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Characterization and Integrated Management of Municipal Waste in Tizi-Ouzou Villages (Algeria)

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Abstract
In this study, we investigated the management of municipal solid wastes in the region of Tizi-Ouzou (Algeria). The evaluation of the current waste management plan and the quantitative and typological characterization of the waste deposit allowed us to highlight the inadequacy of the adopted strategy considering the specificities of the region: both in terms of topography, eccentricity and dispersion of villages and dwellings and in terms of resources. The results of the characterization reveal that over 60% of the waste is organic waste. Our proposed solution involves sorting waste at the household level and transporting it to sorting-composting areas. Following an extensive period of awareness-raising efforts and collaboration with village committees and local associations, we have observed encouraging levels of cooperation from residents. As a result, 67 of the 1500 villages in the region of Tizi-Ouzou have adopted this new plan since 2014. Our study highlighted the efficiency of an integrated and participatory waste management strategy. Therefore, we strongly recommend involving local communities in waste management practices, as this approach produces better results.
Keywords: *Awareness, composting, landfill, selective sorting.*

1. INTRODUCTION

The increase in population and the development of agricultural and industrial production techniques making agricultural and manufactured products accessible to the greatest number of people have resulted in the generation of considerable quantities of waste. The waste produced in small quantities that were naturally degraded became massive masses that require regulated collection and treatment (Damien, 2013).

According to a report published by the Algerian National Waste Agency in 2020, the annual production of municipal solid waste (MSW) in Algeria was estimated at 11 million tons in 2016 and an urban Algerian generates daily about 0.7 kg of waste. These wastes consist of 60% biodegradable organic waste. In large cities, this production is close to 0.9 kg/inhabitant/day. This situation is concerning, especially with the absence of an efficient national plan for the management of MSW, the most used mode of treatment being landfill. The current national waste management plan, especially MSW management, consists of collecting the wastes without sorting them and treating them by landfilling (NWA, 2020).

A better treatment method from an ecological and economical point of view is composting. According to Mustin (1987), composting is a controlled aerobic biological process of conversion and valorization of organic substrates into a stabilized, hygienic product rich in humic compounds called compost. Landfilling of these wastes generates greenhouse gases and leachate which are sources of pollution and responsible for many nuisances.

Furthermore, when wastes are mixed at the source, it necessitates frequent collection, often several times a week, due to the nuisance caused by the organic fraction. This significantly increases the cost of collection, which municipalities are responsible for. However, municipalities often lack sufficient financial resources to ensure this collection (Djemaciand al., 2012).

Waste contains also recyclable waste, such as recyclable plastic, paper/cardboard, metal packaging, and glass (Addou, 2009), which cannot be recycled when the waste is mixed at the source. The non-recovery of these voluminous wastes accelerates the saturation of sanitary landfills.

The current national Algerian waste management plan is particularly not suitable for mountainous regions, due to topographical reasons, dispersion of the deposit, and unavailability of space to build sanitary landfills. Additionally, untreated leachate accelerates the pollution of surface waters and therefore those retained in dams located downstream of the sanitary landfills.

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Our study aims to propose a new waste management plan (which we describe as participatory and sustainable) that would be applicable at any scale (village, municipality, inter-municipality, etc.).
In this study, we propose a solution for sustainable, local, participative, and integrated waste management. Our approach consists of installing local sorting and composting areas. The inhabitants will get involved in the management of their waste and will bring their sorted waste into dedicated spaces. The particularity of this plan is that it is not only sustainable and less costly to implement but it also integrates an educational dimension (training and awareness raising on ecological citizenship for the inhabitants) as well as a socio-economic dimension (creation of activities or jobs, reinforcement of solidarity links and social cohesion). Furthermore, it offers the advantage of flexibility in its implementation, which can be progressive and based on pilot projects before being generalized to a whole region.

2. MATERIALS AND METHODS

2. 1. Presentation of the study area

The region of Tizi-Ouzou (36° 43' 0.001" N 4° 2' 60" E) is located on the central-eastern coast of Algeria, 110 km from the capital Algiers (Fig. 1). The average rainfall is between 600 and 1000 mm per year (ANDI, 2013; ANIREF, 2013). We selected 10 municipalities (Fig. 1) located in the region of Tizi-Ouzou to perform our study. The choice of these municipalities is based on two parameters, the cooperation of the municipality inhabitants and the absence of effective waste management.

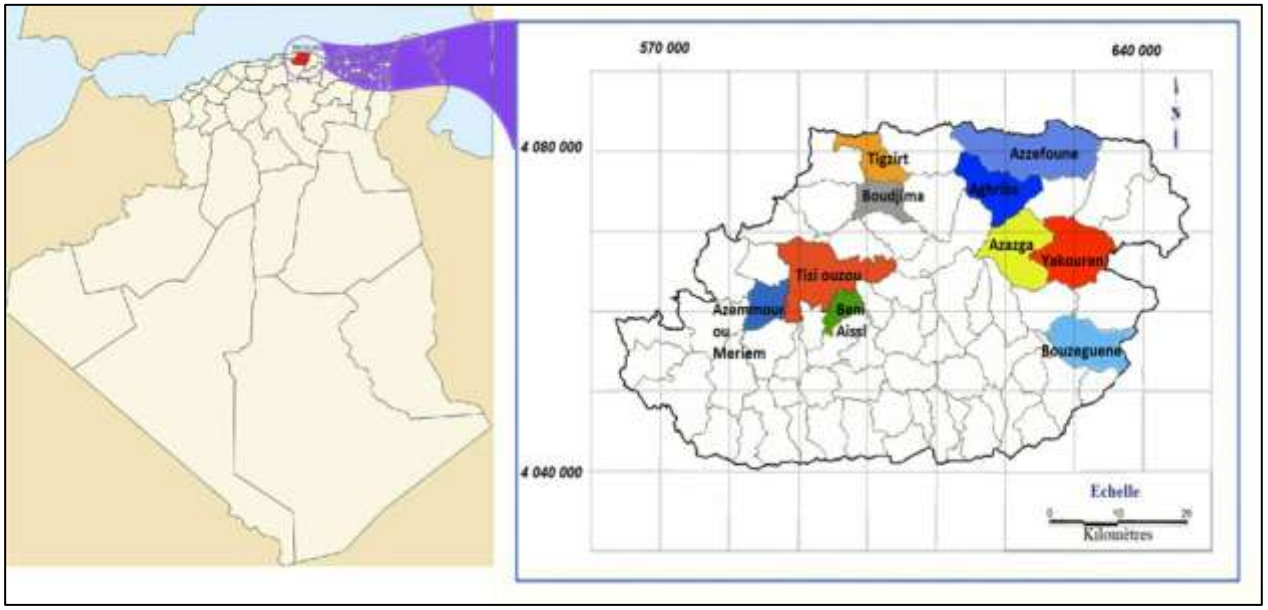

Fig. 1. Geographical location of the region of Tizi-Ouzou and study sites.

2.2. Methodology

2.2.1 Assessment of the current waste management plan

To evaluate and describe the current management plan applied by the local authorities, we performed an investigation by collecting information from several municipalities in the Tizi-Ouzou region concerning the MSW management plan.

2.2.2 Implementation of the new waste management plan

We have organized awareness campaigns in favor of participatory and sustainable management in several villages in the Tizi-Ouzou region. Some villages whose inhabitants were interested by our study were chosen to take part in the characterization of municipal solid wastes.
The choice of households was made with two methods. For the villages that don't have a sorting area, we took 20 households per village. Different colored bags were distributed to the residents to dispose of their waste according to its type and keep it for eight days: organic waste, recyclable waste, and final non-recyclable waste. At the end of the week, the waste was collected, sorted, and weighed, enabling us to quantify it in terms of volume and percentage. The second method concerns the villages that have a sorting area; thus, we prepared a specific schedule for a week during which villagers had to bring their waste to the sorting area in the village so that we could proceed for the sampling. The difference between these two methods did not

interfere with our work, as we used the Ratio, which is the quantity of waste divided by the number of inhabitants divided by the number of days. This characterization work was necessary to know the qualitative and quantitative typology of the waste and was our starting point in drawing up the management plan that we are proposing.

2.2.3 Statistical analysis of the data

The results of the quantitative waste characterization were statistically processed using an analysis of variance (ANOVA) followed by the Newman-Keuls test. A Pearson linear correlation test was used to study the relationship between the different parameters studied (quantity of waste, number of inhabitants, and ratio).

3. RESULTS AND DISCUSSION

3.1. Description and evaluation of the current municipal solid waste (MSW) management plan

In Algeria, despite the efforts made by the government, including programs such as the National Program for the Integrated Management of Municipal Solid Wastes (PROGDEM), aimed at achieving sustainable waste management, the results did not always meet expectations. Our investigation has highlighted the proliferation of illegal waste dumps (Fig. 2. A-B and C), which contaminate the environment and create a visual nuisance. The municipalities are incinerating low-calorific waste to reduce the volume of MSW, thereby causing a deterioration in air quality.

Fig. 2. Illegal dumps in some villages of the region of Tizi-Ouzou. A. Municipality of Beni Douala, B. Municipality of Tigzirt, C. Municipality of Bouzeguene. (original photo, 2019).

Selective sorting is completely absent, which leads to an increase in the number of collection rotations. However, due to a lack of resources, only 50% of waste is collected on average. This has led to an overflow of waste from collection points in the main towns of these municipalities (Fig. 3).

Fig. 3. Piling up of waste in some towns in the region of Tizi-Ouzou (original photo, 2019).

In Algeria, as stipulated in the Article 7 of the municipal code, the management of MSW is the responsibility of the municipality. The latter must define and develop the management plan allowing the collection and

treatment of waste generated on its territory (Djemaci et al., 2012). However, various socio-economic, technical, and organizational challenges sometimes impede the execution of these management plans in certain regions of the country (Cheniti, 2014). This is the case of the villages of Tizi-Ouzou. Indeed, for many years, the topography of the region made effective waste management impossible in the region. The majority of the Tizi-Ouzou villages are scattered over hilly, mountainous terrain, which makes the collection of waste difficult by the public services. In addition, there is a lack of material and human resources for the waste management. Other institutional and educational difficulties, such as the lack of awareness and information, could be an essential factor in making the current waste management plan unsuitable (MATE, 2003).

This situation has led to a proliferation of illegal waste dumps throughout the region (villages and cities) (Fig. 2-3) where fields, forests, and waterways have been transformed into dumps. These dumps present a danger to public health due to the proliferation of pathogens (Chouaki, 2019) and could alter the quality of the environment through greenhouse gas emissions and the production of leachate, which presents risks of soil and groundwater contamination (Makarenko and Budak, 2017).

In Algeria, as in many developing countries, MSW management is supported by public services, where local authorities making the decisions on all planning and implementation activities of the MSW management plan. The latter is based on mixed waste collection. Selective sorting is not considered because of the lack of awareness among citizens and the large financial investment that would be required to increase the frequency of collection and improve transport facilities (Charnay, 2005). Once the waste is collected, it is transported to the treatment site. According to Cheniti (2014), the mode of waste collection and transportation depends mainly on the characteristics of the area served and the financial resources of the municipality. Zurbrügg (2002) states that the means of transportation vary from rudimentary to sophisticated. In the villages of the region of Tizi-Ouzou, the most commonly used means of transport are tractors, dump trucks, and rarely, garbage trucks. Regarding the treatment of MSW, the elimination by disposal at sanitary landfills remains the only mode of treatment adopted at the regional level.

According to Tahraoui-Douma (2013), it is important to replace the current plan of MSW management in Algeria with a new plan that is more environmentally friendly, sustainable and economically rational. Djemaci (2012) reports that municipal services spend huge sums of money to ensure an efficient management of MSW without achieving the expected objective. Several parameters make the current management mode deficient and unsuitable: improvement of the standard of living of the inhabitants which is related to the generation of waste (Beede and Bloom, 1995), the irregularity of the collection and transport of waste (Zurbrügg, 2002), the absence of selective sorting due to the lack of information and awareness of the population (Makarenko and Budak, 2017). Additionally, a lack of monitoring of landfills in some cases, thus, many authors have reported failures in the systems of drainage, recovery, storage, and treatment of leachate and biogas at the level of sanitary landfills (Kehila et al., 2007). Other disadvantages include the absence of composting and recycling of valuable waste.

3.2. Waste characterization results

The results of the waste characterization in selected villages in the region of Tizi-Ouzou during 15 days are presented in Table 1.

Table 1. Results of municipal solid wastes characterization in some villages of the region of Tizi-Ouzou during 15 days

Villages	Number of people	Q (kg)	OW (%)	RW (%)	FW (%)	Ratio (kg/p/d)
Taourirt	1393	6352	56	21	23	0.57
Ahrik	1130	2892	68	2	30	0.32
Ait El hadj	67	268	84	12	4	0.50
Tissegouine	46	132.4	84	10	6	0.36
Azemour Oumeriem	65	280.8	66	28	6	0.54
DjemaaSaharidj	60	201.6	55	39	6	0.42
Icherkiyen	84	215.04	72	26	2	0.32
Tighzert	102	367.2	68	17	15	0.45
AitBouadda	67	337.6	42	9	49	0.63

Adrar	45	118.8	62	31	7	0.33
Ait El Hocine	56	161.2	93	2	68	0.36
Azra	84	302.4	48	32	20	0.45

Q : overall quantity of waste ; OW: organic waste ;RW : recyclable waste ;FW : final waste

These results indicate that the organic fraction predominates in municipal solid waste, sometimes exceeding 90%, while the proportion of recyclable and ultimate waste varies considerably from one village to another. The daily ratio differs significantly between villages, regardless of the municipality to which they belong, given the similarity of their characteristics (same geographical location, the same lifestyle, and the same socio-economic level). Many studies have shown the influence of the population's lifestyle, type of housing, and eating habits on the amount of waste generated, its typology and the daily ratio (Thonart and Sory, 2005; Aloueimine et al., 2006).

In all cases and whatever the local context, the characterization of waste production is an essential step for its management (Parrot et al., 2009). This process enables us to quantify the waste generated, establish its typology, and identify its physical-chemical characteristics to establish a sustainable and efficient management strategy (Féniel and Culot, 2009). The results obtained allowed us to develop and propose a solution for managing the municipal solid wastes adapted to each village according to its particularities, even if the theoretical plan remains the same.

The results of the ANOVA (Tab. 2, Fig. 4-5) show a significant difference among the different regions in terms of the quantity of waste ($p<0.05$, p-value=0.000, F=45,520) and ratio ($p<0.05$, p-value=0.001, F=4,217). The ANOVA show also a significant difference in the parameter number of inhabitants on the quantity of waste ($p<0.05$, p-value=0.000, F=60,157) and ratio ($p<0.05$, p-value=0.002, F=3,971). Thus, the factors of region and number of inhabitants have a significant influence on the variables "quantity of waste" and "ratio". This influence is due to the number of inhabitants that characterizes each of the regions where the waste characterization was performed. The results of the Newman-Keuls test (Fig. 4-5) show three homogeneous groups for the variable "quantity of waste": group C include the village with the largest number of inhabitants (Taourirt: 1393 inhabitants), and group B contain the village Ahrik, with 1130 inhabitants. The other villages are included in group A and their number of inhabitants varies between 45 and 102 inhabitants.

Table 2. Analysis of variance (ANOVA) results

Parameters	**ANOVA results**	**Region factor**	**Number of inhabitants factor**
Quantity of waste	F	45,520	60,157
	P-Value	0.000	0.002
Ratio	F	4,217	3,971
	P-Value	0.001	0.002

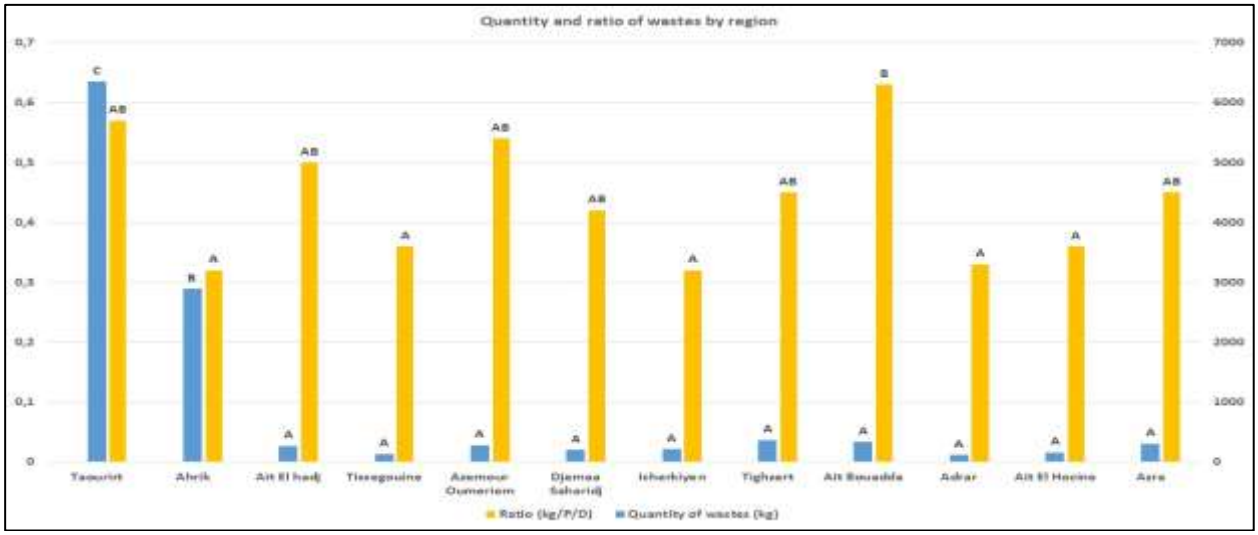

Fig. 4. Quantity and ratio of wastes by region. Different letters indicate significant differences ($p<0.05$)

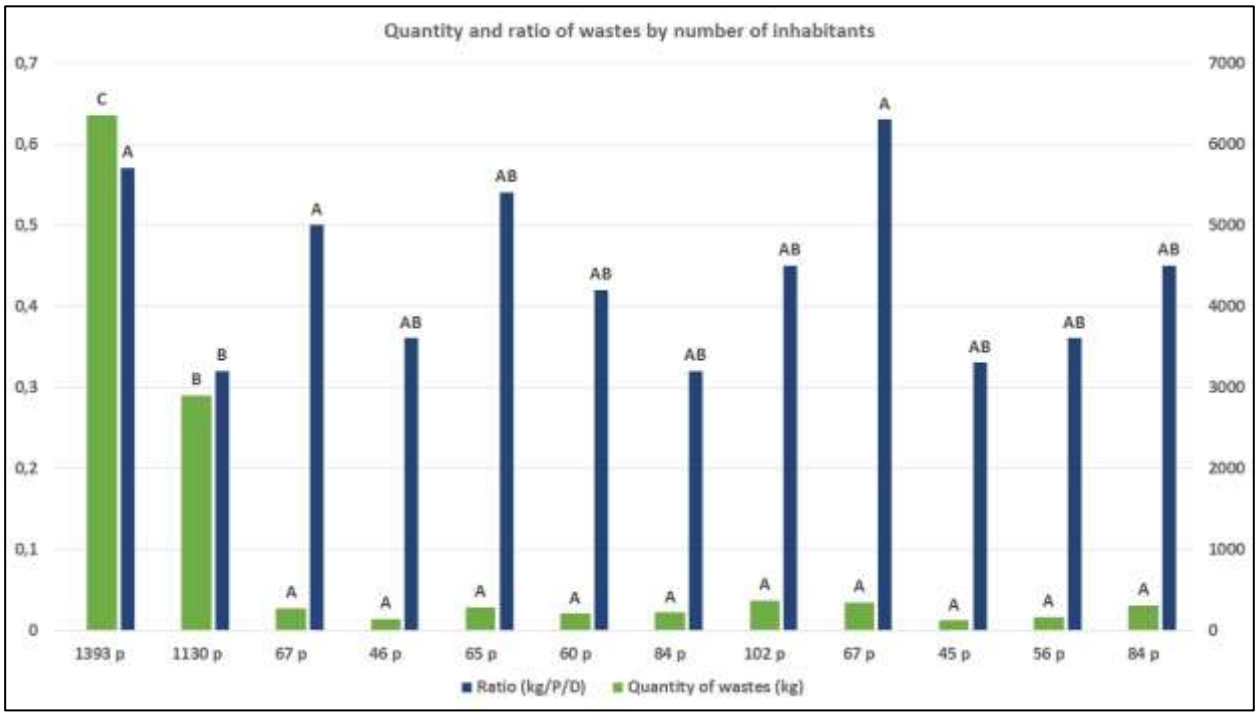

Fig. 5. Quantity and ratio of wastes by number of inhabitants. Different letters indicate significant differences ($p<0.05$).

The Pearson linear correlation (Tab. 3) reveals a significant positive correlation ($p<0.05$) between the number of inhabitants and the amount of waste.

Table 3. Linear correlation test results

Parameters	Number of inhabitants	Waste quantity	Waste ratio
Number of inhabitants	1,000	0,932*	0,076
Waste quantity	0,932*	1,000	0,239
Waste ratio	0,076	0,239	1,000

*significant correlation

3.3. Description of the new municipal solid wastes management plan

The new municipal solid wastes management plan we are proposing for the villages in the Tizi-Ouzou region aligns with the principles of sustainable development and participatory management in which the inhabitants

are involved from the outset in the management of their waste. Cointreau-Levine (1997) highlighted the important role of waste producers, for efficient waste management. We considered several parameters for the development of this new plan: the nature and quantities of waste generated (results of the quantitative and typological characterization) (Tab. 1), the dispersion of settlements, the number of inhabitants, and the topography of each village.

In the new MSW management plan that we propose, households pre-sort waste into categories (recyclable waste, organic waste, ultimate waste, special waste, and electronic waste), which is then taken by the inhabitants to the nearest collection areas. These areas are equipped with separate bins for recycling (solid or recyclable waste) or composting (organic waste). This local management approach is both eco-friendly and economically rational since the organic fraction is processed on-site by composting. The recyclable fraction is sold to recycling companies or intermediaries, which prevents waste from mixing and ensures its transport to the landfill sites, which, by the way, are very far from the villages, which isn't very costly and doesn't put too much of a strain on local budgets.

With the mobilization and financial support of the inhabitants and assistance from associations, several villages have established easily accessible collection areas near homes (Fig. 6-9). The operating principle of these centers is relatively simple: Organic waste is treated by composting (either in piles or in composters); recyclable waste is stored for sale to recycling companies; and the final non-recyclable waste is sent to a sanitary landfill center by the municipal services.

Fig. 6. Organization of sorting-composting area in the village of Taourirt (Bouzeguene).Sorting area, B.Finalize sorting at the sorting area level, C.Sorting area composter

Fig. 7. Organization of sorting-composting area in Ahrik village (Bouzeguene)Sorting area, B. Windrow composting, C. Recyclable waste bins

Fig. 8. Mini-centers for sorting-composting and waste storage in Sahel village (Bouzeguene).

Fig. 9. Organization of sorting-composting area in the village of Tazrout (Bouzeguene).

A. Sorting area, B. Sorting area after the installation of composters, C. Sorting area before the installation of composters,

The centers are managed by permanent agents or by the villagers. The new plan adopted in the villages contributes to reduce illegal dumping and to extend the life of landfills, or at least delay their saturation, given that sustainable waste management aims to reduce the volume of waste destined for final disposal (Greenpeace Environmental Trust, 2003; Mosler et al., 2006). Moreover, the plan aligns with the principles of sustainable development (such as the implementation of recycling, reuse, and composting of bio-waste, and respect for the environment) and implies that disposal by landfill concerns only final waste that is neither compostable, nor reusable, nor recyclable (Aloueimine et al., 2006).

As reported by Bayard et al., (2013), centralized management of urban solid waste in developing countries often shows its limitations (we often end up with a very low collection rate, rapid saturation of controlled landfills, and a proliferation of uncontrolled landfills). Hence, there is a need to develop a decentralized and integrated waste management model. This was our goal in the villages of the Tizi-Ouzou region, with objectives focused on simplifying waste collection, treatment, and recovery, improving sanitary conditions, reducing nuisances from uncontrolled dumping, and creating job opportunities or income-generating activities through waste recovery and treatment.

3.4. Villages and neighborhoods adopting the proposed plan

Among the 1500 villages in the region of Tizi-Ouzou, 67 adopted the new management plan that we proposed and presented to them during the awareness campaigns we conducted between 2014 and 2020. The first village that set up a sorting-composting area for municipal solid wastes was the village of Taourirt in the municipality of Bouzeguene in August 2014. It is a small village of 800 inhabitants, with the furthest house

being 1.5 km from the sorting area. In this village, the inhabitants themselves sort their waste by type (organic waste, recyclable waste, ultimate waste, expired medicines, electrical waste) before taking it to the collection area (Fig. 6.A.), where it is sorted a second time, separating solid waste by category (plastics, metals, colored and transparent glass) (Fig. 6B). Organic waste is placed in composters (Fig. 6C), while special waste is stored in bins and collected by specialized companies for treatment through incineration. Recyclable waste is stored to be sold later to collectors or recycling companies (Fig. 6D). Ultimate waste is treated by landfilling in the technical landfill center. An employee hired and remunerated by the village residents ensures the operation of the sorting center.

In the municipality of Bouzeguene, another village named Ahrik has established a sorting-composting and waste storage area, operational since January 2017. Ahrik is a village of 1500 inhabitants, whose homes are closer to each other, the farthest being 1 km from the sorting-composting area. Initially, organic waste was composted in 10 composters made by the villagers (Fig. 7A), but later, the villagers opted for pile composting because of the large quantities of organic waste generated daily by the households (Fig. 7B). Recyclable waste is stored in separate compartments (Fig. 7C) until it is ready to be sold to recycling companies or specialized firms. ultimate waste (non-recyclable) is treated by landfilling in the technical landfill center.

In the municipality of Bouzeguene, the village of Sahel, larger than the two previous ones, exceeding 3500 inhabitants, took our advice and opted for the realization of 6 mini-centers of sorting-composting (Fig. 8), considering the size of the village and the number of inhabitants. However, due to the deficiencies in the treatment of organic matter by composting, attributed to the absence of employees to manage the mini-centers and the maintain the composters, we proposed to the villagers an alternative solution, which consists in equipping each household with an individual composter and in training the inhabitants to compost their bio-waste themselves. For this purpose, a workshop for the manufacture of composters was built to equip the 292 households in the village. Consequently, domestic composting (at home) has emerged as the appropriate solution for treating the organic fraction. As for the recyclable and ultimate waste, specific bins are placed inside the mini-centers and along the village's streets for their temporary storage. These bins are collected biweekly to be either treated by landfilling in the technical landfill center (ultimate waste) or sold to specialized companies or recycling companies (recyclable waste).

The village of Tazrout, situated in the municipality of Bouzeguene, which has a population of 500 inhabitants, has also created a sorting-composting space (Fig. 9A), made possible through contributions and donations from villagers. This space includes composting sites for in-situ treatment of the organic fraction of waste (Fig. 9B); a baler (Fig. 9C) for compacting recyclable waste such as plastic, aluminum cans, and paperboard. The ultimate waste istreated by landfilling in the technical landfill center

4. CONCLUSION

This study has demonstrated that the current municipal solid waste management strategy in the Tizi-Ouzou region is not aligned with sustainable development principles and environmental standards. Therefore, the implementation of a waste management strategy based on selective sorting and recovery is essential, as it promotes ecological sustainability, social acceptance, and economic feasibility. And given the structural, demographic (village distribution), and geo-morphological constraints of this region (mountainous relief), the most viable solution is to establish small-scale sorting and composting facilities within the villages as part of an integrated and participatory waste management approach. Furthermore, our study has also highlighted the importance and benefits of involving inhabitants in their own waste management.

REFERENCES

1.Addou, A., (2009), Treatment of waste :recovery, elimination, (Traitement des déchets : valorisation, élimination), Ellipses, Paris.

2.Agence Nationale d'Intermédiation et de Régulation Foncière (ANIREF), (2013), Provincial monograph: Wilaya of Tizi-Ouzou (Monographie provinciale : Wilaya de Tizi-Ouzou. Algiers: ANIREF), National Agency for Intermediation and Land Regulation, Algiers, Online at: https://www.aniref.dz/index.php?layout=edit&id=165

3.Agence Nationale du Développement de l'Investissement (ANDI), (2013), Monograph of the Wilaya of Tizi-Ouzou (Monographie de la Wilaya de Tizi-Ouzou), National Agency for Investment Development, Algiers, Online at: http://www.andi.dz/pdfmonographie/Tizi-Ouzou.pdf

4.Aloueimine, S., Matejka, G., Zurbrügg, C.,and Sidi Mohamed, M.,(2006), Seasonalcharacterization of householdwaste in Nouakchott (Caractérisation saisonnière des ordures ménagères à Nouakchott), Environnement, Ingénierie & Développement,**44**, 4–8, Online at: https://hal.science/hal-03175156

5.Bayard, R., Lacour, J., Naquin, P.,and Dorval, S., (2013), Management of urbansolidresidues in Cité Soleil (Haiti): Establishment of a decentralizedcomposting platform (Gestion des résidus solides urbains à Cité Soleil (Haïti) : mise en place d'une plateforme de compostage décentralisée), Environnement, Ingénierie & Développement, **63**, 4–14, https://doi.org/10.4267/dechets-sciences-

techniques.2419
6.Beede, D. N., and Bloom, D. E., (1995), The economics of municipal solid waste. The World Bank Research Observer, **10**(2), 113–150. https://doi.org/10.1093/wbro/10.2.113
7.Charnay, F., (2005), Composting of urbanwaste in developingcountries:Development of a methodologicalapproach for sustainable compost production (Compostage des déchets urbains dans les pays en développement : Élaboration d'une démarche méthodologique pour une production pérenne de compost), PhD Thesis, University of Limoges, Limoges, France, 229 p.,Theses.fr. http://www.theses.fr/2005LIMO0035.
8.Cheniti, H., (2014), Management of urbansolidwaste: Case of the city of Annaba (La gestion des déchets urbains solides : cas de la ville d'Annaba), PhD Thesis, Badji Mokhtar University, Annaba, Algeria, 135 p., https://biblio.univ-annaba.dz/wpcontent/uploads/2015/06/These-de-CHENITI-Hamza.pdf
9.Chouaki, S., (2019), Seasonal physico-chemical and microbiologicalcharacterization of the dumps of Ain-El-Hammam and Timizart (Tizi-Ouzou Province, Algeria) (Caractérisation physico-chimique et microbiologique saisonnière des décharges d'Aïn El Hammam et Timizart (wilaya de Tizi Ouzou, Algérie)), PhD Thesis, Mouloud Mammeri University, Tizi-Ouzou, Algeria, 127 p., https://www.ummto.dz/dspace/handle/ummto/8894
10. Cointreau-Levine, S., (1997), Occupational and environmental health issues of solid waste management, International Occupational and Environmental Medicine, St. Louis, MO: Mosby.
11. Damien, A., (2013), Guide to wastetreatment:Regulations and choice of processes (sixthedition) (Guide du traitement des déchets : Réglementation et choix des procédés), Dunod, Paris.
12. Djemaci, B., Kertous, M., and Soufi, I., (2012), Prospective analysis of municipal waste management costs (Analyse prospective des coûts de la gestion des déchets municipaux en Algérie), Les Cahiers du MECAS, **8**, 72–84, https://asjp.cerist.dz/en/article/9323
13. Féniel, P., andCulot, M., (2009), Household solid waste generation and characteristics in Cape-Haitian city, Republic of Haiti, Resources, Conservation and Recycling, **54**(2), 73–78, https://doi.org/10.1016/j.resconrec.2009.06.009
14. Greenpeace Environmental Trust, (2003), Mechanical Biological Treatment: A state-of-the-art alternative to incineration for residual municipal waste, Greenpeace Environmental Trust,
https://business.senedd.wales/documents/s12826/Consultation%20Response%20PET4WAI%2015%20Greenpeace.pdf
15. Kehila, Y., Aina, M., Mezouari, F., Matejka, G., and Mamma, D., (2007), Perspectives for technicallandfilling and eco-compatible storage of solidresidues in developing countries with regard to their impacts on the urbanhydrosphere (Quelles perspectives pour l'enfouissement technique et le stockage éco-compatible des résidus solides dans les pays en développement au regard de leurs impacts sur l'hydrosphère urbaine.), Proc. JSIRAUF, Hanoi, https://www.researchgate.net/publication/273953993
16. Makarenko, N., and Budak, O., (2017), Waste management in Ukraine: Municipal solid waste landfills and their impact on rural areas, Annals of Agrarian Science, **15**(1), 80–87, http://dx.doi.org/10.1016/j.aasci.2017.02.009
17. Ministère de l'Aménagement du Territoire et de l'Environnement (MATE), (2003), Information manual on the management and elimination of urbansolidwaste (Manuel d'information sur la gestion et l'élimination des déchets solides urbains), Ministry of Land Management and Environment, Algiers. https://www.me.gov.dz/fr/environnement-urbain/
18. Mosler, H.J., Drescher, S., Zurbrügg, C.,and Cabral Rodríguez, T., (2006), Formulating waste management strategies based on household practices in Santiago de Cuba, Habitat International, **30**, 849–862, https://doi.org/10.1016/j.habitatint.2005.09.008
19. Mustin, M., (1987), Compost: Management of organicmatter (Le compost : Gestion de la matière organique), Inzinzac-Lochrist (Paris) : François Dubusc, 954 p.
20. NWA, (2020), (National Waste Agency). Report on the state of waste management in Algeria (Rapport sur d'état de la gestion des déchets en Algérie), On line at:https://and.dz/site/wp-content/uploads/rapport%20DMA2.pdf
21. Parrot, L., Sotamenou, J., and Kamgnia Dia, B., (2009), Municipal solid waste management in Africa: Strategies and livelihoods in Yaoundé, Cameroon, Waste Management, **29**, 986–995, https://doi.org/10.1016/j.wasman.2008.05.005
22. Tahraoui Douma, N., (2013), Recovery by composting of urban solid residues from the municipality of Chlef, Algeria (Valorisation par compostage des résidussolidesurbains de la commune de Chlef, Algérie), PhD Thesis, University of Limoges, Limoges, France, 224 p., http://www.theses.fr/2013LIMO4038
23. Thonart, P., and Sory, D., (2005), Practical guide on householdwaste management and technicallandfill sites in southern countries (Guide pratique sur la gestion des déchets ménagers et des sites d'enfouissement technique dans les pays du Sud), Francophonie Institute for SustainableDevelopmentIFDD, Quebec. https://www.pseau.org/outils/biblio/resume.php?d=4949
24. Zurbrügg, C., (2002), Urban solid waste management in low-income countries of Asia: How to cope with the garbage crisis, Proc. The Scientific Committee on Problems of the Environment (SCOPE), Durban, South Africa.
https://www.researchgate.net/publication/228735642