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SUMMARY

Recently Published Articles

ACCEPTANCE OF AGGREGATORS IN DEMAND RESPONSE PROGRAMS DURING THE AGE OF RENEWABLE ENERGY
András PUSKÁS-TOMPOS, Romania

INVENTORY OF HOUSEHOLD SOLID WASTE MANAGEMENT IN THE CITY OF PARAKOU
YEMADJE Alda Aude Sèna, YETONGNON, Judith Eric Georges, KADJEGBIN Toundé Roméo Gislain, Benin

UNIFIED EMBEDDED FUSION SENSORS FOR AIRCRAFTS
Nickolay Zosimovych, China

IMPACT OF IRRATIONAL INVESTMENT ON THE PERFORMANCE: THE CASE OF NON-FINANCIAL COMPANIES IN VIETNAM
Tan Nghiem Le, Long Hau Le, Ly Thuy Hang Vo, Viet Thanh Truc Tran, Viet Nam

Latest Issue

ISSN : 2456-3676

Volume 7, Issue 4, Aug 2022 is in progress...

Article Title & Authors	Page	Down
Inventory of Household Solid Waste Management in the City of Parakou YEMADJE Alda Aude Sèna, YETONGNON, Judith Eric Georges, KADJEGBIN Toundé Roméo Gislain, Benin	1-15	PDF
Acceptance of Aggregators in Demand Response Programs During the Age of Renewable Energy András PUSKÁS-TOMPOS, Romania	16-35	PDF

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Vol. 7, No. 04; 2022

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Inventory of Household Solid Waste Management in the City of Parakou

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Abstract

The constant increase in the quantity of waste is a thoughtful issue for the city of Parakou, which mainly adopts traditional dumping as a waste treatment method. The obvious consequence is the proliferation of uncontrolled dumps that annoy for the population. The aim of this work is to present the current situation of waste management in this city for a more effective and sustainable intervention.

A descriptive and analytical study was conducted. The choice of purposive sampling was adopted and mainly concerned institutions, pre-collection and collection structures involved in waste management. Excel software was used for data processing and Arc-View to produce the maps.

The results show sixteen (16) pre-collect waste structures from 31.50% of households in the city of Parakou with rudimentary and insufficient equipment and understaffed staff for an average of 4.11 garbage collectors per structure. As for collection, the two companies that collect waste from the collection points to the final dump are no longer working. Thus, the collection points are overflowing, the waste is up to the level of the storefront and makes it difficult to move around. So, the garbage collectors are forced to go to the final dump, but 10.30% of them dump the waste on the illegal dumps. Dumps proliferate in the city and generate olfactory and visual nuisances that constitute a danger to the health of the population. 66.67% of NGOs raised issues related to complaints from people living near the dumpsites. It is therefore crucial to strengthen both financially and technically the structures involved in waste management and opt for management based really on recovery.

Keywords: City of Parakou, Household solid waste, Management,

Vol. 7, No. 04; 2022

ISSN: 2456-3676

1. Introduction

The world, in the midst of industrial and technological change, is facing major challenges, including the environment and public health safeguard (I. Ali et al, 2015, p 787). Scientific debates as well as international donors' reflections focus on appropriate initiatives that can help maintain planetary ecological integrity, one of the conditions for achieving sustainable development. Thus, household solid waste management, with its positive contribution to the environment and public health preservation, is becoming an issue of global governance. Internationally, efforts are being made. In this vein, large-scale meetings, such as the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro (Brazil) in 1992, have been organized. In this regard, the Rio Declaration Principle No. 4 assumes that environmental protection must be an integral part of the development process and cannot be considered in isolation to achieve sustainable development. In addition, there has been the establishment of funding tools such as the United Nations Environment Program (UNEP) and the United Nations Development Programme (UNDP). However, according to the Municipal Development Partnership (MDP) newsletter, cities in West and Central Africa produce between 20,000 and 30,000 tons of waste daily, almost half of which is not managed.

The rest is either buried, incinerated or in front of the concessions, or thrown in the street, in depressed and swampy areas as the case may be. As a result, sanitation has become a crucial issue in Third World cities (B. G. Tanhoun, 2010, p 4). In Africa, this worrying situation has given rise to multiple water and sanitation sector development policies. The latter, strategies and other measures to improve waste management in large African cities are being taken. These include regulatory texts since the Rio conference, the direct involvement of civil society since the 1990s through the creation of NGOs (Non-Governmental Organizations) and private structures throughout Africa to fill the gap left by the States in the sanitation sector. According to the RGPH (General Census of Population and Housing), 83.80% of households throw rubbish in the nature. The phenomenon is frightening in most of the country's large cities.

In the 2063 African Union's Agenda, one of the priority targets is to "ensure 100% recycling of urban waste by 2063". Despite all these virtuous intentions and efforts made at the international, sub-regional, national and communal levels to curb the crisis of poor waste management and urban sanitation, the situation in terms of waste management and sanitation is hardly improving.

The effort to improve management in the sanitation sector and mainly in the management of solid household waste in Parakou is just a consequence of reflections and actions decided at national level. Specifically, the collection of the colonial era, the collection of the revolutionary era, marked by voluntary discipline, the collection organized in 1990 by the municipality in synergy with NGOs (B. G. Tanhoun, 2010, p 9). It consisted of collecting household waste from a few households (belonging to certain managers) to be transported to the peripheral areas. This stage remained the practice of the commune until the period of decentralisation that began in the 2000s. Currently, there are several NGOs (Non-Governmental Organisations) involved in the collection of waste.

The NGO DCAM-BETHESDA (delegated project manager of the town hall in the sanitation sector since 2008) has drawn up a number of documents that will serve as waste management tools in the city. These documents include the study report on the evaluation of actions and major

Vol. 7, No. 04; 2022

ISSN: 2456-3676

problems related to the hygiene and basic sanitation sector in the city of Parakou, carried out in 2010, and the waste management plan (PGD) of the municipality of Parakou. In the latter waste management plan, priority is given to revitalizing the existing household solid waste management systems in the town.

In the summary note on the update of the diagnosis and prioritisation of the targets of the municipalities published in 2019 with regard to SDG (Guarantee access to water supply and sanitation services and ensure sustainable management of water services), it is noted that gutters and shallow areas are filled with waste of all kinds, particularly plastic waste; the multiplicity of unauthorized dumpsites; and the discharge of domestic wastewater on public roads. It is clear that all the weaknesses and threats listed above still persist till today. This has worsened, as solid waste collection is currently at a standstill; only pre-collection continues to be carried out. The city of Parakou, which has already recorded a high growth rate of 4.84% between 2002 and 2013 (INStaD, 2013, p 14), is an integral part of cities with a high production of household waste. These different observations lead to reflections that revolve around methods of managing solid household and the strategies to improve the living environment through good management of this waste. Field observation validates these scientific results, as the final dumping site is located in a depression. The consequence is that the leachate is in touch with the water table; the aforesaid landfill does not respect any norm. However, one of the main objectives of the PGD 1 of Parakou city was to revitalize the existing solid household waste management system in that city.

After thirteen years of implementation, the situation has hardly changed, if not worsened. This means that either the plan has shortcomings or that it has not been properly implemented. What is currently observed is that the town hall has stopped collection; the dumpsites are clogged; the presence of many illegal dumpsites; the non-compliance with the pre-collection periodicity. In view of this situation, the actions carried out by the main actors and the current state of the waste management system in the city of Parakou will be presented.

2. Materials and methods

The methods were both qualitative and quantitative for a descriptive and analytical cross-sectional study. The data collection involved a literature review, determination of the sample size followed by the survey and direct observations in the field.

2.1. Presentation of the research framework

The municipality of Parakou is located in the north of the Republic of Benin between parallels 9°15' and 9°27' north latitude and meridians 2°30' and 2°46' east longitude. It is located at an average altitude of 350 m (D. D. Adjé et al, 2019, p. 300). It covers an area of 441 km2 and is the smallest town in the department of Borgou. It is bordered to the north by the commune of N'Dali, and to the south, east and west by the commune of Tchaourou. It is subdivided into three districts with a total of 58 neighborhoods (Mairie de Parakou, 2006, p. 14). Figure 1 shows the geographical location of the municipality of Parakou.

Vol. 7, No. 04; 2022

ISSN: 2456-3676

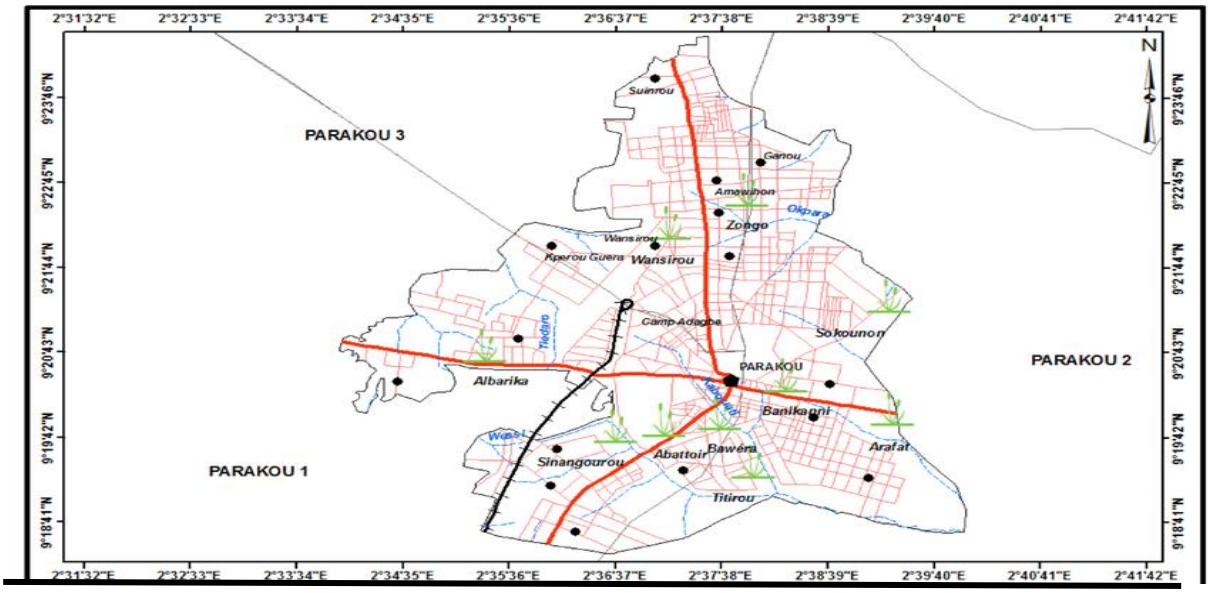

Figure 1: Geographical location and administrative subdivisions of the municipality of Parakou
Source: IGN, 1992

2.2. Data collected

The data used in this research are, among others, the demographic data of the population of Parakou from 2013 to 2021 taken from the RGPH 2013 and collected at INSAE, the average monthly rainfall from 1981 to 2018 obtained from Benin Weather report, then those on the actions of the institutional, pre-collection and collection actors involved in the household solid waste management system and on the current state of waste management.

2.2.1. Documentary research

It was carried out in libraries, documentation centres, research institutions whose activities are related to the theme of this study and on the internet. It enabled the identification and use of scientific books, dissertations, theses, reports, journals, articles and maps. These documents provided information on the study area and the research topic.

- **Sample size**

The sample size was exhaustive for the pre-collection and waste collection structures, the agents of the hygiene department of the town hall, the environmental and health police department. For reasons of conformity, the same sample sizes were retained at the level of DECAM agents (Table I). A total of 32 people were surveyed.

Vol. 7, No. 04; 2022

ISSN: 2456-3676

Table I: Sample size distribution of respondents

Structures	Frequency
NGO pre-collection of waste	16
Waste collection NGO	2
Town Hall	5
Environmental Police Service	3
Sanitary Police Department	3
ONG DECAM	3
Total	**32**

Source: Field survey results, october 2021

2.2.2. Field work

The information from the documentary research was supplemented by interviews with officials from Parakou town hall, environmental and health police, DECAM Bethesda NGO and the pre-collection and household solid waste collection structures. These investigations enabled a better understanding of the actions carried out by these different actors in the waste management system in the municipality of Parakou and the current situation of waste management in this city. The direct observation consisted then of assessing the environmental state through the management and sanitation of the collection points and the final dumping site, and then identifying and locating the collection points, the final dumping site and the headquarters of the pre-collection structures using GPS.

2.3. Data processing and analysis of results

The data collected was processed using Excel and Arc-View software. Descriptive statistics were used to calculate frequencies and averages and produce tables and graphs. The data analysis was descriptive and analytical.

3. Results

3.1. Main institutional and collection actors in the DSM management system of the municipality of Parakou

The household solid waste management mechanism in the city of Parakou involves five main actors: the mayor's office, the DECAM (Community Development and Environmental Sanitation) structure, the NGOs' pre-collection, the collection companies, the environmental and the health police.

3.1.1. City hall of Parakou

The results show that the town hall is one of the vital links in the waste management mechanism in the municipality of Parakou. It has been the primary actor since decentralisation became a reality in Benin. To achieve its mission, it has entered into a partnership with DECAM and made an effort to provide NGOs with tricycles and protective equipment. It has built several assembly

Vol. 7, No. 04; 2022

ISSN: 2456-3676

points in the three districts and a final dumping ground. Figure 2 illustrates their distribution in the city.

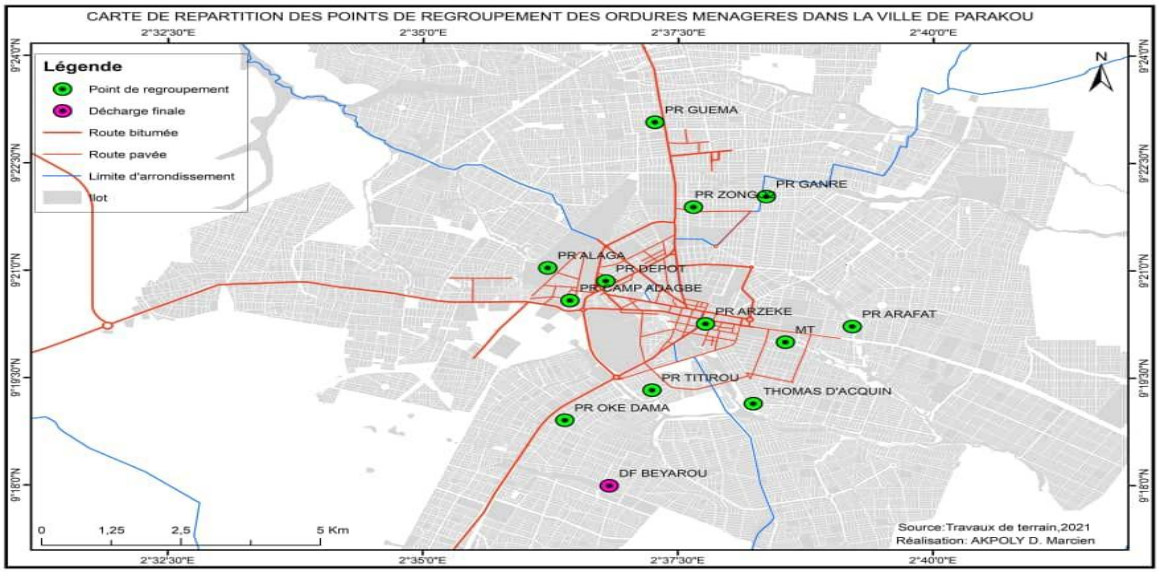

Figure 2: Mapping of collection points and final disposal site
Source: Field survey results, October 2021

Figure 2 shows that of the twelve (12) regrouping points fixed in the municipality of Parakou, five (5) are located in the 1st district, three (3) in the 2nd and four (4) in the 3rd. The only final dumping site is located in the first district, especially in Bèyèrou. This landfill is very eccentric.

3.1.2. DECAM NGO

The field investigations show that this structure, which is now the delegated project manager for sanitation issues, has been coordinating activities relating to the management of household solid waste in the municipality of Parakou since 2008. It has had to carry out a number of actions, including: the organization and implementation of NGOs for the pre-collection of MSW, the financing and implementation of the PDG (Waste Management Plan), the zoning of the city, the waste recovery and destruction of illegal dumpsites.

3.1.3. NGO pre-collection and waste collection

The results of the identification of pre-collection facilities in the municipality of Parakou reveal an uneven distribution of these facilities across the city (Figure 3).

Vol. 7, No. 04; 2022

ISSN: 2456-3676

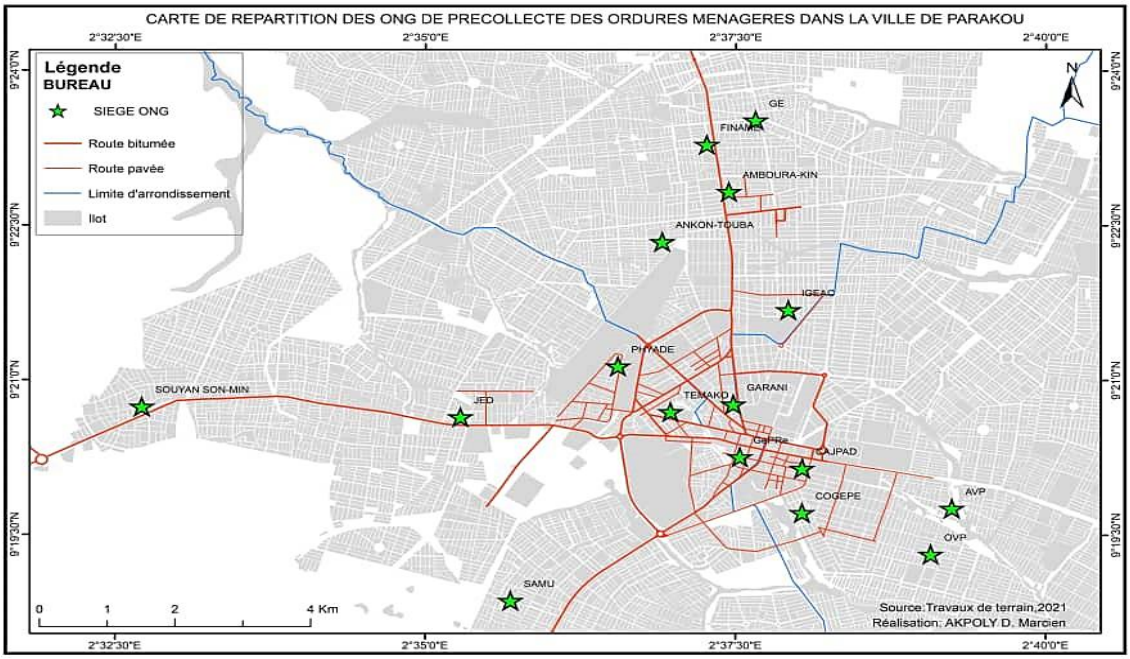

Figure 3: Pre-collection NGOs' Mapping in Parakou
Source: Field survey results, october 2021

Figure 3 shows that there is a concentration of waste pre-collection NGOs in the city centre, while they are few and dispersed in the periphery. To achieve their task, they have work teams, pre-collection equipment for MSW and protective equipment for cart operators (Table II).

Table II: Average number of work teams, pre-collection equipment and protective equipment available to waste pre-collection facilities

Variables	**Average**
number of workers	4,11
number of administrative staff	3,11
number of carts	0,22
number of trucks	0,22
number of tricycles	1,67
number of boots	5,44
number of gloves	6,56
number of hoes	2,44
number of cutters	2,33
number of shovels	3,89

Source: Field survey results, october 2021

Vol. 7, No. 04; 2022

ISSN: 2456-3676

Table II shows that the averages for means of transport and protective equipment are very low, followed by pre-collection equipment and work teams, which have average rates. It should therefore be noted that the pre-collection structures in the city of Parakou are cruelly lacking in means of transport and protective equipment for carters and refuse collectors. They do not have enough pre-collection equipment and are understaffed. Field observations also revealed ageing equipment and a poor maintenance and upkeep strategy.

With rudimentary tools and few staff, garbage collectors spread out in the neighborhoods assigned to them, collect waste from subscribing households and transport it to the collection points (Figure). Field observation and data collected from NGOs revealed that tricycles are the most exploited.

With regard to waste collection, the two collection companies hired by the town hall, Zimex-sarl and New Star, are the most used: Zimex-sarl and New Star use trucks. These companies collect the waste from the collection points to the final landfill.

3.1.4. Environmental and health police

In the field of waste management, the environmental and health police frequently deal with complaints in the city of Parakou, complaints arising from the discharge of waste by NGOs in unspecified places, the burning of waste in the open air, and the non-compliance with the pre-collection frequency. This structure also carries out actions such as raising household awareness for subscription, support for the establishment sanitary brigades, repression against those involved in anarchic DSM rejections.

3.2. Current situation of the functioning of the DSM management system in Parakou

Observations and field investigations show that the solid household waste management system in the municipality of Parakou consists mainly of pre-collection, collection and treatment through embryonic recovery and traditional dumping.

3.2.1. State of pre-collection and collection of waste by approved structures

The data collected from DCAM-Bethesda officials, waste collectors pre-collect waste from 31.50 per cent of households in the city of Parakou for the collection points. The collectors collect the waste from the collection points to the final dump. Today, the collection stage, which represents an important link in the household solid waste management chain, is neglected because the town hall is at its wits' end. This lack of collection services means that the collection points are overflowing with waste. This waste overflows the site and makes traffic difficult (Photo 1). So, garbage collectors are forced to dump the waste at the front of the sites.

Vol. 7, No. 04; 2022

ISSN: 2456-3676

Photo 1: Partial view of an assembly point in Woré that has been overrun to the front

Shooting: YEMADJE, October 2021

Photo 1 shows the dysfunction of a collection point in Woré. According to the leaders of pre-collection structures, most of the collection points in the municipality of Parakou are overflowing with waste. This is not without consequences for the accessibility of the sites.

3.2.2. Access to the collection point

Figure 4 shows the opinion of those responsible for pre-collection facilities on the problem of accessibility to collection points.

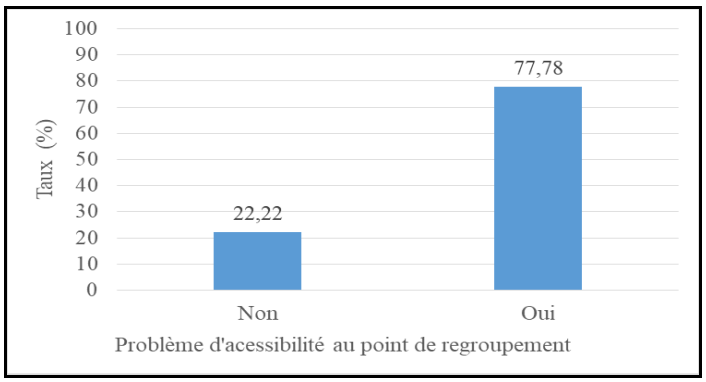

Figure 4: Access to the collection point

Source: Field survey results, October 2021

Figure 4 shows that nearly 7/9 of the managers of pre-collection facilities, i.e. 77.78%, claim to have difficulties in accessing the collection points. According to the managers, the non-accessibility is not only linked to the overflow of waste but also to the state of the access roads, which are deteriorated. They also reported that this situation means that most of the machines regularly break down. In this very painful circumstance, a surplus of work falls on the heads of the pre-collection structures. The pre-collectors are obliged to take the waste directly to the final

Vol. 7, No. 04; 2022

ISSN: 2456-3676

dump or evacuate it to the illegal dumps that are multiplying throughout the city. This situation does not fail to exasperate the residents of the dumpsites. The vast majority of pre-collection NGOs also expressed this concern (Figure 5).

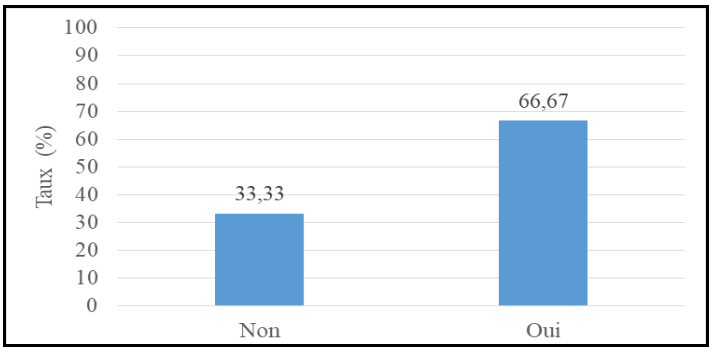

Figure 5: Frequency of complaints from people living near collection points

Source: Field survey data processing, october 2021

Figure 5 shows that more than two thirds, i.e. 66.67% of the population located near the collection points complain. According to the statements made by those in charge of pre-collection facilities, these complaints are diverse and can be summed up as nauseating odors, the proliferation of flies and mosquitoes, waste that washes up in their homes due to the wind, and leachate that flows into the neighborhoods when the garbage collectors pass by.

3.2.3. Waste treatment

According to field investigations, treatment by dumping is more common in the city of Parakou. Recovery is almost non-existent.

- **Valorisation des déchets**

Recovery is almost non-existent. It is more noted at the level of households, craftsmen and is limited to reuse, re-employment and traditional recycling. The solid household waste recovery project is no longer operating because the contract has expired. It should be added that the raw material, the biodegradable waste used for recovery, is small in the amount of waste collected. These few forms of recovery go along with traditional dumping in the city of Parakou.

- **Traditional waste disposal**

Traditional dumping is the main means of waste disposal in the city of Parakou. This method is used by both households and facilities. Table III shows the landfill sites currently used by pre-collection facilities in the city of Parakou.

Vol. 7, No. 04; 2022

ISSN: 2456-3676

Table III: Place of deposit of waste by pre-collection NGOs

Place of deposit of pre-collected waste by Pre-collection facilities	Percentage (%)
Final disposal	52,2
Collection point	25,0
Fly-tipping	10,3
Consolidation point and final disposal	12,5
Total	100,0

Source: Field survey results, October 2021

Table III shows that the most common waste disposal site used by the pre-collection facilities is the final dump (Photo 2). More than 52% of the pre-collection facilities reported depositing waste at this site. The remainder of the facilities stated that they dump waste at the consolidation points in order of importance, at both the final dump and the consolidation point, and then at the illegal dumpsites (Photo 3).

Photo 2: Partial view of the landfill

Photo3: Partial view of an uncontrolled dumping ground behind

Plate I: DSM drop-off locations in the city of Parakou
Shooting: YEMADJE, octobre 2021

Photo 2 shows that the final dump is not fenced and does not benefit from any management and monitoring. Also, there is no difference between the wild dump (photo) and the final dump.

4. Discussion

The management of household solid waste in the city of Parakou has been a major concern for both the local authorities and the population for several years. This situation is mainly linked to the rapid growth of the population, which goes hand in hand with the increase in the quantity of waste. However, the city is still struggling to ensure effective and sustainable management due to the lack of financial and technical resources. The results of a field survey identified five main

Vol. 7, No. 04; 2022

ISSN: 2456-3676

institutional and pre-collection actors who are working hard to ensure good waste management in the city. Each of them has specific tasks. These are: the town hall, the DECAM structure (Community Development and Environmental Sanitation), pre-collection NGOs, collection companies and the environmental and health police. They are confronted with difficulties while carrying out their mission. These are: lack of personnel, insufficient transport and protection equipment. These results confirm those of S. T. Dansinou et al, (2019, p 1154). Garbage collectors pre-collect waste from 31.50% of households in the city of Parakou at the collection points. They collect the waste from the collection points to the final dump. The height is that the collection is at a standstill and the direct consequence is the overflow of waste to the front of the collection points. This state of affairs slabs the passage. These results are similar to those of B. G. Tanhoun (2010, p 51) who found that the household waste management system in Parakou essentially boils down to primary and secondary collection via private providers. These results are also similar to those of M. Kple (2015, p. 8) who showed that the collection of household solid waste, which is often the responsibility of the communes' technical services, is poorly carried out due to a lack of suitable operational rolling stock. A. G. Dje (2012, p 133) came to the same conclusion about the institutional failure of urban household waste management structures in Abidjan in the communes of Cocody, Yopougon and Abobo. According to her, the pace of pre-collection does not follow that of collection. There is then a lack of coherent coordination between the two stages of action. This displacement obviously leads to insalubrity in the city. Also, B. G. Tanhoun, (2010, p 51) came up with a proposal for a compacted (expensive) controlled landfill that could accommodate the waste production of the city of Parakou for a period of 20 years. This contradicts our decision of a landfill without treatment of leachate or gas from fermentation. This choice is driven by the level of development of the municipality, which cannot accommodate an overly sophisticated and expensive technology. Indeed, although a landfill is a time-limited project, its effects are not. It is crucial to consider the two stages of impact: during operation and after closure and sometimes rehabilitation (M. P. Aïna, 2006, p 36). However, the findings of Dansinou et al, (2019, p 1159) in a study on the viability analysis of NGOs collecting solid household waste in the commune of Parakou concluded that most NGOs do not have enough equipment and work tools per worker; it would therefore be important to take action to clean up the city of Parakou; increase the equipment for transporting waste (carts, tricycles and trucks) and work tools (hoes, shovels, rakes and cutters); carry out awareness-raising campaigns to ensure that the laws governing the management of household waste are respected; provide these NGOs with appropriate equipment and tools for collection, taking into account the area of intervention, the distance travelled by the NGO for the work, the weight and composition of the waste collected, the frequency of collection, the condition of the roads, etc. These same results also corroborate those of Din and Cohen (2013, p 43) that the lack of tools to carry out collection is a feature of the household waste management system in West Africa. Our results are also in line with those of Rouyat et al. (2006, p 21) that most NGOs are also struggling to renew and expand their equipment in Senegal.

Tibaijuka (2010), quoted by Daninou et al (2019, p 1159), came to the same conclusion when he stated that the choice of appropriate collection equipment is very important to limit repair and depreciation costs. The author considers that some equipment is not suitable for collection in a

Vol. 7, No. 04; 2022

ISSN: 2456-3676

given area. The equipment subjected to heavy loads of waste that exceed its capacity and used in degraded areas deteriorates more quickly. The equipment should be chosen according to the collection area, the amount of waste produced by households, the density of garbage, the distance of garbage transport, etc. The results from Tibaijuka are consistent with our results in a context where the town hall has completely disengaged from collection. The NGOs therefore need to be provided with powerful equipment so as to take over the collection. However, there are remote corners that are difficult to access for which the use of tricycles will have to be continued.

Likewise, studies by L. Citeretse (2008, p 17) on 'Solid household waste in the city of Bujumbura (Burundi): What prospects for sustainable management?" concluded that rubbish collection is limited by the inadequacy of the road system and the lengthening of distances due to the expansion of neighborhoods. He goes on to write that the municipal technical services have set up a system of waste collection by truck, but the latter is often hampered by the lack of sufficient financial means, which is manifested through the lack of fuel, the lack of maintenance of vehicles and prolonged breakdown of equipment (I. Citeretse 2008, p 27). In Parakou, this problem is expressed by the NGOs when they talk about the difficulty of accessing the dumpsites.

Conclusion

It emerges from the analysis that after 13 years following the implementation of the first Waste Management Plan in the city of Parakou in 2010 and after the two updates (2017 and 2021), the city of Parakou is far from being immune to the problems inherent in the optimal management of household solid waste, since shortcomings have been noted from the pre-collection stage to the final disposal stage. Indeed, in view of the current situation, it was noted that it is the implementation of the plan that has not been well done, although good intentions have marked the various plans, only the acts are struggling to follow. In fact, field surveys have shown that fifteen (15) pre-collection structures operate in the household solid waste management sector in Parakou, supervised by DCAM-Bethesda NGO, which is considered as resourceful by the town hall. However, many NGOs deposit the collected waste at the final dump, indicating that access to collection points is problematic. Thus, problems of accessibility to the dumpsites and opposition to dumping by people living near the dumpsites, as well as those of under-equipment of pre-collection NGOs arise. Currently, what serves as a final dump is located in a watershed, this poses the problem of groundwater pollution by leachate. In short, to overcome all these shortcomings noted in the field by the household solid waste management structures, it urges to create at least three worthy dumpsites, one per district so as to raise awareness of the need to subscribe and to equip NGOs for the pre-collection of household waste in the city of Parakou.

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Vol. 7, No. 04; 2022

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