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Waste Management in Cosmopolitan West African Cities: Towards the Need for Environmental Education of Populations

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Authors' contributions

This work was carried out in collaboration among all authors. Author MG designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SAA and MNB managed the analyses of the study. Author RCT managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The majority of cosmopolitan cities are affected by the environmental problems inherent in the phenomenon of urbanization, which have a negative impact on people's lives. This article analyzed actors' perceptions on strategies for managing the environmental problems facing cosmopolitan West African cities through the case study of Parakou in Benin. The exploratory qualitative approach based on group and individual interviews was used. The data collected relate to the environmental problems of the city, the reasons for the persistence of the problems, and the strategies to be implemented for a better management of these problems. Qualitative speech analysis and descriptive statistics were used to analyze the data. It emerged that household waste (solid and liquid) is the main environmental problem of the city. The persistence of these problems is explained by the incivility characterized by ignorance, irresponsibility and indifference of the

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population. The population supports that awareness raising and education in environmental management is a core solution to prevent and avoid the environmental problems of big cities. But how to ensure this environmental education of the population for an efficiency management of the environmental problems of cities?

Keywords: Environmental problem; household waste; management strategy; West Africa.

1. INTRODUCTION

Africa is considered nowadays as a continent that is urbanizing at a cruising speed through the accelerated growth of its megacities and even small towns [1]. In almost African countries, there is a propensity for an increasing concentration of populations in megacities [2,3]. This propensity is supported by the rapid migration of rural populations in search of better living conditions [4]. According to [1], Africa's urban population will more than triple, from 395 million in 2010 to 1.339 billion in 2050, corresponding to 21% of the world's projected urban population. This rapid population growth is one of the drivers of the environmental crisis that underlies the environmental problems of sub-Saharan Africa [5]. The inescapable consequence of this situation is that, whether in Africa or elsewhere in the world, it is accepted that the environmental crisis is caused by the impact of human activity [5]. This means that rapid urbanization, when poorly managed, endangers the health of populations [3]. This contributes to the spread of various infectious diseases in the megacities, affecting vulnerable groups, mainly women and children [4].

In recent years, the management of environmental problems in megacities has become a particular concern in order to preserve the health of the population [6]. Demographic explosion, human activities, insufficient financial resources of local governments and lack of effective waste management policies are some of the factors that explain the presence of waste in sub-Saharan African cities [5,7]. [8] also argued that the health of populations is strongly influenced by strategies to manage environmental problems, particularly household waste. The implementation of effective and efficient management strategies is necessary and requires a good understanding of the environmental problems specific to cosmopolitan cities as well as stakeholders' perceptions of the strategies for their management [6,9,10]. This paper is part of this logic through the analysis of stakeholders' perceptions on the management strategies of environmental problems in cosmopolitan cities. The paper is based on the case study of the city of Parakou, the third of the three megacities in Benin and the capital of the northern part. In recent years, a strong proliferation of waste has been noted in the city of Parakou. The efforts of municipal officials have not, however, led to real changes in the behavior of the population, as shown by the persistence of the problems decried. An understanding and consideration of the perceptions of these populations allows for an improvement in the strategies for managing environmental problems.

2. METHODOLOGY

2.1 Study Area

The study is carried out in the municipality of Parakou. Parakou is recognized as the capital of the north and the third city with a special status in Benin. The waste management became the major issues in this municipality. The annual production of household waste in the city of Parakou is estimated at 30,295 tons, of which an average of 12.5% is actually collected [11]. Nowadays, the city's population has more than doubled and environmental problems have become a concern. The data used in this article were collected in the urban areas of Parakou. The city neighborhoods involved are presented in Fig. 1.

2.2 Observation Units and Sampling

The observation units in this study are globally the population of the city of Parakou and the key informants: Environmental police officers, the forestry inspection of the department of Borgou, the Borgou health police brigade and the land and environment directorate of the municipality of Parakou.

At the level of the population, the choice is random because every inhabitant of the city of Parakou is supposed to be able to give his perceptions on the environmental problems he has noticed in the city. The three (03) districts of Parakou are involved in data collection. The total sample size is 171, varying by district based on its density of population.

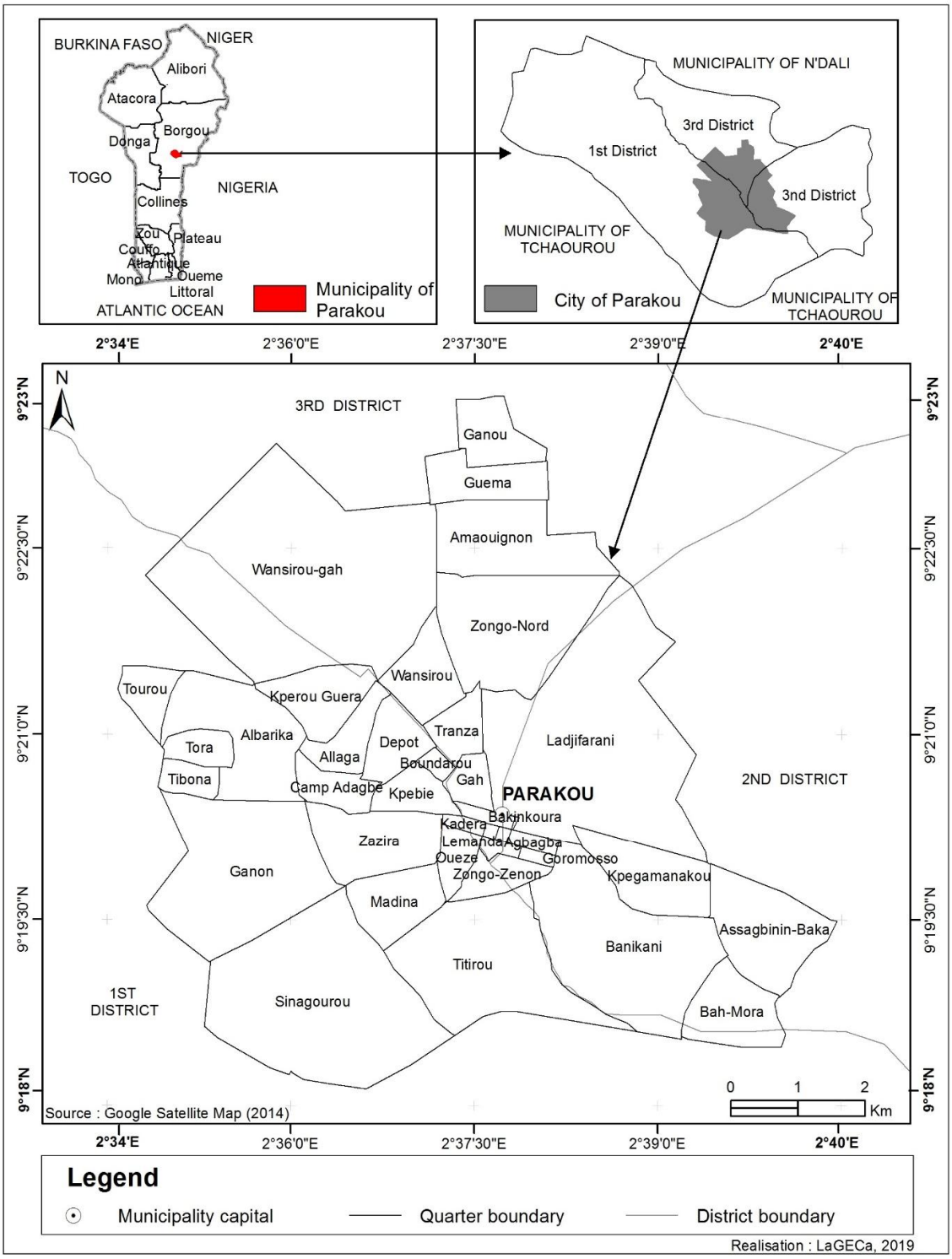

Fig. 1. Situation of the study area

2.3 Data Collection and Analysis

Two methods were mainly used for data collection.

(i) Group interviews

At the population level, six group interviews were conducted, two in each district. To facilitate the management of the interview, the size of the participants is set at a maximum of 10 individuals. In order to have reliable information during group interviews, participants are categorized in two groups in terms of age, according to [12]. Thus, in each district, the first group interview took into account young people (between 18 and 35 years old) and the second took into account adults (over 35 years old) [13]. In addition, the group interviews are also used with key informants. The group interviews focused on three main informations:

- The environmental problems observed in their living environment;
- The reasons for the persistence of the main environmental problems;
- The perceptions on the strategies to be put in place for the management of the main environmental problems.

(ii) Individual interviews

The results of group interviews are used to draw up a questionnaire. The aim is to evaluate the importance of environmental problems, the reasons for their persistence and the management strategies at the level of the population.

These two main data collection methods were supplemented by direct observation of the environmental problems in the city during.

The exploratory qualitative approach was mainly used in this study. The discourse collected during the group interviews was analyzed using speech analysis. This method of analysis allowed to transcribe the content of the speeches and identify the key messages. In this way, the reasons and perceptions of actors on the strategies or actions to be taken to remedy environmental problems were synthesized. Then, the strategies proposed by actors were categorized according to the targeted action groups: education, repression/sanction, infrastructure/funding, empowerment, based on the work of [8,14–17]. Descriptive statistics are used to calculate the frequency of actor's perceptions. According to key informant perceptions, a categorization of the main environmental problems evolution were assessed through a three-level scale:

- Less severe: when people consider that the main environmental problems were not noticeable in the city or that they were practically absent in the city 10 years ago.
- Moderately severe: when people consider that the main environmental problems were already noticeable in the city 10 years ago but they were not as important as they are today.
- Very severe: when people consider that the main environmental problems observed in the city of Parakou 10 years ago were more important.

3. RESULTS

3.1 Main Environmental Problems of the City of Parakou

The environmental problems identified in the city of Parakou are various. They include household waste (solid and liquid), plastic bags, nauseous odors, noise pollution, obstruction of gutters and open defecation (including public places). The importance of the environmental problems identified varies according to the districts of Parakou (Table 1).

In the city of Parakou, household waste, both solid and liquid, is the main environmental problem. These problems are at the top of the problems identified with a rate of 60%, with 39% for solid household waste and 21% for liquid household waste. In the districts, a preponderance of household waste is also noted, with solid waste at the top of the list.

In addition to this main problem, plastic bags are added with a rate of 15%. This overall trend is also observed in the district 1 and 2 where plastic bags come after household waste. The problem of nauseating odors is most noticeable in districts 2 and 3 with a rate of 14%. The other environmental problems are poorly indexed by the populations. They are: noise pollution, obstruction of gutters, absence of family or collective latrines, absence of family or collective cesspools.

Table 1. Environmental problems of the city of Parakou by district

Environmental problems (%)	District 1 (N=70)	District 2 (N=51)	District 3 (N=50)	City of Parakou (N=171)
Household solid waste	41	31	45	39
Household liquid waste	19	20	25	21
Plastic bags	17	19	8	15
Nauseous odors	4	14	14	11
Noise pollution	3	10	2	5
Open defecation (including public places)	8	2	4	5
Obstruction of gutters	7	0	2	3
Total	**100**	**100**	**100**	**100**

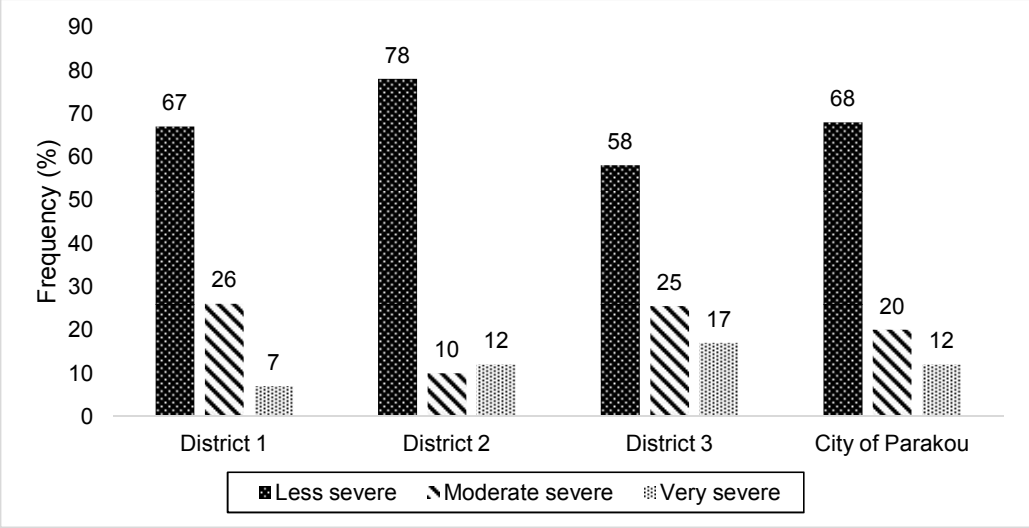

Fig. 2. Actors' perceptions of the evolution of the main environmental problems in city of Parakou

3.2 Actors' Perceptions of the Dynamics of the Main Environmental Problems

The main environmental problems in the city of Parakou are the household solid and liquid wastes. The Fig. 2 shows the dynamics of the main environmental problems in the city of Parakou and according to the districts 10 years ago.

According to 68% of the population of the city of Parakou, the main environmental problems were less severe about 10 years ago. The same trend is observed in the three districts of Parakou. This means that the severity of major environmental problems increases over time. Household waste is dumped around homes and sometimes on roadways. Households subscribe very little to waste collection structures. For those that have subscribed, overfilling of trash cans is frequently noted due to non-compliance by collection structures.

3.3 Actors' Perceptions of the Reasons for Environmental Problems

There are several reasons for the increase in environmental problems in the city of Parakou. Actors' perceptions of the reasons for the main environmental problems are presented in Table 2.

In addition to the galloping increase in Parakou's population, actors explain the seriousness of environmental problems mainly by a lack of education or awareness (48%). Thus, the populations believe that the local government; initiates very few awareness activities on the management of environmental problems. They also put emphasis on other reasons such as

Table 2. Main reasons for environmental problems in the city of Parakou

Main reasons for environmental problems (%)	District 1 (N=70)	District 2 (N=51)	District 3 (N=50)	City of Parakou (N=171)
Lack of education/awareness	36	76	32	48
Widespread ignorance	30	12	22	22
Weak management policy or progressive resignation of local government	14	6	14	19
Refusal of subscription to waste collection structures	16	0	12	9
Absence of sanctions	1	4	4	3
Lack of public waste bins	0	0	6	2
Believing that public space is a collective property	1	0	6	2
Believing that the maintenance of public space is the responsibility of government	1	2	2	2
weak empowering of the actors	1	0	2	1
Total	**100**	**100**	**100**	**100**

widespread ignorance (22%) and the weak management policy or progressive resignation of the local government (19%). In the latter specific case, a 52-year-old inhabitant of the first district explains:

> "*The abandoning of the initiative of work contract with the women street sweepers, which the municipality of Parakou has experienced in the meantime (more than 10 years ago), is at the origin of all these environmental problems nowadays. There is no final waste dump, which discourages waste collection structures. The municipality no longer supports non-governmental organizations in the management of household waste*".

It therefore appears that the local government has tried to take action to remedy the environmental problems. But due to the non-encouraging results, there is a progressive resignation of the local government in the management of environmental problems.

3.4 Actors' Perceptions of Strategies to Address Environmental Problems

Four groups of strategies to address environmental problems emerge from actors' perceptions (Table 3).

(i) Education/awareness raising

This group of strategies constitutes the main action suggested by 86% of the actors as the solution to limit environmental problems in the city of Parakou. According to these actors, it is necessary to educate or raise awareness of the population on environmental issues. Through this action group, people believe that there is a need to disseminate the laws and regulations in decentralization and local government decisions on environment management. It will thus be necessary to make the population aware that public spaces are common properties which, as such, must be protected by everyone.

(ii) Repression/sanction

For this group of actors (41%), the solution to the environmental problems of the city of Parakou is repression or sanction. To this end, it is necessary to combat incivility, denounce and punish polluters, force urban households to subscribe to waste collection structures and, finally, compel waste collection structures to respect the appointments with subscribed households.

(iii) Empowering of actors

For 23% of respondents, empowering of actors through the initiation of collective actions constitute the key strategy to reduce the city's environmental problems. The specific actions proposed include making the population responsible for managing environmental problems, and initiating and mobilizing actors to participate in collective actions.

(iii) Funding/Infrastructure

This group of perceptions is supported by 38% of the respondents. They believe that a good management of the environmental problems of the city of Parakou requires the strengthening of equipment and infrastructure through financing.

The specific actions in this case are: installation of public waste bins, increasing the number of waste collection structures, equipping them and increasing the number of paid public latrines.

These perceptions suggest that the main strategy for reducing environmental problems remains environmental education or awareness. Interventions in the management of the problems facing the city must start with education. It revealed that most of the people are ignorant of the environmental issue and make very little connection between human health and the living environment. But the question that remains unanswered is what should be the basis for successful education for sustainable management of environmental problems?

4. DISCUSSION

4.1 Household Waste: The Main Environmental Problem in Cosmopolitan Cities

This article analyzed the perceptions of population of management strategies of environmental problems of the cosmopolitan city of Parakou. It emerges that the environmental problems of the city of Parakou are diverse and the most frequent are household waste.

The results revealed by this study are similar to those of [7] and [9]. These authors shows that household waste is the main environmental problem in large African cities, based on case studies of the city of Uvira in the Democratic Republic of Congo and the city of Mohammedia in Morocco. Similar conclusion comes from [18–20] in United Kingdom, Nigeria and Korea respectively. The household waste is rich in biodegradable materials and constitutes an opportunity in the context of the development of peri-urban ecological agriculture [9,10].

Contrary to the work of [7,9], plastic bags come third in environmental pollution in the city of Parakou. This difference can be explained by the period when the data were collected, which was preceded by the interdiction of using of plastic bags in Benin through the law N° 2017-39 of 26 December 2017. For [21], plastic waste is also a business opportunity for municipalities. For these authors, this waste can be used in road construction because it improves the adhesiveness and Marshall stability of asphalt concrete [21].

Table 3. Actors' perceptions of strategies to address environmental problems

Group of strategies	Strategies	Frequency (%)
Education/ awareness raising	Educating actors among environment	66
	Make understood that the maintenance of public spaces is a common task	15
	Disseminate and raise awareness on decentralization laws and municipal decisions	5
Total education		*86*
Repression/ sanction	Fighting incivism	15
	Denouncing and punishing polluters	16
	Obliging households to subscribe to waste collection structures	8
	Forcing waste collection structures to respect appointments	3
Total repression/ sanction		*41*
Empowering/ Action collective	Empowering everyone in the management of environmental issues	18
	Undertaking and participating in public activities	5
Total empowering		*23*
Funding/ Infrastructure	Install public waste bins	17
	Increase the number of waste collection structures	6
	Equipping waste collection structures	5
	Increase the number of public and private latrines	10
Total funding/ infrastructure		*38*

4.2 Waste Management in Cosmopolitan Cities: The Need for Environmental Public Education

The results showed the municipality's attempts to reduce environmental problems. The recorded failures seem to be explained by an ignorance characterized by a lack of awareness and education of environmental issues by the population. This has resulted in an increase in environmental problems in the city. According to most studies, the main barrier to environmental management in large cities in Saharan Africa is incivility characterized by ignorance, irresponsibility and indifference [17,22–26]. For some, including [15,17], funding waste management seems to be the solution. Finally, other studies consider that the solution to environmental problems in cities lies in raising public awareness [6,14,27,28]. In this specific case, [14] proposes that awareness raising, education and sanctions are needed. [16] recommend the awareness raising and demonstration. These various studies have shown the importance of awareness raising, which consists of educating people about environmental management. It therefore appears that environmental education is necessary to improve waste management. This is supported by actors' perceptions from the case study of Parakou. Awareness and education of population of environment management constitute a solution for waste prevention and avoiding. But the question that remains is how to ensure this environmental education of the populations for a better management of the environmental problems of the city?

5. CONCLUSION

The article characterized and analyzed the environmental problems of cosmopolitan cities through the case study of Parakou in Benin (West Africa). It emerged that household waste is the major environmental problem. Their persistence is mainly due to the incivility of the population, characterized by the ignorance, irresponsibility and indifference of urban households. Stakeholders argue that environmental education is the main strategy to better manage these problems. But through which channel this education could be effectively implemented for achieving the objective of managing the environmental problems of megacities in a sustainable manner.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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