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Problems of solid household waste management in parakou

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Abstract

The management of solid household waste (MSW) is a challenge for large cities in sub-Saharan Africa. The city of Parakou is experiencing difficulties in this regard. The objective of this research is to analyze the management of MSW in Parakou. The methodological approach adopted is based on Participatory Action Research (PAR). This method is based on documentary research and data collection. The fieldwork consisted of observation, direct interviews and the administration of questionnaires with one hundred (100) subscriber households, the technical staff of the town hall, the managers of the pre-collection and collection structures and the workers. These tools made it possible to collect socio-economic data. The processing and analysis of the data provided results using the SWOT model.

The management of MSW has become a major concern of the municipal authorities. The city has nine (09) Assembly Points (APs), seven (7) of which are functional, built and not. The MSW is not sorted, let alone treated, and is dumped in the final dump. The production of MSW in the Commune is approximately 197 tons in 2019. In spite of the positive change observed in the management of MSW in the city, illegal dumping is a distressing sight in the urban landscape. The nauseating and pungent odors harmful to health, but also nuisances such as: dust and black fumes, contain toxic substances for humans and living organisms.

Keywords: Parakou, household solid waste, participatory management

1. Introduction

The world is under the influence of numerous natural and human crises that shake it and threaten its existence. In the same way, man, by his multiple actions, contributes to the permanent degradation of his environment. Air, soil and water pollution and climatic crises are all threats to the environment in general and to humans in particular (J. A. Akpaki, *et al.*, 2009, p.2) ^[2]. The last decades are marked by many environmental challenges related to industrialization, economic development, population growth, urbanization or changing lifestyles (R. Gbinlo, 2010, p.1) ^[8]. Households produce waste as they seek to satisfy their basic needs such as food, heating, in short consumption. With population growth and rigid urbanization, uncontrolled waste production has become so significant that it poses a real problem for the governance of urban agglomerations in developing countries (DCs) (M. R. Bangoura, 2017, p.24) ^[12].

Economic growth, if accompanied by an accelerated exploitation of natural resources, its natural resources, its corollary, the production of waste, is by definition inevitable. More than a more than a theoretical issue, it poses an enormous logistical and economic problem for city administrators, especially in developing countries. The generation of the production of household solid waste (MSW) is increasing all over the world due to changes in lifestyles, increased purchasing power and the individualization of products through packaging that no longer serves other purposes (R. Gbinlo, 2010, p.4) ^[8].

Furthermore, the decentralization processes underway in African countries provide a new opportunity to confirm the particular importance of waste management. Thus, MSW management is considered one of the main municipal services in the sense of strategic direction and administrative authority (M. Kple, 2015, p.3). These municipalities are faced with strong population growth, as well as changing consumption patterns that result in increased waste volumes. This situation, the effects of which are visible to all, causes significant nuisance for the inhabitants and has adverse consequences on the health of the populations, the environment and natural resources (S. A. Wari, 2012, p.2) [14]. The municipality of Parakou is faced with a strong growth of its population (60915 79 in 1979; 103577 in 1992, 149 819 in 2002 and 255 478 in 2013) as well as a change in consumption

patterns that results in an increase in waste volumes. This situation, the effects of which are visible everywhere, causes significant nuisance for the inhabitants and has harmful consequences on the health of the populations, the environment and natural resources.

2. Materials and Methods

2.1 Study environment

The Commune of Parakou is located between 9°20'45" and 9°20'47" North latitude, and between 2°36'35" and 2°38'39" East longitude. It is bordered to the North by the Commune of N'dali, to the South, East and West by the Commune of Tchaourou. It comprises three (03) districts and fifty-eight (58) city neighborhoods. Figure 1 shows the geographical location map of Parakou.

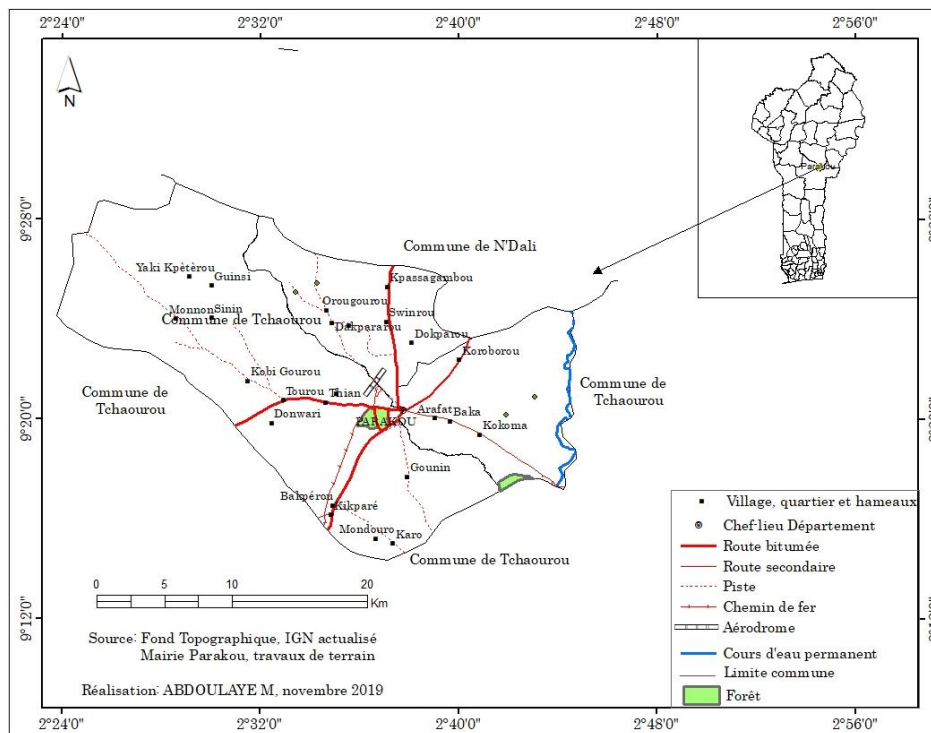


Fig 1: Geographic location of the commune of Parakou

The population of the commune of Parakou, unevenly distributed in the three districts, increased from 149,819 inhabitants in 2002 to 255,478 inhabitants in 2013 (RGPH4, INSAE) with an average annual growth rate of 4.90%. Three quarters of this population live in the truly urbanized area. The commune of Parakou is the smallest in the department of Borgou with an area of 441 km² and an average density of 510 inhabitants/km².

2.2 Methodology

The methodological approach used in this research concerns the collection of quantitative and qualitative data. The quantitative data relate to the number of actors involved in waste management (NGOs, carters, etc.). The qualitative data consists of the assessment of the environmental state of the city of Parakou and its inhabitants. To obtain this data and information, we collected and analyzed various documents on waste in the city of Parakou. This approach consisted first of all in doing research on the Internet and other organizations likely to provide information on this topic. It allowed us to identify the scientific works, journals and

articles, and the basic and thematic maps needed to analyze household solid waste management and pre-collection activities. Table I presents the sample for this research.

Table 1: Study Sample

Person surveyed	Proportion
Households	100
City hall officials	3
Managers of collection structures	2
Managers of pre-collection structures	5
Workers	10
Total	120

Source : Fieldwork, January 2020

The analysis of the table shows the different people surveyed during this research. The criterion for choosing households is related to the loyalty of the household in the context of the subscription to the pre-collection structures. As for the other respondents, the choice was random according to the availability of the respondents.

3. Results

3.1. Technical stage of household solid waste management

Theoretically, the waste management chain is made up of 3 essential links includings:

- pre-collection, which consists of bringing the waste from the places of production to the primary collection points indicated (grouping point). It can be done either by voluntary contribution of the producer or through local service providers against payment. It is of simple technicality and the tools and equipment, depending on the level of service desired, are still affordable and available locally.

- collection is the removal of waste from the place of production (e.g. markets) or from the place of collection to the place of elimination through recovery or dumping. This segment requires a little more organization and technicality and relatively more important means.

- the elimination of waste by recovery and/or landfill, which is highly technical and requires large investments often accessible to the State and the private sector. This involves the construction of landfills. As for recovery, its success depends on 3 main ingredients: political will, a market and determined people. However, the waste collected every day is deposited in an old sand quarry, located in the Damagourou (Okédama) district, which serves as a final landfill without any recovery and sorting.

- Subscription rates and coverage levels

Statistics reveal that subscription rates vary from 10% to 66% depending on the neighborhood covered, with an average of 32% for the entire city of Parakou. Up to October 2019, there are 7738 households subscribed to the pre-collection structures. Despite this growing number of subscribers (7,000 households in 2018), uncontrolled dumpsites still exist, especially in the outlying neighborhoods, but also in the city center on empty plots. Photo 1 shows a pile of garbage in Zazira.



Photo 1 : Garbage heap in the Zazira neighborhood

Shot: Moussadikou ABDOULAYE, January 2020

From observation of Photo 1, it appears that the empty plot has been transformed into a wild dump, despite the presence of pre-collection NGOs in this neighborhood.

- Garbage collection sites

The city of Parakou has nine (9) consolidation points (intermediate dumps) but seven (7) are functional (built and

not built). In fact, four (4) consolidation points have been built thanks to the Parakou/AIMF/Mairie d'Orléans partnership. These are the assembly points of Arafat, Nouveau quartier, Damagourou and Woré. Two others were built by the partnership with DCAM-BETHESDA ONG in Banikani (end of post) and Titirou. And finally, the Banikanni collection point is undeveloped (still in a wild state). The waste is then taken to the final dump, located in the Damagourou (Okédama) district. The dump site is undeveloped and easily accessible to everyone. Plate 1 shows the collection points in Banikanni and Arafat.



Photo 2a: Grouping point in Banikanni.



Photo 2b: Grouping point in Aarafat

Shot: ABDOULAYE M., January 2020

The analysis of Plate 1 shows the condition of the collection points. The Banikanni collection point is not equipped, the MSW is on the ground, and during the dry season it invades the homes of residents under the effect of the wind, especially plastic bags. While the one in Arafat has been developed to avoid the infiltration of certain substances contained in the waste during the rainy season and especially to prevent people from coming to look for precious objects at the risk of exposing themselves to other diseases. However, human-drawn cart operators are not equipped with personal protective equipment and are therefore exposed to the risks associated with household solid waste management. Figure 2 shows the mapping of the intermediate and final dump sites.

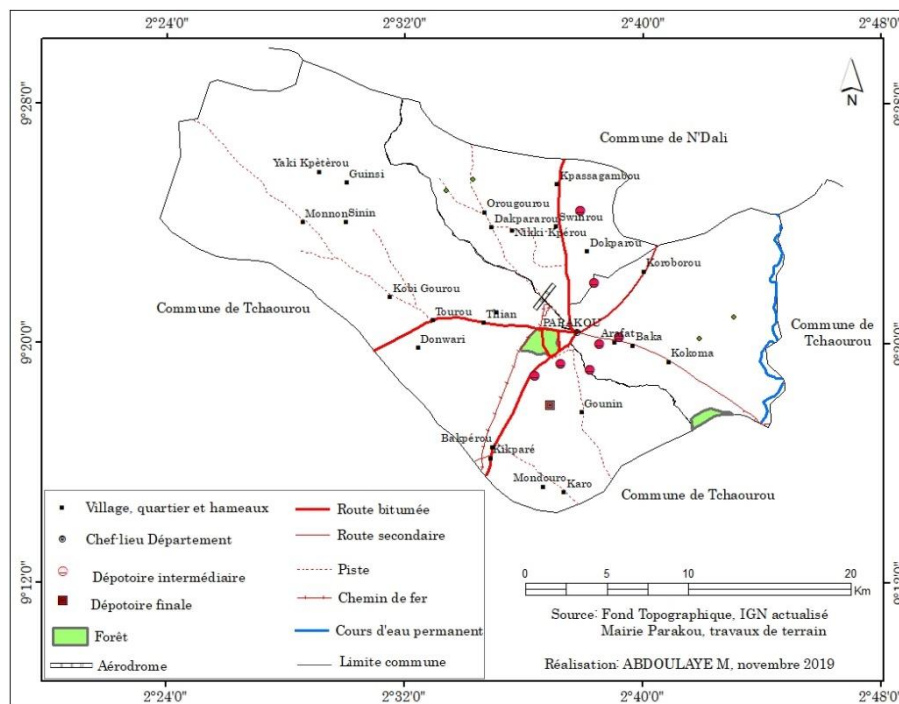


Fig 2: Mapping of Intermediate and Final Landfills

Figure 2 shows the mapping of the consolidation points but also the final landfill.

3.2. Quantity, nature and composition of waste produced in the city of Parakou

Quantity and Nature of Waste

The quantity of household waste produced is estimated on the basis of the population and its specific production. Thus, the estimated production of solid household waste for the entire Commune is 148 tons per day for a population of 255,478

inhabitants in 2013, this production is about 197 tons in 2019. These estimates are based on 2013 Population and Housing Census data with an average growth rate of 4.90% and a population of 255,478. The waste production is taken from the data of the study conducted by the NGO Bethesda in the commune of Parakou and included in the Report on the Household Solid Waste Management Plan.

Table 1 presents the estimated daily and annual waste production by 2030, assuming a constant specific production (inhabitant/day).

Table 1: Annual waste production in the commune of Parakou

Year	Growth rate	Population (hbt)	Specific production (hbt/d)	Quantity of waste generated per day (tons)	Quantity of waste generated per year (tons)
2013	4.9	255 478	0,58	148	54 054
2019	4,9	340 413	0,58	197,43	72 107,30
2025	4,9	453 585	0,58	263,07	96 080,98
2030	4,9	576 150	0,58	334,16	122 166,16

Source: Municipal MSW Management Plan

Currently, 197.43 tons of waste are produced per day according to our estimates, or more than 72,107.30 tons per year, and by 2030 this production may reach 334.43 tons per day and 122,166.16 tons per year. However, the current collection rate of pre-collection NGOs is estimated at less than 50% according to data from BETHESDA ONG. It is therefore urgent to strengthen the capacity of pre-collection NGOs in terms of equipment, human and financial resources,

as well as collection structures.

Physical composition of waste

The physical characterization of the waste indicates a dozen different waste compositions, the highest proportions of which are fine materials and organic waste, respectively 38.12% and 35.85%. Table 2 presents the characterization and proportion of waste produced in the city of Parakou.

Table 2: Characterization of waste in the city of Parakou

Waste composition	Weight in Kg	Proportion (%)
Organic waste (dead leaves, leftover ruminant food, ...)	108,80	35,85
Battery	0,25	0,08
Paper - cardboard	8,56	2,82
Textiles	19,81	6,53
Glassware	7,76	2,56
Fine materials (sand and other fine residues)	115,67	38,12
metals	4,76	1,57
Hard plastic (bottle, can, other containers)	4,25	1,40

Bones	0,75	0,25
Plastic films	30,09	9,92
Others (please specify)	2,75	0,91
Total	303,45	100

Source: Municipal MSW Management Plan, 2017

The analysis of Table 2 reveals that construction residues such as stones, concrete blocks, sand occupy an important place in the production of household waste. Organic, biodegradable waste also occupies an important place whether it is food scraps or agricultural detritus; some of it is used by city farmers, more numerous in the outlying neighborhoods to fertilize the soil of the yard or empty plots used as fields.

2.3 Mapping of illegal dumpsites

Despite the many efforts of the municipality of Parakou to make the living environment clean for its population. The number of uncontrolled dumpsites continues to increase in certain areas of the city. This situation is linked to population growth and urban dynamics. However, existing pre-collection NGOs continue to work to meet the needs of subscribing households. Figure 3 shows the mapping of uncontrolled dumpsites in the city of Parakou.

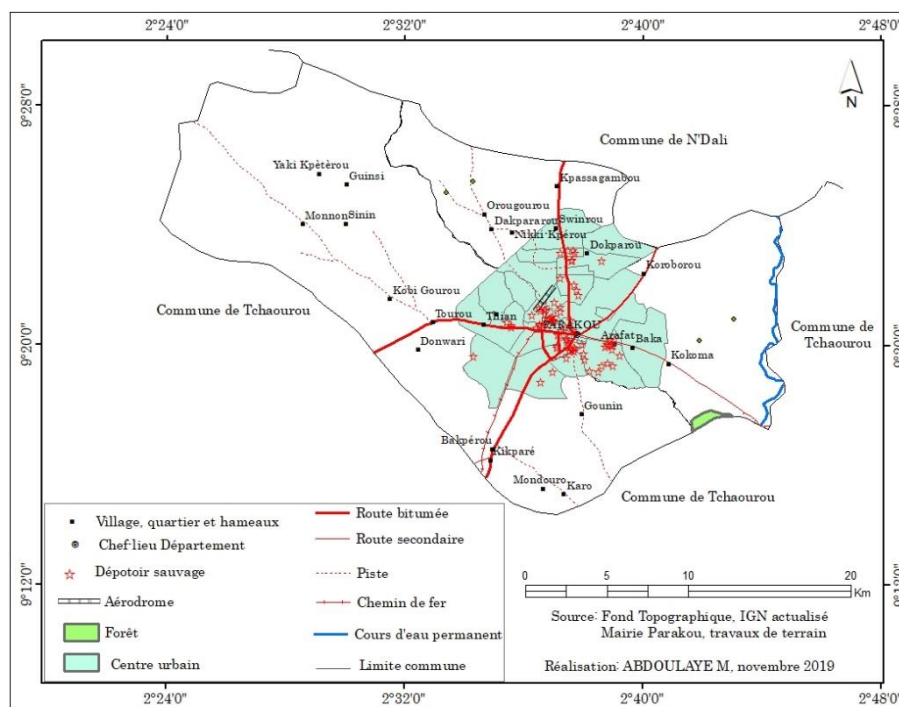


Fig 3: Map of Dump Sites

The analysis of Figure 3 shows that the ninety-four (94) dumpsites are more concentrated in the heart of the city. Despite the presence of pre-collection structures, this is due to the unwillingness of some households to subscribe. They prefer to throw their waste in the shallows, empty plots, etc.

3.4. Impacts of waste management on health and the environment

3.4.1. Health impacts of waste management

The different treatment processes can generate specific pollutant emissions:

- Collection operations can contribute to the diffusion of dust and microorganisms that can damage the respiratory tract or tissues (mycosis),
- Anaerobic fermentations occur on compacted storage sites and generate traces of toxic mercaptans and significant quantities of hydrogen sulphide and methane, a greenhouse gas that is explosive in certain concentrations,
- The combustion of waste and the gases it generates emits oxides of carbon, nitrogen and sulfur, acids, dust and volatile organic compounds. These emitted substances are diffused in the environment and are likely to have a

health impact on the neighbouring populations.

Thus, this gives information on the dangers that the populations living near the various dumps and the landfill run:

- the proliferation of flies, mosquitoes and cockroaches. Flies land on the uncovered food of the houses surrounding the gathering points (infections, diarrhea) ;
- Mosquitoes invade homes. These populations are victims of diseases such as : malaria.

The final dump located in Damagourou is not well equipped to receive all categories of waste efficiently. Trucks dump waste there in an uncontrolled manner, with waste being deposited even on the access road. The irregular dumping on the edge of the access road is a hazard for traffic jams, as well as a permanent handicap for truck traffic.

The final dump is at one with a swamp, resulting in contamination of the water table. In addition, this dump is regularly searched by young people in search of elements that are still usable (scrap metal, cans, bottles, shoes, clothes). This constitutes a great health risk for the population of the city.



Photo 3: Final dump, visited by youth

Shot : ABDOULAYE, M, January 2020

The observation of the photo 2 shows the teenagers investigating objects for various needs. These are: cans, scrap metal, clothes, shoes, cans.

Impacts of waste management on the environment

Impacts on the organization of the landscape and space

Waste in general occupies a significant amount of space that increases over time and according to population dynamics. It also has an impact on the visual quality of the landscape. For example, it is noticeable that the area reserved for waste is no longer usable by the population and domestic animals. The allocation of land to the storage and disposal of waste requires a particular management of space, including the protection of the site, the organization of access roads, the development of infrastructure for disposal, ...

▪ **Impacts on flora and fauna**

At the level of the flora: the deposits of waste can involve the destruction of the elements

of the flora which are useful for the human population and the animals (medicinal plants, plants being used as pasture, the trees being used as nesting boxes of the birds,?); certain plants can assimilate substances resulting from these waste and transmit them to the animals which are consumed by the humans; the environments of deposit of waste can become favorable frameworks of the proliferation of the cryptogamic flora (mushrooms) and the population which would come to be supplied by it can be infected by the waste

At the level of the fauna: the waste can contaminate the animals which search for food, the animals can be wounded during the trampling of the sharp or pointed elements in the places of storage of waste. This can lead to infections that can result in the death of some animals; some waste can be used as food by some animals.

▪ **Impacts on the air**

Waste impacts the air in a number of ways: fumes from burning burning often wet waste contains carbon monoxide, carbon dioxide, dioxins, chlorofluorocarbons (CFCs), some of which may affect the ozone layer or contribute to the greenhouse effect.

The storage of waste often leads to the release of unpleasant odors that are inconvenient for the surrounding population. Therefore, it is important to choose the right storage and disposal site to avoid affecting the air in populated areas. It is

important to note that the final dumping site in Damagourou is very disturbing to the population of this area because of the unpleasant odors it emits.

▪ **Impacts on water**

The final landfill is at one with a watercourse. Indeed, runoff water carries part of the waste in formal or informal deposits into the watercourse. The consequences of this phenomenon are multiple, one can quote:

- **Turbidity:** water loaded with suspended matter is very turbid. This water source is exploited by farmers in the area. The latter are then exposed to the risks of contamination of diseases related to infection. Also, this waste contributes to the filling of the environment and suffocates the aquatic biodiversity.
- **Eutrophication :** the nitrogen and phosphorus elements contained in household waste contribute to the enrichment of the aquatic environment in mineral elements and there can be an algal bloom which leads to the eutrophication of the aquatic environment.



Photo 3: Final disposal site located near a watercourse

Shot: ABDOULAYE, M, January 2020

The analysis of Photo 3 reveals that the landfill slightly fills a watercourse. This situation has many disadvantages on the flora and fauna of the environment through the pollutants contained in the solid household waste.

4. Discussion

In the city of Parakou, the waste collected every day is deposited at the level of the regrouping points (intermediate dumps), then in an old sand quarry, located in the Damagourou district (Okédama) which acts as a final dump without any valorization and sorting. According to R. Gbinlo (2010, p.18) ^[8] the treatment of household waste, in particular, is still very underdeveloped, apart from uncontrolled dumping, which can no longer be allowed to continue in view of the significant damage it causes to the environment in the city of Cotonou. As for S.A. Wari (2012 p. 26) ^[14], there is currently no transit center or technical landfill center as such, except for controlled dumping sites that exist to receive waste of all kinds in N'Djaména (Chad). In Abomey-Calavi, the household solid waste management system is reduced to pre-collection, which is the only functioning link, as no collection or disposal activities are operational. This situation has enormous consequences for human health and the environment. Several authors have

shown the health and environmental risks of MSW. The accumulation of quantities of waste in a city creates problems that degrade its living environment: foul odors, larvae breeding sites, air, water and soil pollution, etc., which must be eliminated. The following authors have reached the same conclusions : M. R. Bangoura (2017 p. 87) ^[12]; J. A. Akpaki et al, (2009, p. 13); ^[2] S. Babioet al, (2016, p. 7).

Despite the will of the authorities to ensure a pleasant living environment for the population, and the effort of the pre-collection structures, the wild dumps present a desolate spectacle in the city of Parakou. These results are identical to the work of several authors J. A. Akpaki *et al*, (2009, p. 13) ^[2]; R. Gbinlo (2010, p. 18) ^[8]; J., D. Gevalor (2018, p. 8); M. Kple (2015, p. 52); P. Laviolette (2007, p. 17) ^[10].

5. Conclusion

The large production of waste, its proliferation in public places and the organization of the sector have led to the emergence of household solid waste management activities in the city of Parakou. Waste management activities are organized by NGOs, which make extensive use of carters. Despite the dynamic organization of the sector, solid household waste continues to litter the streets, major arteries and public places, and some illegal dumps tarnish the image of the city. The populations are exposed to health and environmental risks.

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