, Gao, 36 p
- EPOH-MVABOUM Yolande Pélagie et MOUSSINGA Isaac, (2003) : « *La gestion des ordures ménagères et leur impact sur l'environnement : cas de la ville de Yaoundé »*. Université de Yaoundé, 11 p.
- Etude de collecte et de traitement des eaux usées et des déchets solides dans 46 villes du Mali- 1ère tranche (11 villes), Rapport phase A : ville de Gao.
- KEITA Modibo (2020) : *La croissance urbaine, production et gestion des déchets solides à Bamako*. Thèse de doctorat, Institut de Pédagogie Universitaire (IPU), Bamako, 297 p
- NGAMBI Jules Raymond (2015) : *Déchets solides ménagers dans la ville de Yaoundé (Cameroun) : de la gestion linéaire vers une économie circulaire*. Thèse de doctorat en Géographie sociale et régionale, Université du Maine, Le Mans-Laval, 485 p
- ONIBOCUN Adepoju, (2001) : *La gestion des déchets urbains : des solutions pour l'Afrique*, Paris et Ottawa, Karthala et CDRI, 256 p
- OUATTARA Issa (2019) : *Gestion des déchets solides ménagers à Bamako : acteurs, moyens et stratégies de gestion durable.* Thèse de doctorat en Géographie de l'Environnement, Institut de Pédagogie Universitaire de Bamako (IPU), Bamako, 372 p
- OUATTARA Issa, DIARRA Yakourioun, MARIKO Seydou, (2019). « *Gestion des déchets solides des marchés urbains au Mali : cas du marché central de Sikasso »*. Revue Africaine des Sciences Sociales et de la Santé Publique (RASP), 18, Janvier-Juin 2019, pp.173-192.
- Programme de Consolidation de la Paix, (2021) : *Programme de Développement Economique Social et Culturel de la municipality urbaine de Gao 2021-2025*, Mairie municipality urbaine de Gao, 43 p
- TINI Apollinaire (2003) : *La gestion des déchets solides ménagers à Niamey au Niger : essai pour une stratégie de gestion durable*. Thèse de doctorat en Géographie, Aménagement et Urbanisme, Institut National des Sciences Appliquées de Lyon, 306 p
- YAO-KOUASSI Quonan Chistian (2010) : *A la recherche d'une synergie pour la gestion des déchets ménagers en Côte d'ivoire : cas du District d'Abidjan*. Thèse de doctorat en Géographie, Université du Maine, 264 p
-

Webographie

- Rapport sur l'urbanisation en Afrique, le 09 février 2017, disponible en ligne sur https://www.banquemondiale.org/fr/news/press-release/2017/02/09/world-bank-report-improving-conditions-for-people-and-businesses-in-africas-cities-is-key-to-growth, consulté le 18 janvier 2022.
- Tombeau des Askias Gao : https://fr.wikipedia.org/wiki/Tombeau_des_Askia consulté le 29/01/2022
- Site du tombeau des Askias classé patrimoine mondial de l'humanité : https://whc.unesco.org/fr/list/1139/ consulté le 29/09/2022
- Site du tombeau des Askias, patrimoine en péril : https://fr.wikipedia.org/wiki/Tombeau_des_Askia consulté le 29/01/2022
-