

# Municipal Solid Waste Management in Constantine, Algeria

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## Abstract

Constantine, with a population of 480,000 and containing 90,000 households, generated 164,250 tons of solid waste in 2015 in which domestic waste is the primary source. The aim of this study was to assess the situation of municipal solid-waste (MSW) management in Constantine. Actually, the collection and transportation of solid waste is managed by the municipality, with a small participation of the private sector. More than 90% of the municipality solid waste is disposed and treated in an environmentally sound manner (landfill). Unfortunately, there is a poor culture with respect to the 3R principles (reduce, reuse, recycle) in Constantine leading to a rapid growth of waste generation which has overwhelmed the capacity of the already saturated available landfill. There remain important challenges in solid waste management for the municipal authorities in Constantine which include: the proper management of the financial resources, public education aimed at reduction and separating household waste and optimizing the existing collection system.

## Keywords

Municipal Solid Waste Management, Constantine, Algeria, Legislative Laws

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## 1. Introduction

As with other emerging countries, Algeria rose from dumping to the controlled discharge and landfills, reflecting awareness to environmental protection and the necessity of an integrated management of urban solid waste. But in spite of the huge budget allocated to the system of collection, transport and disposal of MSW, the system of management is showing an array of problems at the municipality's level and Constantine is depicted as a city in need for cleanliness. This image is creating a lot of resentment and frustration among its population. The mismanagement of financial resources and the rapid increase of the amount of

solid waste remain the main challenges to the local authorities as the management of MSW is regarded as one of the essential missions of the municipality. It is important to mention that the organization of municipal solid waste management is dominated by public services but not as a unique service provider [1]. Private firms are involved in the collection and transport of solid waste.

The aim of this study was to present an overview of the current solid waste management practices in Algeria and assess the situation of MSW management in Constantine. It also provides a brief discussion of future challenges. This was achieved by reviewing the quantity and composition of waste produced in the city and the currently applied methods of collection and transport of waste. The paper is organized as follows. Section 2 introduces waste quantities and composition in Constantine. The MSW management system in the city is presented in Section 3. Section 4 summarizes the actual system of storage, collection and transport of waste. Section 5 discusses the current practices and provides some recommendations for system improvement.

## 2. Municipal Solid Waste Management

### 2.1. Background Information about Constantine

Constantine, the third largest city in Algeria, is located in the Northern part of Algeria, occupying a 231.63 km<sup>2</sup> area limited by varied reliefs; in certain cases truly steep (Figure 1). The region altitude varies between 300 m (riverbeds level) and 800 m at the summit. The slope inclination varies from 12° to 35° with the exception of the Rhumel river canyon with its cliff-type morphology. Constantine's climate is overall continental with a mean maximum and minimum temperature of 12° and 0° in winter and 40° and 25° in summer. The annual precipitation varies between 500 mm and 700 mm.

The territory of the city comprises 10 urban regions and it has a population of 480,000 with 90,000 households. The average population density is about 1936 inhabitants per Km<sup>2</sup> and the population dispersion throughout the different urban sector of the city is shown on Table 1.

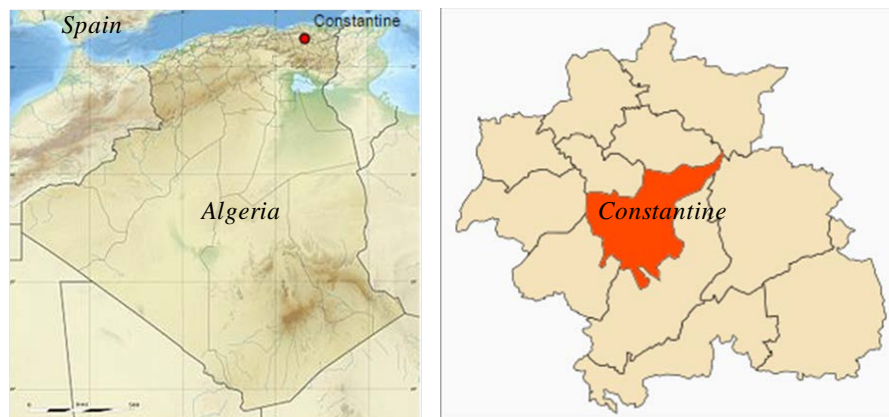


Figure 1. Map of Constantine, Algeria. Source: wikipedia [3].

**Table 1.** Population & households of the different urban sectors of Constantine.

Urban sector	Households	Population
Sidi Rached	9684	52,535
Belle Vue	9569	57,421
Kitouni	5994	28,856
Boudraa	9579	52,297
05 Juillet	5730	27,699
Les Muriers	9353	55,064
Gammas	8507	39,515
Sidi Mabrouk	12,877	79,465
Ziadia	9857	39,929
El Kantara	9010	47,488
Total	90,160	480,239

Source: Office National des Statistiques [2].

## 2.2. Solid Waste Generation and Characteristics

Over the last two decades the Algerian economy has been moving steadily on the fast lane with a GDP per capita of 5460,1\$ in 2014. This has been followed by a significant progress in the rate of solid-waste generation per capita as a result of several factors, such as a steady increase of the population, improved financial resources and rise in community living standards and consumerism. Today, this rate is nearly 0.93 Kg/person/day. Constantine solid waste contains a very high concentration of organic matter and consequently has high moisture content. Municipal Solid Waste (MSW) is defined to include refuse from households; on-hazardous solid waste discarded by industrial, commercial and institutional establishments, market waste, yard waste and street sweepings which is collected by municipal authorities for disposal [4]. **Table 2** shows the main components of MSW for different areas in Constantine.

All waste whether it is biodegradable or recyclable is mixed together. No system of segregation at the source level is available. Sorting of waste is practiced, at a small scale, by scavengers. Most of the scavenging takes place on the collection spots and targets preferably plastics and glass. Hospitals waste is collected and incinerated only for the main hospital of the city. The incinerator, dating back to 1985, is frequently out of order. Healthcare centers and private clinics are not equipped with waste incinerators.

## 3. Solid Waste Management Practices

In Algeria, the mission of collecting municipal solid waste is devoted to the municipalities by the Law No. 01-19 of the 12/12/2001 related to the Management, Control and Disposal of Waste which defines the basic principles that lead to an integrated waste management, from their generation to their disposal. **Table 3** summarizes the arsenal of Algerian legislative laws for municipal solid waste management [5].

**Table 2.** Waste characterization data for different areas in Constantine (waste characterization\*, Mars 2015).

Material group	Residential	Low income residential	Slum area	Shopping district
<b>Organics</b>	74%	70%	71%	68%
<b>Plastics</b>	15%	10%	13%	12%
<b>Paper</b>	11%	10%	11%	15%
<b>Cardboard</b>	08%	08%	10%	12%
<b>Glass</b>	07%	07%	02%	08%
<b>Textile</b>	02%	02%	01%	01%
<b>Metals</b>	01%	01%	01%	02%
<b>Others</b>	02%	01%	01%	0,5%

\*By weight.

**Table 3.** Algerian legislative laws for municipal solid waste management.

Law and Executive decrees	The related field
Law N°. 01-19	The management, control and disposal of waste.
Law N°. 03-10	The protection of the environment in the context of sustainable development.
Executive decree N°. 02-175	The creation of the national waste agency.
Executive decree N°. 04-410	The general rules for the development and operation of waste treatment facilities and the admission of waste at these facilities.
Executive decree N°. 07-205	The modalities and procedures for the preparation, publication and revision of the scheme of municipal household and similar waste management.
Executive decree N°. 04-199	The modalities for the establishment, organization, operation and financing of the public system of treatment and recovery of packaging waste.

However, the local authorities having been facing a lot of problems with regards to the collection and transportation of waste due to several factors. During the last three years, they have resorted to contract 39 private microenterprises which were created in a different scheme to absorb the sharp unemployment amongst young people and to help in the collection and transport of waste. These private microenterprises are contracted, under separate contracts, for the collection of MSW and the transportation to landfill disposal site. The mean cost of this service is 3000AD (\$30) per ton of waste and the landfill tipping fee is 750 AD (\$7.5). On average, 32% of the local authority's operating budget is spent on municipal solid waste collection and transportation. **Table 4** presents information on the cost of municipal solid waste components.

In Algeria, the system for waste collection and disposal is flat rate system [6]. The fee has to be paid for the benefit of the municipally regardless how much of the service is used by the generator [7]. **Table 5** shows the waste collection fees currently charged in Constantine.

The Algerian Ministry of Environment has adopted the land filling for the

**Table 4.** Cost of municipal solid waste components (municipal authorities, Constantine, 2015).

Manpower			
Laborers per truck	Salary per month	Clothing per person	Tools per truck
4 + driver	50,000 AD	20,000 AD	5,000 AD
Waste trucks fleet (per truck)			
Fuel cost per Week	Maintenance per year	Insurance per year	
2,000 AD	50,000 AD	200,000 AD	
Containers price (for one container)			
240 L container	740 L container		
8,000 AD	25,000 AD		

1\$ = 100 Algerian Dinars.

**Table 5.** Solid waste collection fee charged annually in Constantine (municipal authorities, 2015).

Type	Fee
Residential (household dwelling)	500 - 1000 AD
Commercial use and Professional	1000 - 10,000 AD
Industrial use Craft producing large quantities of waste	10,000 - 100,000 AD

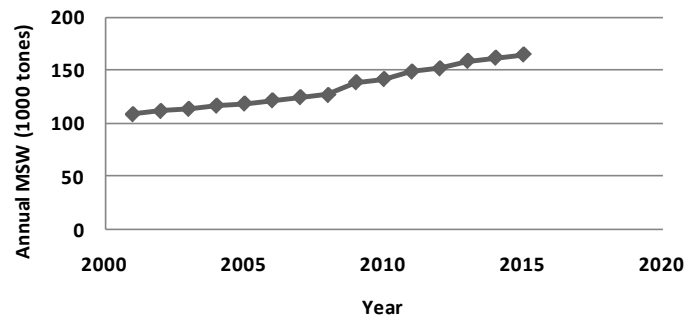
1\$ = 100 Algerian Dinars.

disposal of solid waste as it is the case in most developing countries [8]. It is actually the only method used for the disposal of MSW since 2001. In Constantine and Algeria's other cities, municipalities are responsible only for the collection and transportation of all municipal solid waste to landfills, according to the law of the management, control and disposal of waste mentioned previously. The construction and operation of the final disposal sites is devoted to the Ministry of Environment.

Constantine with its 10 urban sectors generates a daily quantity of disposed solid waste of 450 (tones/day). The trend in the annual quantity of generated waste for the period 2001-2015 is shown in **Figure 2**. This information on the quantity of solid waste generated is fundamental indicator for the management of solid waste [9] especially the lifespan of disposal sites.

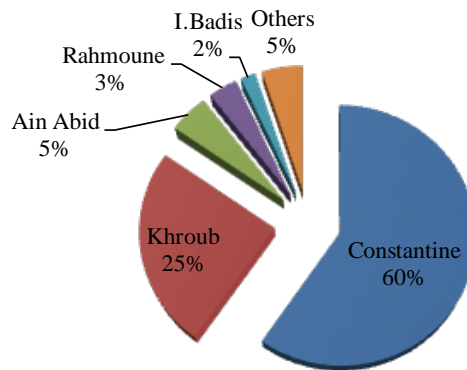
The actual landfill site, distant 60 Km from the city, is scientifically managed but the site is filling up at a very fast rate and should be definitely closed by the end of 2016 as it is already overloaded. It should be noted that this landfill is shared with 05 municipalities which form the Great Constantine. As illustrated in **Figure 3**. The waste generated by the municipality of Constantine is taking the big share although the landfill is situated outside its territory.

The construction of a new landfill in a nearby Municipality is facing a lot of



**Figure 2.** Trend in generated solid waste: 2001-2015.

Daily quantities of MSW buried from the different municipalities  
 (Source: Managing body of the landfill, October 2015)



**Figure 3.** Solid waste from the different municipalities of the Great Constantine.

difficulties at the local level by the not in my back yard (NIMBY) syndrome. Constantine will soon remain without a comprehensive solution to the problem of MSW disposal if an answer is not found to this situation in the near future.

#### 4. Municipal Solid Waste Collection System

In residential areas, fixed collection points are set for waste storage. It consists of setting containers in designated locations for scheduled pickups. The storage system consists of several 240 L plastic containers. An average of 50 containers are allocated for every 1000 households which is not offering sufficient containers capacity for the waste generated and creating many black spots in the system of collection as shown by **Figure 4**.

The collection of the waste, once per day, is done by an automated compactor trucks. The truck used can accommodate two 240 L containers at the same time, and it has a capacity of 7 tons. Large communities, small and medium sized companies use special containers for onsite collection of their waste. These are lifted mechanically; hauled to disposal site and emptied mechanically too. This waste is comparable to household waste [10].

There are several fixed waste collection points in a residential area which constitute the visiting sequence and the route of the truck. The vehicle starts at the parking lot of its company at seven o'clock in the morning and then visits the



**Figure 4.** MSW around plastic containers.

collection points one by one. When the truck is full, it travels to the landfill and finally returns to its company. An average time of the duration of the visiting sequence for each urban sector is presented in **Table 6**.

If managed properly, the number of collection trucks and their capacity to carry the waste seemed sufficient to collect 100% of the generated waste in the city. The results of our field survey show that only 92% of MSW is collected and landfilled. The Ministry of Environment has recently acquired for the benefit of the municipality 225 new waste containers as part of its Program for the Mechanization of the MSW Management for the cost of 243 millions of Algerian Dinars. With this scheme; households will put their solid waste in these containers and municipality-owned special trucks will collect the waste directly from these public containers. This program will be launched late this year; it aims to introduce “separation at source” of the waste. The involvement of households is of paramount importance for the success of this operation. The final aim is to manage the waste in increasingly effective manner by implementing waste sorting operations [11]. The scarcity of land to build new landfills is behind this operation.

## 5. Current Practices and Future Challenges

The functioning of the municipal authority in charge of solid waste management is frequently crippled by political as well as public interference. So in spite of the huge expenditure allowed to the collection and transportation of the MSW of Constantine, the services are not provided to the desired level and some practices regarding solid waste are creating some environmental problems. Our field survey showed that:

- People not cooperating with the sanitary workers as household and commercial waste is discarded outside of authorized times into the streets. A common practice is also to throw the waste along the road site instead of into the container.



**Table 6.** Average time of the duration of a visiting sequence for the different urban sectors.

Urban sector	Duration of visiting collection sequence*
Sidi Rached	03 h 25 mn
Belle Vue	03 h 45 mn
Kitouni	02 h 20 mn
Boudraa	03 h 25 mn
05 Juillet	02 h 28 mn
Les Muriers	02 h 56 mn
Gammas	04 h 30 mn
Sidi Mabrouk	03 h 28 mn
Ziadia	05 h 15 mn
El Kantara	03 h 21 mn

\*Not including the time travel to the landfill.

- Improper sizes and sitting of containers at storage sites hence the people throw their waste anywhere at vacant places.
- Incineration method is still followed on the outskirts of the city by citizens when they are not seen or objected by anybody
- Animals feeding on the waste in urban and semi-urban areas.

The challenges of sustainable development are overwhelming for cities like Constantine as it is grappling with increasing population and heightening environmental problems. One of the key areas for future progress is to reduce the amount of waste generated through public awareness as recycling and re-use practices are the most promoted solutions. Scavenging activities should be discouraged for the benefit of organized markets for the recyclables. Waste needs to be sorted at the source as much as possible to reduce the amount of waste requiring disposal. This option has been endorsed by the Ministry of environment through its new policy for waste management in the country. Constantine was chosen for the launching of this operation during the year 2016.

## 6. Conclusion

In the last decade, MSW management in Constantine has improved substantially. The well-funded municipality has intensified its efforts in the generalization of collection and transportation of waste and eradication of dumpsites. However, there are still problems in the separation of MSW at the source as this activity is largely neglected. This is putting a lot of stress on the management of the landfill with regard to the rapid increase in waste generation. The promotion of high quality solid waste management system is nowadays seen by many nongovernmental organizations as one of the most important functions of a city government.



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