Household Waste Management Challenges the Case of Constantine, Algeria

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Abstract

Household waste management is considered one of the main problems in developing countries, especially in large cities due to high population growth and improved living standards of the population. In Constantine, this phenomenon appears to be more acute in the main urban centers due to the enormous amount of household waste. In most Algerian cities, solid waste is piled up in huge quantities in landfills and disposed of in a traditional way without recycling and utilization of this waste. Urban expansion and commercial activities have increased waste production, while the waste management techniques used are still old. Hence our research study came to analyze and study the management of household waste in the capital of the East, Constantine, through a spatio-temporal approach, practices of household waste management in order to assess the status of this management and integrated and modern planning of waste management.

Keywords: *Household Waste, Traditional Management, Sustainable Management, Environmental Pollution, Constantine, Algeria.*

1. INTRODUCTION

Algerian cities are experiencing rapid urbanization [1]. Strong demographic growth, coupled with economic, social, and political challenges, directly impacts the ever-increasing volume of household waste generated daily [2]. This waste burden strains the capacity of urban authorities responsible for its management. A lack of adequate material and human resources further exacerbates difficulties in waste management, including collection, transport, and disposal [1, 5]. Authorities struggle to contain and properly dispose of waste, as evidenced by overflowing bins, roadside litter, and the proliferation of illegal dumps [4]. A survey by the Ministry of Urban Planning and Environment identified over 3,000 such illegal dumps. Waste management practices in Constantine's urban administration remain particularly weak [5, 6]. Effective solutions require the involvement of all urban stakeholders: residents, the municipality, and the state, working together to promote recycling and waste valorization.

While environmental considerations, particularly in waste management, necessitate the use of current methods to address increasingly complex issues, modernization of the sector and the adoption of modern, sustainable practices are crucial. Algeria's current waste management policy is outdated and characterized by inefficient interventions [9]. The process remains largely limited to collection, transport, and disposal, neglecting sorting and recycling. This strategy lacks both technical sophistication and sustainability [8]. Research efforts must focus on aligning the material and human resources of waste collection companies with the rate of population growth. Regulating landfills is essential to address the problem of overcapacity, and waste valorization for potential reuse is critical [7].

Despite ongoing efforts, progress in modernizing the waste sector remains insufficient. Existing literature on household waste tends to concentrate on the technical and organizational aspects of public waste services, the threats waste poses to ecosystems and public health, and the visual pollution that plagues urban landscapes [10]. However, critical areas within waste valorization and recycling require more in-depth research to fully understand the multifaceted nature of waste [13]. This research should inform the development of innovative approaches to household waste valorization and the implementation of sustainable recycling methods [22]. This paper presents a detailed field study of the waste sector in Constantine, contributing to the broader effort to address solid waste management challenges and develop improved strategies for sector modernization and sustainability [12].

2. MATERIALS AND METHODS

The methodology employed combines a literature review with field studies. The literature review, encompassing memoranda, books, theses, and articles sourced from libraries and online databases, provided information on urban dynamics and the existing waste management plan. Field observations allowed for the identification of waste disposal sites, assessment of environmental conditions and infrastructure, and evaluation of the state of these sites [23]. These observations revealed disparities in waste management practices across different city districts and housing types, notably between collective and individual housing areas. Subsequently, interviews were conducted with sector managers and authorized waste collection institutions, and their responses were compared with the data gathered during the field study. Household waste characterization was performed following the NF X30-408 and NF X30-413 standards for waste characterization (sampling and sorting) [40].

2.1 Presentation of the study area

Located in northeastern Algeria, 430 km from Algiers, the Constantine metropolitan area, encompassing five municipalities (the Constantine intercommunal group), is the country's third largest, with a population of 1,059,000 in 2018 [19].. The wilaya (province) of Constantine, comprising twelve municipalities, includes this metropolitan area.

Constantine is an ancient city with Numidian and Roman origins, built on a remarkably defensible site carved out by the Rhumel and Boumerzoug wadis (rivers). A significant trading center, it commands a vast territory [14].. As a regional capital, Constantine has developed important infrastructure, including an airport and a university. While the city was long confined to its rocky plateau—the medina remains the primary commercial and administrative center—it has expanded significantly in two main phases:

- During the colonial period and the subsequent rural exodus, leading to the creation of suburbs until around 1970 [11].

- Through the development of existing urban centers and the creation of a new city, Ali Mendjeli [15]."

2.2 The evolution of the legal framework for household waste management in Algeria

Waste management and valorization are intrinsically linked to environmental protection. While the now-repealed Law No. 83-03 on environmental protection played a role in the historical development of waste management legislation in Algeria, including a dedicated chapter on waste, the current legal framework is built upon subsequent laws. This analysis

examines the key legislative texts currently in force that address, directly or indirectly, waste valorization:

- **Law No. 01-19 on waste management, control, and removal:** Enacted in 2001 concurrently with the establishment of Algeria's first Ministry of Territorial Planning and Environment, this law forms the cornerstone of waste management regulations. It defines key terms, sets environmental standards for waste valorization, establishes the waste management apparatus, and outlines financial and penal provisions.

- **Law No. 03-10 on environmental protection within the framework of sustainable development:** Unlike its predecessor, this law contains fewer specific provisions on waste management. However, Articles 51, 52, and 55 address waste disposal in aquatic environments, prohibiting dumping in groundwater recharge areas, wells, and regulating the protection of seawater from hazardous materials during disposal, immersion, or incineration.

- **Annual Finance Laws:** Several finance laws, including Law No. 01-21 of 2002, the 2003 finance law, and the 2020 finance law (Law No. 19-14), have established and modified fees related to household waste.

- **Law No. 11-10 on the municipality:** This law mandates municipalities (Article 123) to manage the collection, transport, and treatment of solid waste. Article 149 allows for the creation of technical public services to handle household and other waste, including sewage and market waste. Municipalities can manage these services through direct operation, public institutions, concessions, or delegated contracts. The institutional framework for household waste valorization will be discussed further in the second part of this study.

- **Law No. 12-07 on the Wilaya (province):** This law also permits the creation of Wilaya public services responsible for hygiene, public health, and quality control, utilizing mechanisms deemed appropriate by the Wilaya People's Assembly.

The implementation of the aforementioned legislative texts requires a set of regulatory texts, such as executive decrees and ministerial decisions, that clarify the implementation mechanisms of the provisions related to waste management and valorization.

Several key decrees form the legal framework for waste management and valorization in Algeria:

- **Decree 84-378 defining the conditions for cleaning, collecting, and treating urban solid waste:** This decree serves as the foundational legal framework for household waste valorization, defining household waste categories and outlining controls for urban solid waste collection and treatment methods.

- **Executive Decree 02-175 related to the creation, organization, and operation of the National Waste Agency:** This decree outlines the agency's broad competencies, encompassing waste sorting, collection, transportation, treatment, valorization, and removal activities.

- **Executive Decree No. 04-88 including the regulation of the used oil treatment and regeneration activity.**

- **Executive Decree No. 07-205 dated June 30, 2007, determining the modalities and procedures for preparing, publishing, and revising the municipal plan for the**

management of household and similar waste: This decree focuses on the controls for collecting, transporting, sorting, recovering, and valorizing household waste.

- **Executive Decree 04-199 defining how to establish, organize, operate, and finance the public system for treating packaging waste:** This decree establishes a system for recovering and valorizing packaging waste through private networks.

- **Executive Decree 04-410 defining the general rules for the preparation and operation of waste treatment facilities and the conditions for accepting waste at The institutional framework:** This framework defines the roles of key actors, including the Ministry of Environment and its affiliated institutions (such as the National Waste Agency), the Ministry of Interior and Local Authorities, as well as the Wilayas and Municipalities.

- **National Program for Municipal Waste Management (PROGDEM):** This program provides an integrated and gradual approach to household and similar waste management through a set of defined objectives.

Significant investments, totaling approximately 88 billion DA between 2002 and 2017, have been made in the waste management sector. This includes 41 billion DA for transport and collection equipment and 37 billion DA for the construction of infrastructure dedicated to the treatment of household and similar waste (sorting centers, recycling centers, etc.) .

Financial support for the sector is provided through the household waste collection tax (TEOM), established under Article 30 of the 1993 Finance Law and subsequently revised. It's important to note that the financing of DMA (presumably "Déchets Ménagers Assimilés" - Household and Similar Waste) management in Algeria relies on the general budget of the municipalities **[26].**

3. THE SITUATION OF SOLID HOUSEHOLD WASTE MANAGEMENT IN ALGERIA

In Algeria, a staggering 97% of waste ends up in public landfills untreated, leading to significant methane emissions. Waste recovery rates remain dismally low, at under 10% [28]. The growing volume of household waste, particularly in urban centers, presents a persistent challenge for local authorities and waste management operators. According to the National Waste Agency, Algeria generated 13.1 million tons of solid household waste annually [19].. The average daily household waste production per person has steadily increased, from 0.67 kg in 2020 to 0.68 kg in 2021, and further to an estimated 0.80 kg in 2023[31]

4. RESULTS AND DISCUSSION

4.1 The Situation of Solid Household Waste Management in Algeria

In Algeria, a staggering 97% of waste ends up in public landfills untreated, leading to significant methane emissions. Waste recovery rates remain dismally low, at under 10%. The growing volume of household waste, particularly in urban centers, presents a persistent challenge for local authorities and waste management operators. According to the National Waste Agency, Algeria generated 13.1 million tons of solid household waste annually. The average daily household waste production per person has steadily increased, from 0.67 kg in 2020 to 0.68 kg in 2021, and further to an estimated 0.80 kg in 2023[39]

Collection process

Household waste collection rates are estimated at 67.5% in rural areas and 85.5% in urban areas. The majority of waste collection and transportation operators (DMA) are private, with the remaining operators being state and municipal institutions, which operate either directly or through concession agreements. Studies conducted by SOPTE indicate that these collection and transportation operations cost the relevant institutions approximately 2,500 million Algerian dinars in 2019. **[32]** This cost is attributable to the logistical resources required, including containers, compactor trucks, support vehicles, and large-capacity trucks.

❖ **Waste valorization**

Waste recovery encompasses the processes of waste reclamation, recycling, and composting. The National Waste Management Strategy for 2035 sets a government goal of achieving a 30% waste recovery rate, thereby transitioning towards sustainable waste management **[25].** In 2021, the National Waste Agency recorded only 700 economic operators nationwide engaged in waste recovery. This figure represents only those officially registered with the agency **[20].** It is important to note that an unknown number of informal operators also exist in this sector. Currently, recovered waste accounts for only 9.83% of the total household waste generated. The following figure illustrates the composition of this recovered waste.
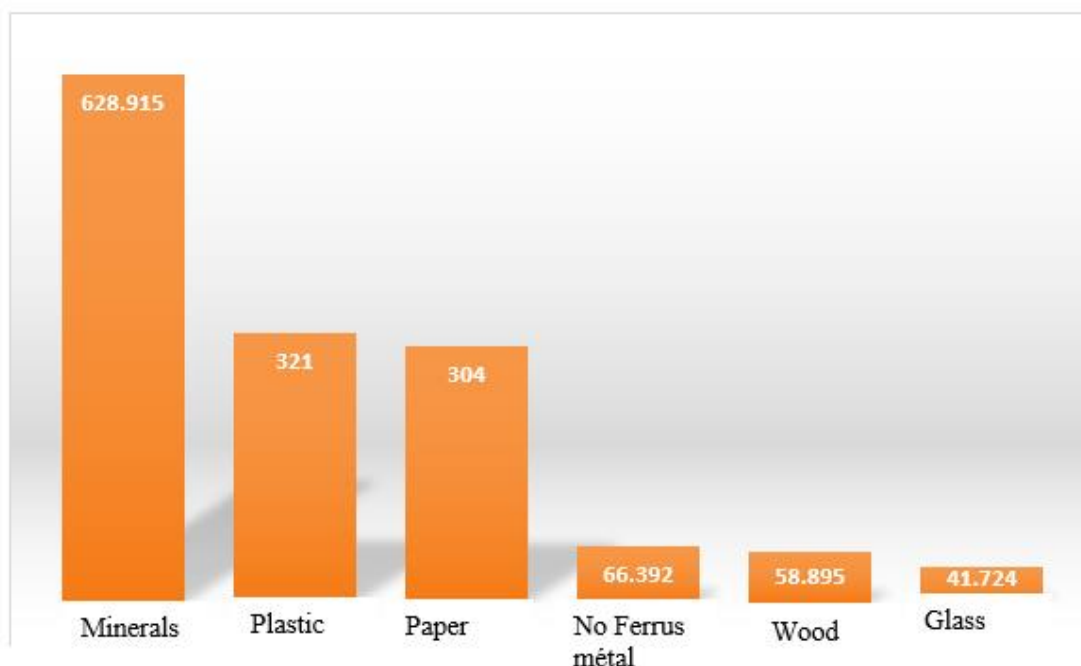

Figure 01: The amount of recovered waste in Algeria for the year 2019

The waste recovery rate across all sectors is 9.83%, a figure that remains relatively low compared to the annual waste production. Figure 7 illustrates the recovery rate for each material. Ferrous and non-ferrous metals from industrial activities are fully recovered, with quantities of 2,496 tons/year for non-ferrous metals and 469,016 tons/year for ferrous metals. Wood follows these two sectors, achieving an approximate recovery rate of 81%. This primarily involves wooden packaging, which is recovered separately for reuse, reprocessing, or shredding. [26 Glass waste has a 30% recovery rate, while plastic has a 15% rate. This latter figure remains notably low compared to the quantity of plastic produced.

❖ landfill

The amount of treated municipal solid waste in sanitary landfill centers and controlled dumps was estimated at 6 million tons in 2020, representing 45% of the total amount produced. Household waste is treated *only* in these facilities, as they are specifically designed to protect the environment. Currently, 221 treatment centers have been built (including 191 under construction), along with 90 operational controlled dumps. Nationwide, there are a total of 280 landfill sites. Of the 197 operational sites, 87 are between 50% and 100% saturated, 24 are completely saturated, and 25 are over-saturated.

4.2 Waste in Constantine

The municipalities with the highest production of household solid waste are El Khroub and Constantine, with estimated amounts ranging from 7,000 to 9,000 tons per month. This high volume is attributed to their status as the two most densely populated municipalities in the province, as well as the concentration of economic activities within them. Municipalities with moderate waste generation (Hamma Bouziane, Didouche Mourad, Zighoud Youcef, and Ain Smara) have an average monthly production of 900 to 1,900 tons. This lower volume is attributed to their comparatively lower population density and less concentrated economic activity. The municipalities with the lowest waste generation (Ouled Rahmoun, Ain Abid, Ibn Ziad, Masoud Boudjeriou, Ibn Badis, and Beni Hamidan) are the least densely populated in the province, and a predominantly rural character prevails in most of them.

Factors Influencing Waste Generation, From the above, it can be concluded that the factors influencing the amount of household solid waste generation are population density, the concentration of economic activities, and the level of urbanization **[37]**. Organic waste constitutes the largest portion (53.5%) of household waste in Constantine Province, consisting primarily of food scraps and plant and animal products. Plastic is the second most prevalent component at 15.41%, consistent with the national average reported by the National Waste Agency. Cardboard makes up 8.05% of the total household solid waste, followed by glass, textiles, and other miscellaneous materials.

3.3 Responsible Institutions:

In Constantine, waste management is handled by several public entities (EPICs) at both the municipal and provincial levels. These EPICs were created to address previous shortcomings in municipal waste management. The primary institutions responsible for waste collection include

The Provincial Public Cleanliness and Health Establishment (EPIC-PROPREC)

- The Constantine Municipal Public Cleanliness Establishment (EPIC-PROPCO)
- The Multi-Services Establishment for Works and Environment (EPIC-SOPT)
- EPCA and EGUVAM, along with other local institutions.

The monthly waste collection volumes for each institution are as follows:

- EPIC-PROPCO: 2,344.02 tons
- EPIC-PROPREC: 3,855.07 tons
- EPIC-SOPTE: 3,752.9 tons
- EGUVAM: 3,410.26 tons
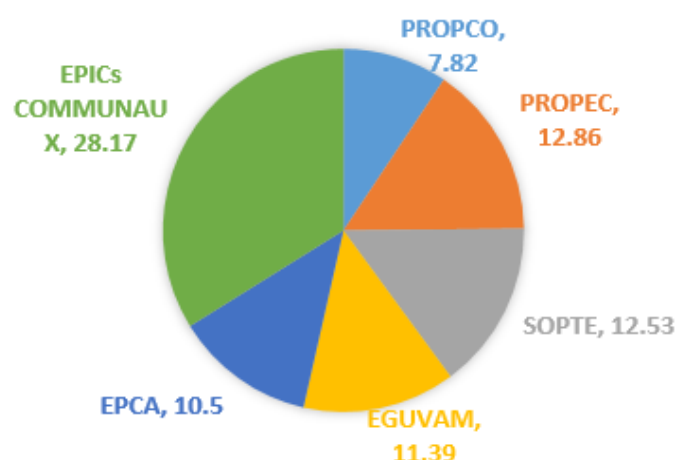- EPCA (El Khroub municipality): 3,144.12 tons

Figure 02: The amount of waste collected by each institution

Several institutions manage waste in the province of Constantine, with responsibilities distributed among the municipalities as follows:

- **Constantine Municipality:** SOPTE, PROPREC, and PROPCO share responsibility for waste collection in this municipality, which is the largest waste producer in the province (see Table ...).

- **El Khroub Municipality:** Waste collection in El Khroub is divided geographically:

  o The town of El Khroub: managed by EPCA.

  o Ali Mendjeli: managed by EGUVAM and PROPREC.

- **Other Municipalities:** In Zighoud Youcef, Beni Hamidan, Ain Smara, Masoud Boudjeriou, Ibn Ziad, Didouche Mourad, Ibn Badis, Ain Abid, and Ouled Rahmoun, local institutions handle waste collection.

In the province of Constantine, waste management proceeds directly from collection and transport to final disposal. The Public Establishment for the Management of Technical Landfill Centers and Urban Waste Treatment (CET EPIC-EPWG) oversees this final stage, managing landfill and disposal sites within Constantine.

Figure 03: Pre-collection of waste

Proposals and Solutions for Modernizing Solid Household Waste Management in Constantine Municipality

After identifying the shortcomings affecting each stage of the solid household waste management process in the Constantine municipal delegation, we will attempt to develop a set of proposals and solutions that would modernize this sector and improve its effectiveness and efficiency **[35].** These solutions are based on advanced analytical studies appropriate to the study area.

First: Production

The average daily per capita waste production in the study area is estimated at 0.89 kg, which is close to the national average and considered average compared to the global per capita production rate of 1.2 kg per person per day **[24].** To maintain this rate or even try to reduce it, we propose the following solutions:

- Rationalizing the culture of consumption, such as encouraging the consumption of fresh food instead of canned food.

- Encouraging the use of reusable products such as cloth bags instead of plastic bags.

- Awareness campaigns and organized cleanliness campaigns by the authorities or the local community to educate citizens about the need to preserve the environment and the cleanliness of the urban environment.

- Encouraging citizens and educating them about the need to separate waste by type to improve collection and recycling operations and avoid harming collection workers or the environment **[21].**

- Using applications and websites to involve residents in the waste management process by informing them of collection times and routes, as well as the locations of containers, in addition to the possibility of reporting waste.

Second: Collection

1- Waste Collection from Disposal Sites:

The door-to-door collection method is the main reason for the high deficit rate in the number of containers previously recorded. **[30]** The reason for adopting this method is the refusal of residents of individual neighborhoods to place collection containers in front of their homes due to:

- The unpleasant odors emanating from them.

- The tampering of animals and rodents with waste.

- Distortion of the facades of houses.

The door-to-door collection method also has its drawbacks, as it is a tiring process for sanitation workers and also for machinery, and it takes longer, in addition to obliging the citizen to take out their waste at a specific time.

Therefore, the optimal solution is to use modern underground garbage containers and distribute them in a thoughtful manner so that their service area covers the study area, operating using mechanical lifting instead of the old ones.

The advantages of these containers are:

- No emission of unpleasant odors.

- Preservation of the urban and aesthetic appearance of the city.

- Preventing animals and rodents from tampering with and scattering waste.

- Waste is not affected by natural factors (humidity and rain).

- The use of these containers makes the citizen not restricted to the collection time.

- Facilitating the collection process for sanitation workers.

- Raising the efficiency of waste collection and increasing its speed.

- In addition to the possibility of increasing the capacity of containers without considering obstructing pedestrians or occupying a large area of the sidewalk.

2- Redistribution of Containers in Each Sector:

The number of containers needed to cover the deficit in Constantine was estimated at containers, and in order to distribute them spatially ideally **[29].** We use the hierarchical analysis in geographic information systems through the following steps:

Defining the criteria helps in focusing on the data according to its priority and the extent of its service to the phenomenon to be studied, and thus helps in making the decision. In order to determine the spatial suitability for the distribution of collection containers, the following criteria were developed:

- Ease of access, whether for trucks or residents (proximity and distance from roads).

- Proximity to housing.

- Distance to existing containers.

- Distance from unpopulated areas and urban voids.

- Topography of the area (slopes).

Determining weights helps in classifying each criterion according to its degree of importance in the decision-making process. This is done by identifying the most influential criteria in the phenomenon.

Figure 04: Underground garbage containers equipped with mechanical lifting technologies

We have recorded a complete absence of the sorting process, both at the level of Constantine in general and the municipal of Constantine, with the exception of some legal entities that collect plastic from containers randomly and without supervision The waste is transported after collection from its dumping sites directly to the landfills, and this leads to the waste of recoverable or recyclable materials, as well as the failure to reduce the volume of waste, which leads to the rapid filling of landfills or landfill center and the difficulty of controlling them

Figure 05: Collecting illegal plastic

5. CONCLUSION

The world is moving towards development and modernity in all fields, including the solid household waste management sector, which has in turn become the focus of attention for cities around the world. The demographic increase and the improvement of living standards have led to an increase in their quantities and their negative impact on the environment and the urban space, where these countries compete to transform them from a mere obstacle to economic opportunities by innovating and developing modern and sustainable solutions. Algeria, like other developing countries, is trying to control this crisis by enacting a set of laws and mechanisms in order to reach good and sustainable management of it, but these solutions remain traditional and not effective enough

Household waste management is a very real and tangible daily problem, often considered by local authorities and city dwellers as simple and linear: collect and dump. Instead, it has become more complex with the demographic and spatial growth of cities, changes in [1] eating habits, and new environmental challenges to the point that it has baffled urban actors. Seasonal results show that organic matter increases to more than 77% in summer, which is justified by the consumption of fruits and vegetables. In comparison, paper and cardboard [2] decrease to 3.5% during long holiday periods. It should also be noted that waste volumes and composition are not the same in every group of households.

They depend on the standard of living, habits, and morals of the population, to which we can add that waste production tends to increase with the standard of living. For example, residential areas differ from other areas. The current state of household waste management in the city of Constantine highlights that the latter is facing difficulty in managing its waste, and this is due to the following reasons

Conflicts of interest

The authors should state: the authors have no conflicts of interest to declare.

References

1) Ademe, M : 1993 : méthode de caractérisation des ordures ménagères (connaitre pour agir, guide et cahiers technique). ADEME, France

2) Addou A (2009) Développement durable traitement des déchets valorisation élimination. Ellipses, France

3) Aina MP (2006) MSW landfills techniques in developing countries: methodology and experimental applications. Université de Limoges, France, Thèse de Doctorat

4) Assia, L., & Nahla, D. (2024). Impact of Private Real Estate Promotion on Urban Sprawl and Tourism Development in Skikda. Indonesian Journal of Social Science Research, 5(2), 533-544. https://doi.org/10.11594/ijssr.05.02.14.

5) Assia Lifa. (2024). Impact of Urban Sprawl on the Spatial Mutations of the City of Khroub. International Journal of Innovative Technologies in Social Science, (1(41). https://doi.org/10.31435/rsglobal_ijitss/30032024/8113.

6) Abarca Guerrero L, Maas GJ, Hogland W (2013) Solid waste management challenges for cities in developing countries. Waste Manag 33(1) :220–232

7) ANAT (2001) MSW Management in Constantine. Municipal Environment Department of Constantine, ANAT

8) Alouemine SO (2006) Méthodologie de caractérisation des déchets ménagers à Nouakchott (Mauritanie) : contribution à la gestion des déchets et outils d'aide à la décision. Université de Limoges, France, Thèse de doctorat

9) Boukelia T, Mecibah MS (2012) Solid waste as renewable source of energy: current and future possibility in Algeria. Int J Energy Environ Eng. http://www.journal-ijeee.com/content/3/1/17. DOI: 10.1186/2251-6832-3-17. Accessed 31 Aug 2012

10) Bouchareb N (2010) Country report on the solid waste management in Morocco.

11) Bouhadiba B, Mezouari F, Kehila Y, Matejka G (2010) Pour une gestion intégrée des déchets solides urbains en Algérie : approche systématique et méthodologique. La gazette du laboratoire 43 :8–9
http://www.sweep-net.org/ckfinder/userfiles/files/country-profiles/countryreport-Morocco-En-mai2011.pdf. Accessed 10 May 2011

12) Centre d'Expertise en Analyse Environnementale du Québec (2011) Recherche et dénombrement des coliformes fécaux (thermo tolérants) et confirmation à l'espèce Escherichia. Québec. www.ceaeq.gouv.qc.ca/methodes/pdf/MA700FecEc10

13) Cheniti H, Serradj T, Brahamia K, Makhlouf A, Guerraiche S (2013) Physical knowledge of household waste in Algeria: generation and composition in the town of Annaba. Waste Manag Res 31(11): 1180–1186. Doi: 10.1177/0734242X13502383

14) Cheniti H, Serradj T, Brahamia K, Makhlouf A, Guerraiche S (2013) Physical knowledge of household waste in Algeria: generation and composition in the town of Annaba. Waste Manag Res 31(11):1180–1186. doi:10.1177/0734242X13502383

15) De Vries J, Semster M, Procee P, Mengers (2001) Environmental management of small and medium cities in Latin America and the Caribbean. Institute for housing and urban development studies (NL) Inter-American development bank

16) Djemaci B, Chertouk MAZ (2011) La gestion intégrée des déchets solides en Algérie. Contraintes et limites de sa mise en œuvre. International Centre of Research and Information on the Public (CIRIEC N° 2011/04). Belgique : CIRIEC. http://www.ciriec.ulg.ac.be. Accessed 3 Apr 2002

17) Djemaci B (2012) La gestion des déchets municipaux en Algérie. Université de Rouen, France, Analyse et prospective et éléments d'efficacité. Thèse de doctorat

18) Dahman S (2012) Evaluation de la gestion des déchets ménagers et assimilés de la ville d'Oran. Thèse de magister. Université d'Oran, Algérie

19) Etude du schéma directeur de gestion des déchets générés par les activités urbaines de la municipalité de Constantine (2020) Ministère de l'aménagement du territoire et de l'environnement, Algérie

20) Ebot Mangaa V, Fortonet OT, Readd AD (2008) Waste management in Cameroon: a new policy perspective. Resour Conserv Recycl 52:592–600

21) Guermoud N, Ouadjnia F, Abdelmalek F, Taleb F, Addou A (2009) Municipal solid waste in Mostaganem city (Western Algeria). Waste Manag 29:896–902. doi:10.1016/j.wasman.2008.03.027

22) Gillet R (1985) MSW management and its application in developing countries, vol 1. OMS, PUND, Copenhagune

23) Gourine L (2010) Country report on the solid waste management: Algeria. The regional solid waste exchange of information and expertise network in Mashreq and Maghreb countries. Iven UI, Breum NO (1999) Exposure reponse relationship between gastrpontestimal problems among waste collectors and bioaerosol exposure. Scand J Work Environ Health 25(3):238–240http://www.sweep-net.org/content/algeria. Accessed 31 Aug 2012

24) LIFA, A 2024: Peri-Urban and Urban Agriculture in Constantine, Algeria, 7 th International Conference of Contemporary Affairs in Architecture and Urbanism (ICCAUA-2024) 23-24 May 2024

25) MATET-CNFE (2009) Ministère de l'aménagement de territoire de l'environnement et du tourisme, Programme des Nations Unis pour le Développement (PNUD), Guide des techniciens communaux pour la gestion des déchets urbains ménagers et assimilés

26) M. Hafidi, L'impact et la Gestion des Déchets Solides (Région Marrakech-SAFI). Morocco: Konrad-Adenauer-Stiftung E.V., 2015. Rapport sur L'état de l'environnement en Algérie. CNES, 1999

27) Mate (2005). Analyse et recommandations en matière de recouvrement des coûts de la gestion des déchets municipaux en Algérie. Ernst and Young

28) Mate (2004) Atelier international sur le nouveau mode de gestion des déchets municipaux: Le Centre d'Enfouissement Technique (CET). Environment State Department, Algiers, Algeria

29) Moletta R (2009) Le traitement des déchets. TEC&DOC, France

30) Mezouari F (2011) Conception et exploitation des centres de stockage des déchets en Algérie et limitation des impacts environnementaux. Université de Limoge, France, Thèse de Doctorat. Ecole Polytechnique d'architecture et d'urbanisme

31) Ministère de l'économie de l'industrie et de l'emploi (2008) L'industrie française de l'emballage en chiffres clés. France : Ministère de l''économie de l'industrie et de l'emploi. www.insee.fr/sessi/publications/dossiers_sect/pdf/emballage08.pdf. Accessed 12 Oct 2008

32) S. Monqid, "La gestion des déchets ménagers au Caire : les habitants en question," Égypte/Monde Arabe, no. 8, pp. 85–105, Sep. 2011, https://doi.org/10.4000/ema.3003..

33) Jovičić NM, Bošković GB Vujić GV, Jovičić GR, Despotović MZ, Milovanović DM, Gordić DR (2011). Route optimization to increase energy efficiency and reduce fuel consumption of communal vehicles. Therm Sci 14:67–78. UDC: 628.52:628.465 doi:10.2298/TSCI100525067J

34) Spokas K, Bogner J, Chanton JP, Morcet M, Aran C, Graff C, Moreau-Le Golvan Y, Hébé I (2006) Methane mass balance at three landfill sites: what is the efficiency of capture by gas collection systems? Waste Manag 26:516–525

35) Sefouhi, L. (2012). Recycling: a practical solution to the problem of household waste management in Batna City (Algeria). Her J Mark Bus Manag 12–014

36) Sakai S, Yoshida H, Hirai Y, Asari M et al (2011) International comparative study of 3R and waste management policy developments. J Mater Cycles Waste Manag 13: 86–102. doi:10.1007/s10163-011-0009-x

37) Skordilis A (2004) Modelling of integrated solid waste management systems in an island. Resour Conserv Recycl 41:243–254. doi:10.1016/j.resconrec.2003.10.007

38) Tahraoui-Douma N, Matejka G, Chambon S, Touil D (2012) Composition of Municipal Solid Waste (MSW) generated by the city of Chleff (Algeria). Energy Procedia. 18:762–771

39) Yuan H, Wang L, Su F, Hu G (2006) Urban solid waste management in Chongqing: hallenges and opportunities. Waste Manag 26(09): 1052–1062. doi:10.1016/j.wasman.2005.09.005

40) Zurbrugg C, Ahmed R (1999) Enhancing community motivation and participation in solid waste management. Sandel News 4.