

State and Management of Solid Wastes in Mali: Case Study of Bamako

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Abstract: Bamako capital of Mali is the most densely populated and urbanized city of this developing country. Its annual growth rate of the population during the last decade was 3.7%. Bamako is also an administrative and commercial centre, providing many facilities that contribute to attract many people in the city. Thus, the amount of wastes, mainly municipal solid waste, generated is increasing rapidly in parallel with the increasing size of population. Bamako produced about 325,807 m³ in 2007 and this amount is supposed to increase crescendo each year. Municipal solid waste management, notwithstanding the great part of local government budget remains a sector with a large gap. The MSW is disposed in uncontrolled open discharge at the outskirts of the city or even stays in the city in the form of anarchic or illegal rubbish dumps. Moreover, there is no appropriate infrastructure for household wastes treatment. This study points out and evaluates the state of MSW management in Bamako. We summarize the policy and legislative framework; establish a link between rapid population growth and the increasing of MSW generation. Finally, the study gives some details about MSW collection system in Bamako.

Key words: Municipal Solid Wastes (MSW), rubbish dump, management, Bamako

INTRODUCTION

Mali is located in West Africa between 10° and 20° of North latitude, 4° of East longitude and 12° of West Longitude. With 1,241,231 km² as surface area, it is among the largest countries of this region (Statistical Directory of Mali, 1989). The population of Mali was estimated at 11,419,482 and grows at the rate of 3.7% per year (Statistical Directory of Mali, 2004). About 3,551,359 people live in urban areas and 7,868,123 dwell in rural areas.

Like others developing countries, Mali knows a rapid urbanization growth. An important feature of its urbanization is the phenomenal concentration of the urban population in Bamako. That confers to Bamako the status of macrocephalic city.

The rural exodus and the multiplication of the spontaneous areas increased considerably the population of Bamako, estimated at 1,373,265 (Statistical Directory of Mali, 2004; Prospect for the Population of Mali, 1999-2024). Other authors range this amount between 1,500,000 and 2,000,000 inhabitants (L'Essor, 2007).

The rapid urbanization and the exponential population growth which is resulting are not without consequences. Generally, the greater the economic prosperity and the higher the percentage of urban population, the greater is the amount of Municipal Solid Waste (MSW) produced (Hoorweg and Laura, 1999).

In Bamako, the volume of MSW produced is growing more quickly than the means of evacuating them. In Malian capital, as well as in many African cities, each individual produces approximately 0.65 kg of wastes. This quantity is estimated at 2,100 m³ day⁻¹ for the town of Bamako. Most of those wastes remain in the city because of the lack of financial, material means in the sector.

Consequently, the management of MSW is a recurring problem in the capital. The considerable increasing of MSW and their mismanagement have created a catastrophic environmental condition for the population and multitude problems for the local authorities. Thus, MSW management is one of the challenges facing Bamako.

In the present study, the state of municipal solid waste management system of Bamako is point up. The quantity and composition, the pattern of collection

storage, transportation and disposal are discussing. An overview is given on the policy of Solid Wastes Management in Mali.

MATERIALS AND METHODS

Location of the study areas: Bamako, Capital of Mali, is situated inside the earths on the $7^{\circ}59'$ of west longitude and the $12^{\circ}40'$ of North latitude. Surrounded by hills, Bamako is constituted today of two distinct parts.

In the North, the city spreads between the Niger River and the Mount Mandingue in a long alluvial plain of 15 km and big of 7.000 ha that shrink in the 2 extremities east and west.

In the south, the right bank of Niger River occupies a site of 12.000 ha, from the airport of Senou and the hills of Tienkoulou, to the Niger River.

Administratively, Bamako is divided into 6 communes which are leading each one by a Town Council. There are: commune I, II, III, IV, V and VI. The district of Bamako Town council is a kind of structure which regroups some delegates from all the 6 communes as shown in Fig. 1.

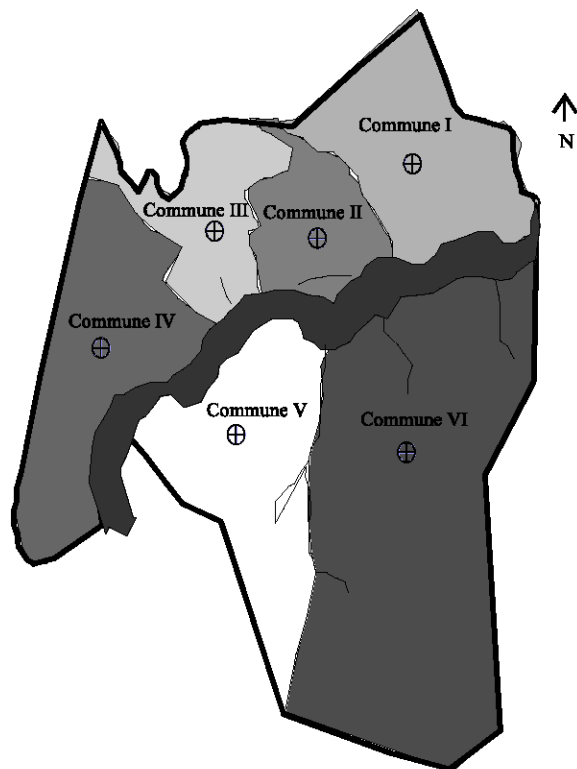


Fig. 1: Communes of Bamako District

Its role is about an overall policy concerning the city. A central mayor is responsible for management of Bamako District (Fig. 1). The methodology developed to evaluate the state and management of municipal solid wastes in Bamako consists mainly in 3 parts:

The first phase of this research consisted to summarize the major point of the documents read and the results of the observations in the field area.

The second phase consisted in collecting the data, to do sampling starting from the preliminary diagnosis and to prepare the survey questionnaires. The second phase was conducted toward different actors and agencies in charge of MSW managements in Bamako for data collection.

Finally, the third step consisted with the exploitation of the data by the following actions:

- Ordering of the data collected during the survey
- Analysis of data (qualitatively and quantitatively)
- Exploitation and review of information including the processing of data and the issuing of tables

RESULTS AND DISCUSSION

Policy and legislative framework for municipal solid wastes in Bamako: Since the 1970s, the environmental problems became a major concern for the Town council of Bamako.

The environmental problem facing Mali are thus summarized:

- Loss of soils fertility
- Reduction of the natural pastures
- Strong pressure on the forest resources
- Climate change
- Desertification
- Pollution because of solid and liquid wastes; etc...

To specifically mitigate negative impact of human activities on environment different measures was taken. In the particular case of MSW management, the government of Mali is trying to initiate efforts to establish better facilities. We don't pretend to expose all the laws regulating MSW management but two recent measures.

The solid wastes disposal and treatment is regulating by the decree number 01-394/P-RM from September 6th 2001.

The item 2 of the decree specifies the objectives of solid wastes management in Mali.

- The prevention and reduction of the solid wastes and their harmfulness
- The valorization of solid wastes by recycling

- The rubbish dumps promotion
- The organization of solid wastes elimination and reconditioning of contaminated sites
- The struggle against the harmful effect of plastic wastes on human health, ground, water, fauna and flora
- The limitation, the surveillance and the control of solid wastes transfer

Although, this decree takes into account number of aspects of MSW management, some problems remain. Bamako seems to be exceeding by its population scale that has as consequence the increasing of MSW production.

In 2003, a strategy of MSW management was elaborated within the framework of the implementation of the project of Urban and Decentralization Development.

The strategy of MSW management in Bamako aims to give to the authorities of the District and the communes of Bamako an instrument of sustainable MSW management.

The strategy identifies the principal actors of MSW management, from the national level to the level of the Districts, submits proposals and the recommendations about the pre-collection, the collection, transport and the setting in controlled rubbish dumps. It envisages in particular:

- The creation of 4 sites of controlled rubbish dumps. The sites of Noumoubougou in the rural commune of Tienfala for left bank and Dialakorobougou in the rural commune of Mountougoula for Right Bank were retained within the framework of starting of the activities
- The installation of a factory of composting for certain types of wastes
- The information and the public awareness campaign in order to obtain their adhesion and their participation

The lack of financial mean makes the implementation of the policy very hard and the site of Noumoubou is the only one that could have a chance in the near future to be the first controlled rubbish dump in Bamako. Thus, before this implementation Bamako is using an abandoned quarry located in Doumanzana in Commune I of Bamako.

Population growth and MSW issue: Since the end of the 1970's, Bamako, formerly named the coquettish of the West Africa, known a demographic expansion and an important urbanization rate. As the largest city of Mali, it had 1,373,265 inhabitants which increase at the rate of

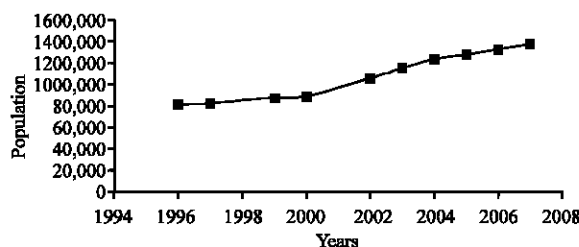


Fig. 2: Plot of population and the number of years. The small squares indicate the increasing size of Bamako population per year

3.7% per year (Statistical Directory of Mali, 2004; Prospect for the Population of Mali, 1999-2024). According to L'Essor (2007), Bamako has a population comprises between 1,500,000 and 2,000,000 inhabitants.

The Fig. 2 shows the trend of Bamako's population growth from 1996-2007. During this period the city gained 563,713 inhabitants almost doubly in 10 years space (Prospect for the Population of Mali, 1999-2024).

This galloping demography has some consequences. As mentioned above the volume of MSW increases more quickly than the means of its evacuation.

Generation and composition of MSW in Bamako

Generation of MSW in Bamako: MSW is defined as the total of all the materials (commonly called trash, refuse, or garbage) thrown away from homes and commercial establishments and collected by local government.

The generation of MSW is related to the urbanization and the rapid growth of urban population, industrialization and especially to the improvement of the townsmen's standard of living.

As the urban population grows rapidly, Bamako like any developing countries is facing to solid wastes management problems. The city produces much MSW which are not well managed. Foreigner who comes to Bamako is firstly impressed by the amount of anarchic proliferation of rubbish dumps (Coulibaly, 1999). In the households, the production of waste is very important. Each household produces an average 2.4 tons of wastes per year (Hamadoun, 1995). Between 2000 and 2002, the city produced an average of 2,000 and 2,200 m³ of wastes per day (General Directors of DSUVA and DRACPN). In 2007, the quantity of MSW secreted in Bamako was estimated at 325,807 m³. Only 40% of this amount is evacuated and then each year Bamako produces mountains of MSW.

Considering that in West African countries in general and in Mali in particular each person produces and average of 0.5-0.8 kg of waste per day (Guene, 2001), the trend of MSW production is showed in the Fig. 3 (Statistical directory of Mali).

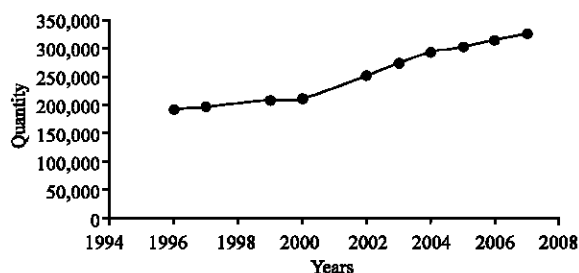


Fig. 3: The MSW production in Bamako District per year. The small squares notify the quantity produced per year

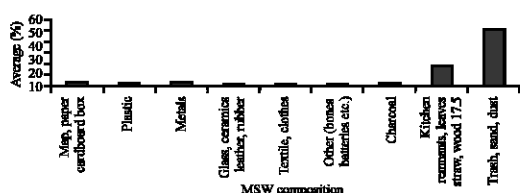


Fig. 4: The average of components and different components of MSW. The histogram indicates the average of those components

Composition of MSW in Bamako: As already mentioned above, the quantity of MSW secreted in Bamako was estimated at 325,807 m³ in 2007.

It is composed of high rate of paper and paperboards in the city centre which has a commercial vocation, a great proportion of inert materials (ashes, sand, dust, etc.) in the popular district. The characterization of MSW gives a high rate to the kitchen remnants and the significant proportion of empties and tins in areas with low standing life. The Fig. 4 shows the rate of MSW in Bamako (Swen, 1984).

Management of MSW in Bamako: Waste management is the collection, transport, processing, recycling or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity. A sub focus in recent decades has been to reduce waste materials' effect on the natural world and the environment and to recover resources from them.

MSW management knows some difficulties due to various factors such as low budget, lack of collection vehicles and so on. The result of this situation, Bamako like all the cities areas in Mali, became a very dirty city.

The headlines of many newspapers give a large place to this issue. Among them we can list: The domestic garbage in the District of Bamako, Salubrity in the District

of Bamako: the Public Works remain to the forefront of the fight. The peripheral areas of Bamako and the question of the environment: A danger chronic.

MSW management budget: Although, developing nations do spend between 20 and 40% of municipal revenues on waste management (Schubeler, 1996; Thomas and Elizabeth, 1998; Bartone 2000), this amount is often unable to keep pace with the scope of the problem. The budget consecrated to the management of solid wastes is 400 million CFA by year. However, the real needs are estimated at 1.425 billion CFA by year.

This budget deficit feels much on the quality of the management of solid wastes.

Waste collection: Transport of MSW from households, factories and other generation sites is a growing problem in Bamako. Thus, the quantity collected every day is far from the real quantity produced.

Collection and evacuation of MSW in Bamako are done like line work. The families are the first ramifications of this line.

Families' role in wastes collection: They are charged to collect the household refuse in order to make them available to the GIE (Groupement d'Intérêt Economique). They put their wastes in metallic or plastic dustbins (trash can) that each household must have in front of its door.

Collection from the families: The GIE, equipped with carts towed by donkeys or tractors, collect wastes from the families towards spaces, called transit or transfer deposits.

Collection from the transfer deposits to final rubbish dumps: This role is playing by the DSUVA (Direction des Services Urbains de Voiries et d'Assainissement). It collects household wastes from transfer deposits to bring them towards the final discharges, generally located at several kilometers from the city.

Bamako city has no standard final rubbish dumps. That is why final deposits are abandoned quarry, naked areas and field situated outside and sometime in the city.

In its daily activities of MSW collection, the DSUVA has materials adapted to each mode of evacuation. There is the first mean of collection with a team which has ordinary tip-lorries, articulated-lorries and shovel loaders.

This technical choice is practiced at places where the management of MSW is not organized and where the wastes are directly dumped on the ground. This method is the only one, which makes it possible to collect and evacuate all the categories of solid wastes.

Table1: The MSW collection materials and their origin

Vehicles and material	DSUVA	Japanese financing	Total
Caisson	40	50	90
Truck 3.5 m ³	13	5	18
Truck 5 m ³	2	4	6
Truck 7 m ³	7	9	16
Tip-lorry	5	2	7
Shovel loaders	3	-	3
Loaders	3	-	3
Caterpillar	-	1	1
Compactor	-	2	2
Total	73	73	146

The second method in collecting with tip-lorries equipped with caisson of 7 m³. It ensures a certain liberty to users who can voluntarily pour their wastes inside these materials. This method permit to avoid dumping waste on the ground and then, impeding their dispersion.

The third method is lorry-compactor utilization. It consists to compact and condition waste inside the vehicle which has a mechanism for this purpose. This process avoids dispersion of odor and visual aggression. It is very adapted to the collection of door to door or in point fixed.

Finally it exists, the collection by tricycle. The pilot is either alone or accompanied by one or two workmen. The method gives access to waste in exiguous zones and is very effective for the garbage collection of very small quantity (Table 1) (Samake, 2003).

The MSW quantity collected every day is far from the real quantity produced in Bamako. Transport relies on operational vehicles, but frequent breakdowns coupled with parts shortages can immobilize collection vehicles for extended periods of time. UNEP (1996) estimates that in West Africa cities, up to 70% of collection/transfer vehicles may be out of action at any one time.

The lack of MSW collection material transforms some transfer deposit to final rubbish dumps. According to Mr. Boubacar DIAKITE director of DNACPN (Direction Nationale de l'Assainissement, du Contrôle des Pollutions et Nuisances) only 40% of MSW is evacuated in Bamako. Then, the household wastes are everywhere present in Bamako. They became the companions of the inhabitants. We can find them in the streets, on the naked areas, in the gutters, along the rivers.

Anarchic proliferation of rubbish dumps: The negligence of certain infrastructures in urban planning and the lack of MSW collection materials explain the phenomenon of multiplication of rubbish dump in Bamako. Every unoccupied place can be used by the dwellers to dispose their household wastes. We can see anarchic rubbish dumps at the following places.

The streets: Bamako endures what one could call the hunger of rubbish dumps. The master development plan of the town does not take in account the rubbish dumps site.

In commune I for example, one counts four transfer deposits on a surface of 56 km², while in commune II (34 km²), we count two of which one is functional today.

All of them have been improvised and are too closed from habitations.

The populations think to do their best by pouring their garbage in the streets because they have not another choice.

The naked areas: The same phenomenon is observable with the naked areas where we found an impressive number of anarchic rubbish dumps. The residents located beside naked areas, generally, use them as rubbish dumps.

The gutters: The gutters are very often the receptacle of domestic garbage. The lack of legal rubbish dump brings some people to use them at this purpose. That contributes to obstruct these infrastructures and make difficult the pluvial water circulation.

Along the rivers: Most anarchic rubbish dumps are localizing near the river. This situation is especially harmful because during raining season, the flooding is frequent with their cortege of desolation.

The gap of MSW management and the anarchic proliferation of rubbish dumps which is resulting create in Bamako a serious public health issue with the tremendous increasing of malaria, which is a great concern in Mali.

The research shows that Bamako, like most of African cities is a dirty capital where population and Municipal authorities attend powerless to the proliferation of the rubbish dump, then to the degradation of their environment.

CONCLUSION

Municipal solid wastes issues represent major problems to Bamako Municipal Authorities. Although, a large part of Municipal budget is allocated to MSW management, this amount proves to be unimportant facing the extent of the problem. The result is an anarchic proliferation of rubbish dumps with what they have like consequences on the environment, human and animal health.

ACKNOWLEDGEMENTS

We wish to thank the Chinese scholarship council for supporting and facilitating our study in China. We also thank our supervisor, Professor Tang Zhonghua for his guidance and good advices.

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