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Sustainable development in Algeria: Municipal waste management and environmental issues

التنمية المستدامة في الجزائر: إدارة النفايات والمسائل البيئية في البلديات

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Abstract:

Algeria is currently driven by a development model based essentially on limited natural wealth, which is ecologically very polluting and unjust in terms of wealth distribution. In addition to the financial crisis facing the whole country, caused by this dependence on a single resource, which income has decreased drastically in recent years, with drastic consequences for the national economy and repercussions on the daily life of its citizens. Therefore, a well-thought-out sustainable development strategy, which would take into account the social, economic, cultural and environmental realities of the country in every detail, would make it possible to develop a rational economy in the exploitation of natural resources, a fair distribution of wealth, protection of the environment and ensuring a dignified life for everyone. The issue of waste provides an interesting and concrete approach to sustainable development. Indeed, from a waste and sustainable development diagnosis perspective: waste management is a strong point of environmental policy. Our research is based on environmental issues and municipal waste management. To this end, we have chosen the municipality of Beni Douala in the province of Tizi-Ouzou to carry out our research.

Keywords: sustainable development, environment, municipal waste management, Algeria, municipality of Beni Douala.

JEL Classification Codes: Q01 ,Q56, Q5, O13,Q53

ملخص:

تتخذ الجزائر حاليا نموذجا تنمويا يقوم أساسا على ثروة طبيعية محدودة وملوثة جدا من الناحية البيئية وفيه تقسيم غير عادل للثروة، إضافة إلى أن الأزمة المالية التي يوجهها البلد كله، والناجمة عن هذا الاعتماد على مورد واحد، انخفضت إيراداته في السنوات الأخيرة، وكان له عواقب وخيمة على الاقتصاد الوطني وأثر على الحياة اليومية للمواطنين.ونتيجة لذلك، وضع استراتيجية للتنمية المستدامة مدروسة جيدا تأخذ في الحسبان الواقع الاجتماعي والاقتصادي والثقافي والبيئي للبلد بالتفصيل سوف يساعد على تنمية اقتصاد عقلاني في استغلال الموارد الطبيعية، وتوزيع عادل للثروات، وحماية البيئة وضمان حياة كريمة للجميع .وتمثل قضية النفايات نهجا مثيرا للاهتمام وملموسا للتنمية المستدامة، والواقع أن إدارة النفايات هي نقطة قوية في السياسة البيئية، بغية إهدار التشخيص والتنمية المستدامة. ويعتمد بحثنا هذا على المسائل البيئية وإدارة النفايات في البلديات. وتحقيقا لهذه الغاية، اخترنا بلدية بني دوالة من ولاية تيزي وزوو لإجراء بحثنا.

كلمات مفتاحية: التنمية المستدامة، البيئة، إدارة نفايات البلديات ، الجزائر، بلدية بني دوالة.

تصنيفات Jel : Q01 ,Q56, Q5, O13,Q53

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Introduction

In recent rapid action. With this in years, Algeria has been experiencing a severe ecological crisis: deforestation, proliferation of urban and industrial waste, deterioration of the living environment, decline of the archaeological and historical heritage, and an increase in pollution which indicators are in red. These indicators encourage mind, the public authorities have implemented a new policy in this area (sustainable development): aiming to ensure that everyone respects and maintains the environment where we live. From now on, the problem will be dealt with by local authorities[2]. As part of the "master plan for the management of household and similar waste" operation (ANTONIOLI, B., et M. FILIPPINI ,2002, p.239-252)

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs[3]. It is considered by experts as the new perception of the general interest, applied to economic growth and reconsidered on a global scale in order to take into account the environmental and social aspects of a globalized planet(SADOUDI M. 2001, p.122-133).

The economic growth recorded in Algeria over the last two decades has worsened the environmental situation with regard to municipal waste management. Awareness on the part of the Algerian State began in 2001 with the adoption of the National Program for Integrated Municipal Waste Management)[4].

The universal principles of sustainable development (the precautionary principle, the principle of responsibility, the "polluter pays" principle, the principle of prevention, the principle of participation and transparency) have been well included in this program (the polluter pays principle, the precautionary-prevention principle, extended producer responsibility, etc.). This awareness of the environmental aspect is therefore amplified mainly by the adoption, over the last decade, of a set of laws on sustainable development, the environment (LE LOUP .F, MOYART. L , PECQUEUR B, 2005, p. 321-332.)the coast, the city, land use planning, waste management, etc.

The objective of our research is ***to study the issue of waste in Algeria because it allows for an interesting and concrete approach to sustainable development.***

We have chosen to study this theme following the alarming situation observed at the level of cities and towns. The lack of specialized and targeted studies dealing with this issue from a scientific point of view in Algeria has reinforced this choice.

For this purpose, we chose the municipality of Beni Douala in the province of Tizi-Ouzou to carry out our research.

Research Methodology: our research methodology is based on:

[2] Seeing the role played by the local authorities, the latter are called within the framework of chapter 28 of the agenda 21 of Rio, to put a program of Agenda 21 on their scale, integrating the principles of development, starting from a "mechanism of consultation of the population". It is in this optics that the Algerian public authorities set up a new policy in the matter aiming at adhering everyone to the respect and the maintenance of the environment in which we evolve. From now on, the problem will be taken care of by the local authorities within the framework of the operation "Management of household and assimilated waste".

[3] This is the definition given in the report of the United Nations World Commission on Environment and Development, known as the Brundtland Report, from which the term first appeared in 1987.

[4] The communal plan for the management of household and similar waste is drawn up by the National Waste Agency under the authority of the President of the Communal People's Assembly and validated by the latter.

- *A literature review;*
- *Interviews with officials of the municipality of Beni Douala;*
- *Investigations carried out within the municipality.*

1. Waste and sustainable development

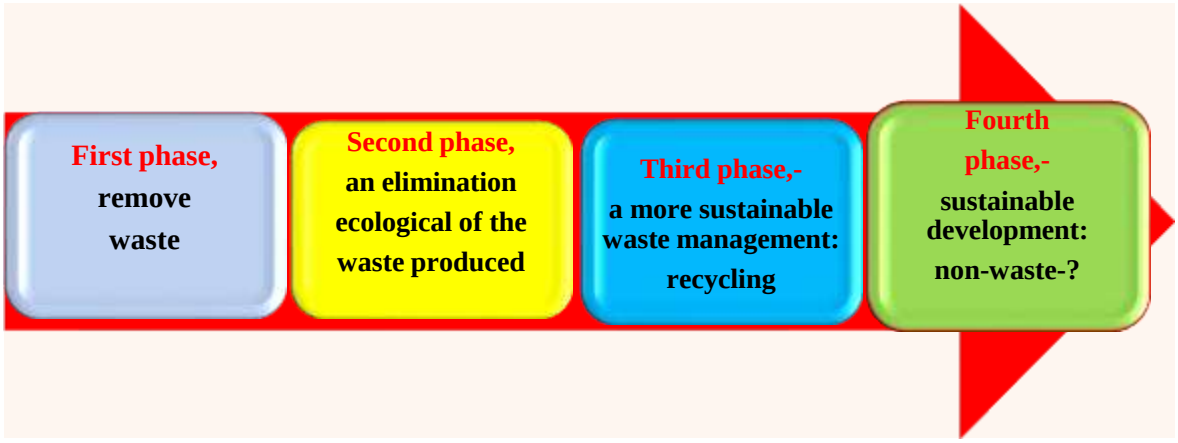
Sustainable development has become the matrix of universal economy, where borders between states no longer exist. This new vision is a vital requirement whose future is at stake today. It is therefore imperative to explain to populations the economic stakes and impacts established on citizen solidarity.

Today, responsible and fair trade, solidarity tourism, selective sorting, waste recycling and transformation, and renewable energies are seen as economic activities that offer alternatives for change and provide a living for entire populations around the world. These niche markets generate billions of dollars, and many countries in the South have seized these significant opportunities.

It crystallizes the environmental problems (and also the related social or economic problems) in an immediately perceptible form: each one of us produces waste every day, knows what a garbage truck with its staff is and can also contribute every day either to a better management (trashing, sorting), or to an environmentally unfriendly disposal.

Sustainable waste management can be broken down into several stages (see Figure 01 below), normally increasingly virtuous (as progress is made), but with paradoxes or false virtues that nevertheless lead us to recommend great caution in the proposals for generalised actions and in public information actions. In particular, proposals for geographical extension or the pure and simple generalization of solutions that seem ideal should be avoided. This is already the case at regional and national level, but also with regards to developed countries that have had a different approach to waste, and with regard to less favoured countries.

Fig 1: Phases of sustainable waste management



Source: Rémi Guillet,conseil général des Mines (2005) « Déchets et développement durable », Annaels des mines

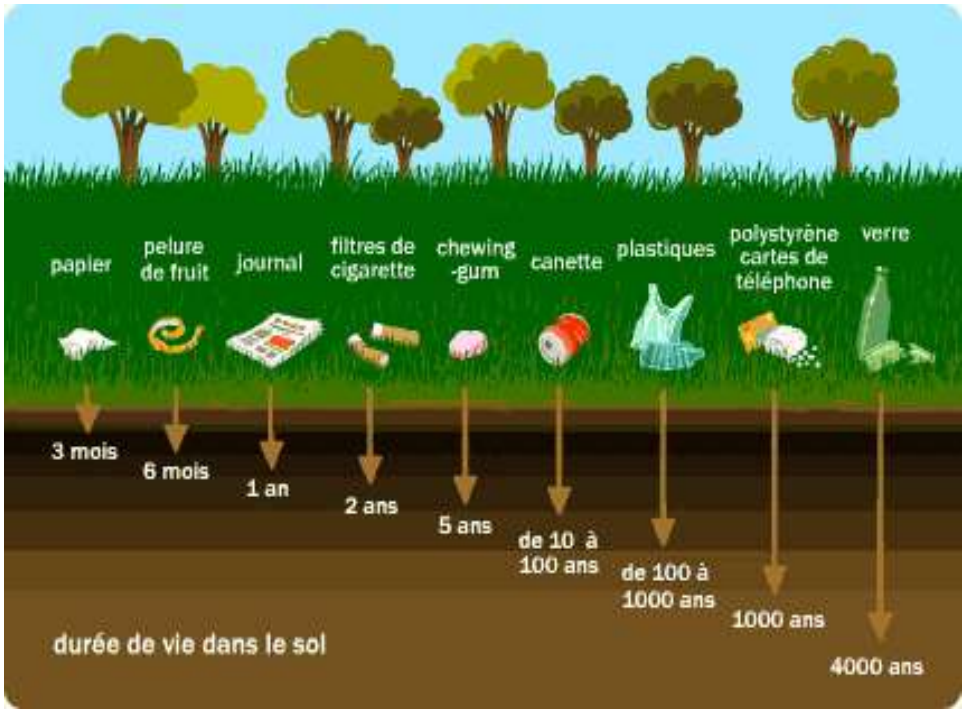
Disposal, ecological elimination, sorting and recycling, the first three stages of sustainable waste management are now more or less accepted and controlled (REMI GUILLET, 2005, p35.) The fourth, and most virtuous stage, that of non-waste, involves a radical change in our

modes of production, distribution and consumption. How far can we go to reconcile the preservation of resources and the environment with the necessary satisfaction of needs?

A real sustainable development policy applied to waste will in fact consist in giving real priority to waste minimization (in general not to eliminate it completely: as in phase 1, there will always be waste). However, can we not avoid a considerable part of it?

The scheme proposed by Ademe and included in the national plan (DANIEL BEGUIN) clearly explains what waste prevention is and where it ends. If it is very clear that the actions of phases 1 to 3 can fit without too many difficulties (and sometimes naturally) into the current production, distribution and consumption scheme. A complete approach (with this phase 4) of sustainable development will however immediately lead to re-examining the products with their cost/benefit, utility/ harmlessness ratios, etc., and then to consider solutions that will quickly call into question the current operating schemes of our society.

Fig 2: Waste management: diagram of the duration of degradation in the soil of the various major types of domestic waste.



Source: waste decomposition duration available on: https://xx-ecoloblog-xx.skyrock.com/2985797271-Decomposition.html

Fig 3: Logics of sustainable development at the level of waste management

Source: Sustainable Development and its Challenges in Developing Countries, available on: http://www.iynf.org/2018/08/a-guide-to-sustainable-development-and-its-challenges-in-developing-countries/

More indirectly, waste is a reflection of the consumer society and its exploitation of natural and energy resources (DJEMACI. B, 2012, p1). Treating waste for recovery is a way of compensating for the depletion of these resources and the degradation linked to their exploitation. Waste in the sense of Algerian regulations comprises three main categories:

- Household and similar waste.
- Special waste (industrial, agricultural, care, services, etc.)
- Inert waste.

The definition of the different types of waste and treatment methods may vary from one country to another. Waste is any residue from a production, processing or consumption process that the owner or holder is obliged to dispose of or eliminate (GOUTTEBEL J-Y., 2003).

2. Algeria: Laws, existent directive norms in protection of the environment

Algeria has set up an environmental policy and waste regulation instruments in order to achieve the objectives expected from its actions. In general, the waste policy is based on three types of instruments: legislative or regulatory instruments, economic instruments (incentives, taxation, etc.) and other instruments (awareness raising, training, etc.). The protection of the environment is governed by the law N° 03.10 of 19/07/2003 on the protection of the environment in the framework of sustainable development. The Algerian waste policy is very strict. A set of texts organizes the public service of waste and in particular the law 01-19 of 12/21/2001 relating to the management, the control and the elimination of waste (National Water and Environment NEE.P3).

The 2001 framework law defines all types of waste and designates the municipality as the competent body to provide the public service of waste removal and disposal. It lays down the principles of prevention, reduction at source, selective sorting, recovery and information. A national plan for the management of special waste (PNADGDES) and a municipal plan for the management of household and similar waste (SCGDMA) have been instituted to ensure effective management.

- **Article 1** of law points out the object and the field of application of this law.
- **Article 2** lists the principles, on which management, control and elimination of waste are based.
- **Article 29** institutes a communal diagram of management of domestic and similar wastes.
- **Article 37**: collection, sorting, transport and bet in discharge of inert waste are supported by their generators. Store, and abandonment of the inert waste are forbidden on any site not indicated with this effect and notably on the public highway.
- **Article 38**: as part of its urban city plan and development and in accordance with the approved diagram of management, the village initiates measures that aim to the establishment, development and management of the sites of discharges indicated to receive the inert waste.
- Executive Decree **n°07-205** of **June 30th, 2007** fixing modalities and procedures of development, publication and revision of the communal diagram of management of domestic and similar wastes.

3. Monographic study and analysis of the waste generated by the commune of BENI DOUALA

Since the administrative division of 1984, the commune of Beni Douala is chief town of the Department, located in the central part of the province of Tizi-Ouzou, and limited as follows:

- In the North, by the commune of Béni-Aissi

- In the South, by the communes of Ouadhia and Tizi-N'thleta

- In the East, by the communes of Ait Mahmoud and Irjen in the NE

- In the West, by the communes of Béni Zmenzer and Souk El Tenine

Fig 4: Geographical location of Beni Douala

Source: Taken from the Ministry of Industry and Investment Promotion website.

2.1 Quantitative analysis of the waste generated by the municipality

An important parameter from a waste point of view is the average amount of waste specific to the inhabitants, i.e. the amount of household waste considered statically, which is produced per inhabitant per unit of time (Kg/inhab./d). In order to determine the quantity of waste collected in the commune of Beni Douala and in the absence of a weighbridge, we have taken into consideration the tractor payload (loaded with waste). The calculation of the tonnages of waste collected by the commune of Beni Douala was established as follows[5]:

Q= P.V. With:

Q: Quantity of waste

P: Density (Tonne/m3)=0.32 T/m3

[5] The total quantity collected of household and similar waste for the commune of Beni Douala is estimated in relation to the quantities collected in the vehicles assigned per sector at 28T/day, i.e. 8764T/year..

Table 1: Daily tonnages of waste collected by the commune of Beni Douala[6]

Sector	Type of vehicle	Theoretical capacity	Waste equivalent	Number of rotations	Filling rate	Shooting collected(T/day)
N°01	Dump truck ISUZU compactor	10T	10T	01/j	70%	7
N°02	Dump truck ISUZU compactor	7,5T	7,5T	01/j	70%	6,25
N°03	Bucket truck FOTON	7,5T	7,5T	02/j	70%	10,5
N°04	JMC Truck	2,5T	2,5T	01/j	70%	1,75
N°05	Tractor CIRTA	2,5T	2,5T	01/j	70%	1,75
N°06	Tractor CIRTA	2,5T	2,5T	01/j	70%	1,75
Collected total 28 T/j						

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

The information collected during the sampling of household waste led to the results shown in the following table[7]:

Table 2: Average ratio of the commune

Agglomeration	N° of household	Quantity of waste generated Kg/d	Number of inhabitants per household	Ratio Kg/j
Beni Douala	**01**	**50 (for 10 units)**	**5**	**1**
	02	9	6	1,5
	03	8	6	1,33
Average Ratio	**1,27 Kg/Hab/day**			

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

2.1.1 Amount of Waste Generated by Households

The production of household waste in the commune of Beni Douala is given in the table below:

[6] For the calculation of the collected tonnage, it has been taken into account: a tractor filling rate of 70%.

[7] The ratio is defined by the amount of waste produced per person per day (kg/inhab/d). To do this, a weighing was carried out at the level of collective and individual dwellings in order to obtain an estimate of the quantity of waste generated per person. The average ratio for the commune of Beni Douala is 1.27 kg/inhab.d.

Table 3: Waste generated by households

Commune	Agglomeration	Population 2013	Specific production Kg/hab/day	Daily production T/day	Annual production T/year
Beni-Doula	ACL	12068	1,27	15,42	5628,38
	AS	9229	1,27	11 ,79	4304,30
	ZE	373	1,27	0,47	173,96
Turning Product 10106.6 T/year					

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

The production of household waste in the commune is estimated at 27.68 tons per day, i.e. 10106.64 tons per year.

2.1.2 Commercial waste

A certain number of wastes, due to their nature, can be considered as household waste and treated as such. Among these commercial waste and markets whose nature is essentially food (fruit, vegetables...), but not exclusively food (packaging, paper...), whose removal is the responsibility of the municipal services.

2.1.3 Administrative waste

The waste produced by public administrations consists almost exclusively of paper and cardboard that is perfectly suitable for recycling.

2.1.4 Waste from Schools

Table 4: Production of waste from the commune's schools

Students	Specific production Kg/hab/day	Daily production T/day	Annual production T/year
2755	0,2	0,55	201,11

Source: PDAU of BENI-DOUALA.

2.1.5 Waste from health care facilities

The commune has:

- **One (1) polyclinic at the level of the chief town agglomeration**
- **And two (2) treatment rooms (Ait Bouyahia , Ichardiouene Oufella)**

And health care wastes are incinerated in health care rooms within polyclinics of Beni Douala.

2.1.6 Total amount of urban waste generated by agglomeration

In order to estimate the quantities of waste not generated by households but nevertheless collected and disposed of at the same time as household waste, it is necessary to use specialized articles that deal with values specific to the inhabitants.

In a major study carried out by the World Bank (Environment Management of urban solid wastes in developing countries; Sandra Cointreau; 1982), the quantities specific to the

inhabitants, the types of waste mentioned above follow each other in the following orders of magnitude:

- Commercial waste: 0.10-0.20 kg/inhab/day
- Roads: 0.05-0.20 kg/inhab/day
- Administrative waste: 0.05-0.20 kg/inhab/day

Table 5: Estimation of the production of commercial, road and administrative waste in the commune of Beni Douala

Beni Douala Commune	Agglomeration	Population 2013	Specific production kg/hab/day	Total production per day (approx.) T/Day	Total production by year T/year
Commercial waste	ACL	12068	0,15	1,81	660,72
	AS	9322	0,1	0,93	340,25
	ZE	377	0	0	0
roads	ACL	12068	0,1	1,20	440,48
	AS	9322	0,05	0,46	170,12
	ZE	377	0	0	0
Administrative waste	ACL	12068	0,2	2,41	880,96
	AS	9322	0	0	0
	ZE	377	0	0	0
Tonnage produced 1831.82 T/year					

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

Table 6: Collection rate in the commune of Beni-Douala

Commune	Quantity of waste generated T/ab	Quantity of waste collected T/year	Collecting rate % of total
Beni Douala	12582.64	8764	69.65%

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

The amount of waste generated by the commune of Beni Douala is relatively large, and the collection recovery rate is 69.65%. This is due to the fact that the PMA (people municipal assembly) does not have sufficient collection resources.

2.2 Qualitative analysis of the waste generated

Manual sorting of waste in the commune of Beni Douala: As part of the study project, the sorting of household waste was carried out at the communal park of Beni Douala, with the presence of representatives of the commune.

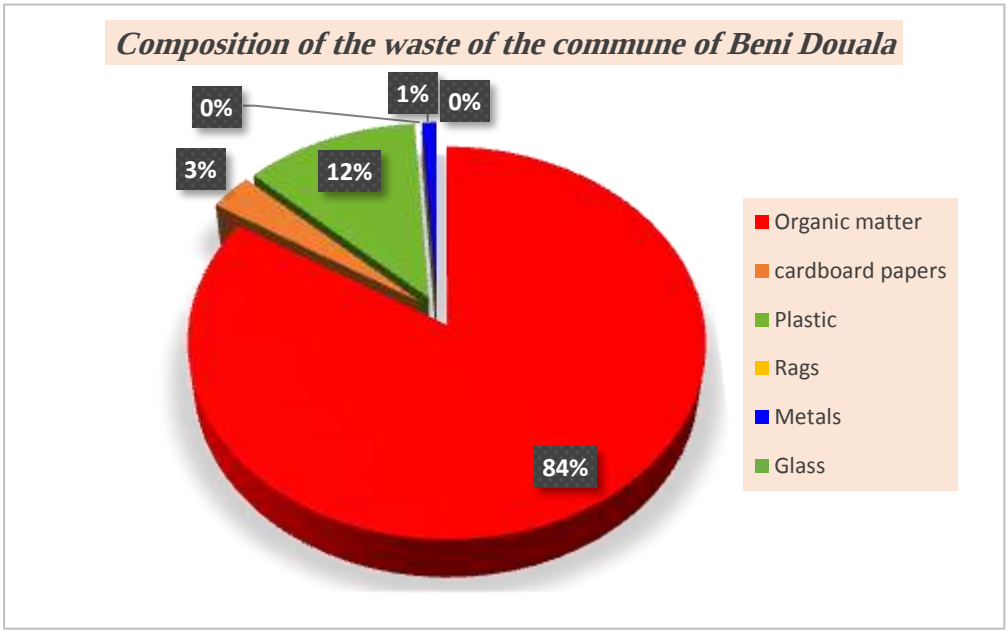
A 33 kg sample was extracted from the municipal solid waste batch. Each waste component was then manually sorted and weighed. The results of the manual sorting carried out at the municipal park are shown in the table below:

Table7: Composition of waste in the commune of Beni Douala

Components	Quantity (Kg)	Percentage%
Organic matter	27.28	84.24%
cardboard papers	1	3.03%
Plastic	4	12.12%
Rags	-	-
Metals	0.2	0.60%
Glass	-	-
Total	**33**	**100.00%**

Source: National Water and Environment NEE «the Master plan for the management of municipal waste of the commune of Beni Douala, province of Tizi-Ouzou».

Fig 5: Composition of the waste of the commune of Beni Douala



Source: designed by the authors.

2.3 Analysis of the inadequacies noted: related to the collection, transportation of waste and sweeping of public roads

The insufficiency of technical means is adapted for urban waste management, especially collection vehicles, to generalize collection throughout the commune of Beni Douala. The organization of solid waste management requires a substantial budget; in order to create resources for this, budget provisions are needed. The analysis of the current situation with regards to waste collection and transport in the commune of Beni Douala has revealed that the municipal garbage collection service is experiencing certain operational difficulties due mainly to:

- Pre-collection means do not meet health and environmental requirements and do not facilitate the work of collection agents, which directly affects the effectiveness of

legislative and regulatory collection. These provisions should be seen as a means of improving and implementing the "polluter pays" principle.

- The collection rolling stock involved in other tasks of the municipality.
- There is a need to acquire new equipment (weaving bucket) and trucks, which will subsequently ensure a better performance in the collection, and ensure the maintenance of the machines in case of a breakdown.
- Insufficient or non-existent and unqualified garbage collectors.
- It is worthy to mention the irresponsible and uncivil behaviour of the population toward the garbage collectors who discourage them in the accomplishment of their tasks.
- the non-respect of the schedule of garbage collection by the population due to a lack of awareness and information, which disrupts the collection. The exit of the bags of garbage deposited on the sidewalk after the passage of the collection vehicle by the inhabitants leaves them exposed for 48 hours until the passage of the collection trucks.
- The garbage dump is located on the edge of a ravine, which increases the risk of contamination during rainfall and creates an unpleasant landscape on the nature surrounding the area.

2.4 Recommendations

In order to better control the situation regarding the collection, transport and disposal of waste, we recommend the following:

- Create a website for the landfill of household waste.
- Adapt a new solid waste management policy in the municipality (encourage recycling and composting of organic waste).
- Reorganize the vehicle fleet with the recruitment of qualified personnel and the purchase of the necessary equipment for the proper functioning of the collection;
- Install sanitary facilities and improve working conditions in the commune's fleet;
- Good management of the rolling stock assigned to the collection and transportation of waste.
- The acquisition of pre-collection means (caissons and bins) would be the solution to be undertaken in the short term to reduce the scattering of garbage and the acquisition of new collection vehicles would be a more effective solution in the short and medium term to reduce the problem of accumulation of household waste and eradicate black spots.
- Optimize the use of personnel assigned to this task (garbage collectors and sweepers).
- Equip garbage collectors and sweepers with work clothes in accordance with the clothing charter.

- To raise awareness of the citizens for the respect of the places and the hours of collection.
- Generalize awareness of the importance of selective sorting and its advantage in facilitating the garbage collectors' task.
- Eradication of wild deposits and black spots existing in the territory of the commune and prohibit anarchic deposits.

Conclusion

The management of municipal waste in Algeria has been considered a priority action of the Ministry in charge of the environment in recent decades (BENOUAR, DJ. (2003). For this purpose, a set of texts and organizations have been adopted. Human and technical resources have been committed since 2001 to improve this service.

At the same time, the production of waste continues to increase due to population and economic growth. These quantities could exceed 30 million tons in 2025 if no prevention policy is implemented and the same macroeconomic trends continue in the coming years.

The adoption of engineered landfill as a method of disposal has resulted in additional costs to collectors. The financing of this service through a lump-sum tax remains inapplicable (BRAHIM DJEMACI, 2012,p1).

The quality of service provided is a very important factor in encouraging households to participate financially to cover the costs of collecting and treating their waste. Adopting a deposit mechanism can be a tool that allows for the source reduction of packaging waste. A reorganization of the collection channels will influence the reduction of costs, particularly those related to the collection distance.

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