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The Circular Economy and Household and Similar Waste (HSW) Management in Algeria: An Overview

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Abstract:
Algeria struggles with waste management due to poor collection, lack of sorting, and weak recycling infrastructure. Most waste is landfilled, leading to pollution and resource loss. Selective sorting, composting, and biogas production offer viable solutions. Stronger regulations, modernized waste facilities, and public awareness are key to sustainability. Public-private partnerships and the informal sector can boost waste valorization. By adopting a circular economy model, Algeria could transform waste into valuable resources, reduce environmental impact, and create economic opportunities. How can Algeria integrate circular economy principles into its waste management system while addressing economic, policy, and infrastructure challenges?
Keywords: HSW Management, Circular Economy, Waste Valorization, Sustainable Development
Jel Classification Codes : Q530- Q01

Introduction :

Waste management is a crucial environmental and economic issue worldwide, and Algeria is no exception. With rapid urbanization, population growth, and increased consumption, the country faces significant challenges in handling household and similar waste efficiently. Traditional waste disposal methods, such as landfilling, dominate the current system, leading to environmental degradation, resource loss, and public health concerns.

Despite efforts to improve waste management, several obstacles remain, including inadequate collection services, the absence of waste sorting at the source, and insufficient recycling infrastructure. The informal sector plays a key role in waste recovery, yet its integration into a structured system is limited. However, Algeria has significant opportunities to enhance its waste management practices through sustainable strategies such as selective sorting, composting, biogas production, and increased recycling efforts.

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This study aims to provide an analytical assessment of the current waste management system in Algeria, highlighting key challenges, existing policies, and potential solutions. By adopting a circular economy approach and strengthening regulations, Algeria can transform its waste into valuable resources, reduce environmental impact, and create economic opportunities.

1. Waste management in Algeria

1.1. Background on waste management in Algeria

Household waste production in Algeria has been steadily increasing due to urbanization, population growth, and changing consumption patterns. Waste generation varies between urban and rural areas, with large cities producing higher amounts of waste per capita. The country faces significant challenges in managing this waste efficiently, as most of it ends up in landfills or uncontrolled dumpsites.

According to the report on the state of waste management in Algeria National Waste Agency (AND), 2020, the total amount of HSW produced in 2020 totaled 13.5 million tons, 90% of which represented household waste. Assimilated waste, resulting from economic and administrative activities including industry, commerce, services and administrations, made up 10%. In order to keep the increase in waste as low as possible, different scenarios have been drawn up within the framework of the NIWM-2035. Thus, the quantity of HSW will reach 23 million tons in 2035 in the case of Business As Usual (BAU). If the strategy is implemented, by introducing various measures such as prevention and financial incentives, it will be limited to 20.5 million tons with a recycling rate that could be as high as 25% to 30%. (AND, 2020)

Table 1: Waste Production Trends

Year	Waste Generation (Million Tons/Year)	Per Capita Waste Production (kg/day)
2010	10.0	0.7
2015	11.2	0.8
2018	13.0	0.85
2023	14.5	0.9
2030 (projected)	18.0	1.1
2035 (projected)	>23.0	1.2

Source: National Waste Management Strategy (NIWM), Ministry of Environment

1.2. Definition of Household and Similar Waste (HSW)

Household Solid Waste (HSW) refers to the discarded materials generated by households, including everyday items such as food waste, packaging, paper, plastics, glass, metals, textiles, and other non-hazardous materials (Tchobanoglous, Theisen, & Vigil, 1993). HSW is a subset of municipal solid waste (MSW) and is typically managed through collection, transportation, and disposal or recycling processes. Proper management of HSW is critical to minimizing environmental pollution and promoting public health (Hoornweg & Bhada-Tata, 2012). The

composition and volume of HSW vary depending on factors such as income levels, consumption patterns, and waste management practices (Zurbrugg, 2002).

1.3. Importance of the Circular Economy in waste management

The circular economy plays a critical role in transforming waste management by promoting the reduction, reuse, and recycling of materials, thereby minimizing waste generation and environmental impact. Unlike the traditional linear economy, which follows a "take-make-dispose" model, the circular economy emphasizes closing the loop of resource use, ensuring that materials remain in circulation for as long as possible (EMF, 2015). This approach not only reduces the strain on natural resources but also decreases greenhouse gas emissions and landfill dependency. (Kirchherr, Reike, & Hekkert, 2017). For instance, recycling and reusing materials such as plastics, metals, and organic waste can significantly reduce the volume of household solid waste (HSW) and contribute to sustainable development goals (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). By integrating circular economy principles into waste management systems, societies can achieve economic, environmental, and social benefits, fostering a more sustainable future.

1.4. Relationship between Circular Economy and HSW

Circular economy and household as well similar waste (HSW) both go hand in hand, as the management of HSW is important for a circular economy success. This is in a conventional linear economy, where the household waste is basically thrown into landfills or combusted resulting resource remorse and contamination. The Circular Economy strives to alter waste management where less waste is being thrown away, more is being reused and the maximum possible recycled and recovered. Key relationships between the circular economy and HSW include:

Waste Prevention – Waste prevention or source reduction / waste minimization is a strategy within the circular economy to reduce generation of waste by taking the waste out of the waste chain. Contrary to the common traditional approach for waste management which limited in disposal and recycling; waste prevention pointed out on designing the product, process use or consumption patterns that will reduces resource use and waste production (Ghisellini, Cialani, & Ulgiati, 2016).

Eco-design is one of the fundamental methods to prevent waste, developed when creating products with the view towards durability and repair ability; recyclability. This response as well lessens the waste, saves raw materials and energy (Ellen MacArthur Foundation 2017). Sustainable consumption (buying in bulk, using reusable packaging; avoiding single-use plastics) are also part of waste prevention (EEA, 2020).

Governments and policy makers are a powerful act of driver in encouraging waste prevention through regulations as well as incentives. Extended Producer Responsibility (EPR) programs for example push manufacturers to be responsible for the end-of-life management of their products, and to include design for disassembly and recyclability (OECD, 2016). For example, awareness campaigns

and educational programs lead the consumer base through correct choice paths in line with waste reduction (UNEP, 2021).

Societies can achieve considerable environmental benefits, at least cost, by focusing on waste prevention and moving toward a low waste society that is resource efficient and sustainable. **Reuse and Repair**, Furniture, electronics and textiles in household waste can be repaired, used again and thus preserved their lifecycle while not requiring to start off from new raw materials.

1.4.1. Recycling and Resource Recovery

Recycling and resource recovery are pivotal strategies within the circular economy framework, aiming to transform waste materials into valuable resources, thereby reducing environmental impact and conserving natural resources.

A comprehensive understanding of the circular economy necessitates a systems thinking approach, recognizing the complex interactions within resource recovery systems. The promoting deep transformational change requires moving beyond merely closing material loops to fostering sustainability in resource exploitation and management (Velenturf, Purnell, & Jopson, 2020)

The political economy of waste utility services is evolving in response to circular economy initiatives. The examination of this shift, highlighting the changing dynamics in waste recovery, incineration, and urban reuse (Velenturf P. J., 2020).

In the context of organic solid waste, integrating aerobic and anaerobic digestion technologies plays a significant role in advancing a bio-based circular society (Khalid, Anjum, & Hameed, 2020).

However, challenges persist in recovering waste from complex consumer products (Velenturf A. P., 2022). The variation issues in waste recovery related to simple versus complex products, underscoring the need for innovative solutions in recycling and resource recovery processes.

1.4.2. Composting and Organic Waste Management

The management of biodegradables such as food waste from households for composting contributes towards sustainable agriculture and energy production as well as biogas and fertilizers production via anaerobic digestion (Velenturf, Purnell, & Jopson, 2020).

1.4.3. Producer Responsibility and Policy Measures

Extended Producer Responsibility (EPR) initiatives are the backbone of a circular economy, meaning manufacturers must pay for the end-of-life management of their products therefore making improvement in design and better collection systems for collecting waste (Velenturf, Purnell, & Jopson, 2020).

2. Conceptual Framework

2.1. Definition and principles of the Circular Economy

Circular Economy (CE) is a strategy of sustainable development that takes economic process redesign as a way of enhancing ecosystem function and human wellbeing (Murry, Skene, & Haynes, 2015) Follows a closed-loop system with reducing, reusing and recycling of materials to material into valuable resources

(Ferro, 2021). Such an approach transcends sustainability to actively fostering natural ecosystem health (Pitt & Heinemeyer, 2015). The implementation of CE is enabled by Fourth Industrial Revolution tools better decouple economic growth and resource use (Heshmati A., 2017). They include waste minimization, increasing product life span, and moving from owning to paying for the service. Recommended policy instruments for CE with fiscal (Ferro, 2021; Ferro et al. 2015). Nevertheless, obstacles persist because the lack of social dimensions in generic CE concept and possible unexpected side effects (Murry, Skene, & Haynes, 2015).

2.2. The role of waste management in a circular system

Waste management needs to be the backbone of a circular economy: transforming waste into valuable resources that do not require more and environmental impacts on disposal, inspired by a system that is circular instead of linear Permanent waste (Ellen MacArthur foundation 2015) is no longer considered the end of waste in a circular system, recycling or multi potency re-using/recovery of materials. Source separated waste, material recovery facilities and other effective waste management strategies are therefore key in closing the loop for all types of resources, with reduction and substitution of virgin materials (Kirchherr et al, 2017). Reusing plastics and metals for recycling is not only a precious resource conservation, but it also can decrease all the greenhouse gas emissions brought by extraction and primary production (Geissdoerfer et al., 2017). When waste management is included in circular economy policy frameworks, enables sustainability development goals achievement; minimizes landfill dependence and creates economic benefits through valorization of its materials.

2.3. The Fundamental principles of waste management

The Fundamental principles of waste management are:

Prevention and reduction at source

- Minimisation: waste minimisation from the outset.
- Prevention: reducing the harmfulness of waste through sustainable practices and ecological design solutions.

Organisation of waste flows

- Set up the structuring of waste sorting, collection, transport and treatment for sustainable and efficient management.
- Make the process efficient and environmentally compliant.

Waste recovery

- Teaching: reuse waste and flood it to give materials a second adventure.
- Make a circular economy by interpreting waste as a source of assets.

Ecological treatment

- Apply ecological treatment strategies.
- Only global consideration of potential damage to the ecosystem and the Salvation of humanity.
- Raising awareness and providing information
- Public education on the health and environmental risks caused by waste.
- Encourage collective awareness: for joint responsibility and commitment.

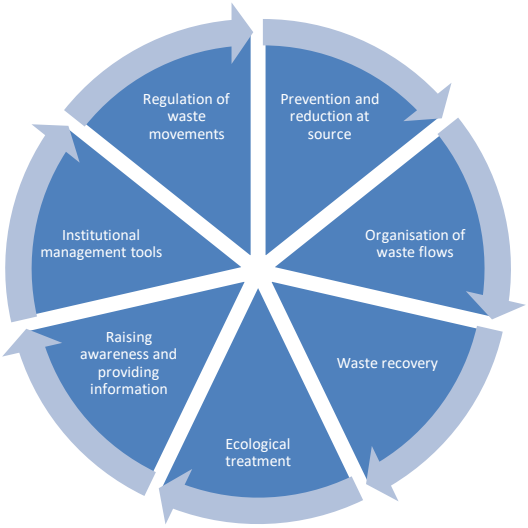
Institutional management tools

- Proliferate plans such as the National Special Waste Management Plan (PNAGDES).
- Guarantee national coordination for comprehensive management.

Regulation of waste movements

- Control cross-border movements and prevent environmental and sanita on risks.
- Comply with international waste management standards.

Figure 1. The Fundamental principles of waste management



Source: Author's own work adopted from AND (2020).

1.1. Key strategies: Reduce, Reuse, Recycle (3Rs)

The **3Rs** (Reduce, Reuse and Recycle) are three principles of sound waste management, circular economy. These principles are designed to reduce waste generation, protect resources and be as kind to the biosphere. Below are each of the strategies breakdown :

- **Reduce**

First and best approach is to stop whole waste from generated (Function Level) This is about reduction in consumption, resource optimization and designing the product using less material. As an instance, decreasing the packaging or minimizing paper has digital alternatives can drastically cut landfill waste (Tchobanoglous, Theisen, & Vigil, 1993). Businesses and individuals are able to decrease their environmental impact as well as save money by cutting down on waste.

- **Reuse**

The second Strategy, Reuse is about keeping the life span of products and materials and looking for new uses and re-creative ways of consuming instead of throwing. This could range from repair work, resell and/or recycle items. In this

way reusing glass jars (eg for storage), donating clothes that are too good to waste reduces the need for new products or sent to landfill (Hoornweg & Bhada-Tata, 2012). Of course, Reuse conserves resources but also drives product creativity and innovation in design.

- **Recycle**

The third strategy, recycle is reprocessing the waste materials into new products. Recycling offers resource recovery of metals, plastics and paper from used products minimizing virgin raw materials from energy intensive production processes (Geissdoerfer, Savaget, Bocken, & Hultink, 2017). Good recycling needs to be coupled with waste segregation, collection and infrastructure so that materials are processed well and fed back into the economy.

The **3Rs** are necessary for moving a circular economy, (whereby waste will be drastically decreased and resource use will stay within use phase for prolong) The following ways can help those societies to reduce environmental pollution, save natural resource and encourage sustainable consumption and production paradigms (Ellen MacArthur Foundation, 2015).

2. Current State of HSW Management in Algeria

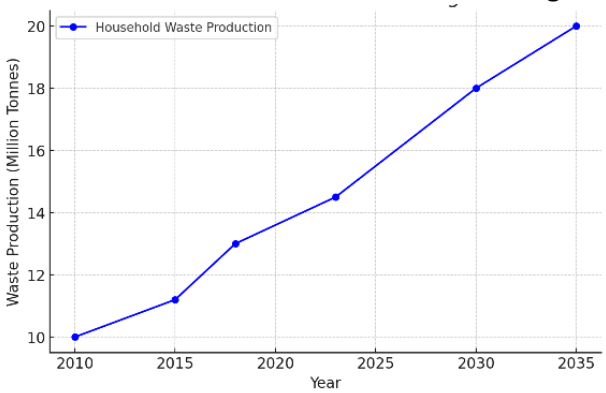
2.1. Waste generation trends and composition

2.1.1. Waste Production trends

Increasing urbanization and expanding population growth has raised household as well as similar waste production in Algeria exponentially. Most of the waste is produced in urban, implying you consume more as an aggregate. Due to the non-existent or inadequate collection services and low infrastructure (Dahmane, et al., 2024), waste management had to make great efforts in coping up with this increasing load. Rural areas likewise play their own share in waste generations, the management of which too do not remain as consolidated.

No efficient waste sorting infrastructure at the source, leading to a large percentage of mixed-waste which increases recycling/recovery value. This huge amount ends up in Landfills or open dumpsites causing severe environmental pollution and resource exploitation (Hassaine & Abrika, 2023).

Figure 2. Evolution of Waste Productions Trends in Algeria (2010-2035)



Source: AND (2018/2019), P18

Algeria household waste generation has increased from 10 million tons to 14.5 in 2010–2023 as a result of urbanization, population growth and increasing consumption. Forecasts suggest a steeper acceleration to 18 million tons in 2030 and more than 20 million tons by 2035, which would produce waste generation that doubles in just 25 years. This sudden increase, overtaxes the waste management system — landfills are putting all in us and polluting are around natural environment as always costly land disposal. Among the many contributing elements: urban sprawl, economic development and poor recycling policy resulting in most waste being dumped into landfills. If left to their own devices, Algeria already struggles with pressing environmental and economic issues. This will require country by inducing the recycling infrastructure, supporting composting and biogas production, and regularizing the informal sector.

2.1.2. Waste Composition

Waste composition of Algeria — Homogenous with the nearly fully organic material in household and similar waste AL. The main waste categories are:

• **Organic Waste**: Includes Dood Scraps Agricultural residues and other bio-material This fraction is highly suitable for composting and biogas generation

• **Recyclable Waste**: Consists of plastic, paper, cardboard, glass and metals etc. A fraction of these materials is recovered back through informal recycling networks, though the overall recycling rates remain low.

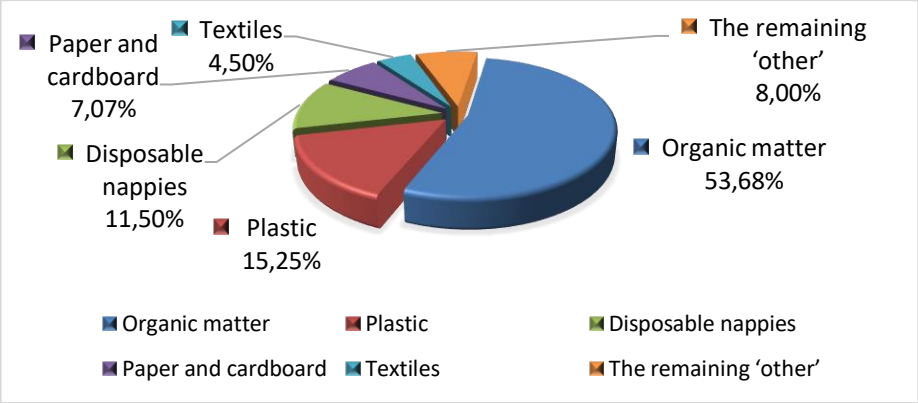
• **Inert and Miscellaneous Waste**: Includes construction debris, textiles, and non-recyclable materials that often end up in landfills.

Understanding waste generation and recycling potentiality is a key step for policy development in the field of waste management. Better waste sorting, recycling and citizen awareness can expand the scope for resource recovery from waste while minimizing pollution.

The work carried out in the 4 pilot wilayas (Jijel, Constantine, M'Sila, Ouargla) during the period April 2018 - March 2019 provided an overview of the average composition of household waste across the country. Overview of the average composition of municipal solid waste across the country (AND, 2020):

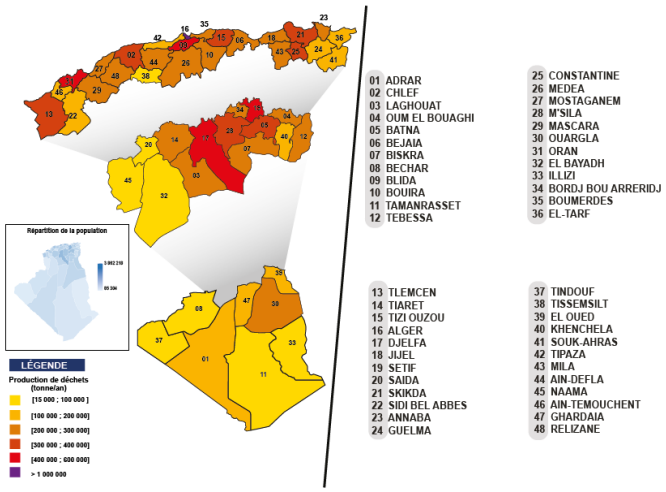
- Organic matter represents the largest fraction of WAS produced, with **53.6%;**
- Plastic represents **15.2%;**
- Disposable nappies **11.50%**;
- Paper and cardboard **7.07%**;
- Textiles **4.5%**;
- The remaining 'other' about 8%, are very small fractions; metals, glass, shoes, inert waste, complex/composite, etc.

Figure 3: Average composition of HWS in Algeria during the period 2018-2019



Source: AND (2018/2019), P17.

Figure 4. Quantity generated per wilaya (2020)



Source: SNID, 2020 (https://snid.and.dz/indicateurs.php)

2.2. Collection, transportation, and disposal methods

The management of Household Solid Waste (HSW) in Algeria is composed of three stages: collection, transport and final disposal. Yet there are substantial obstacles for the country to integrate effective waste management practices. Below is the run-down of these methods:

- **Collection**

The collection of HSW in Algeria is primarily carried out by municipal authorities, with waste bins placed in urban and suburban areas for residents to dispose of their waste. However, collection systems are often inefficient, particularly in rural areas, where waste is sometimes dumped indiscriminately due to a lack of infrastructure (Bouchenak, Benzaid, & Belhadi, 2019). In urban centers like Algiers and Oran, door-to-door collection services are more common, but

inconsistent schedules and insufficient waste bins often lead to overflow and littering (Khelil, Cherif, & Benzina, 2018).

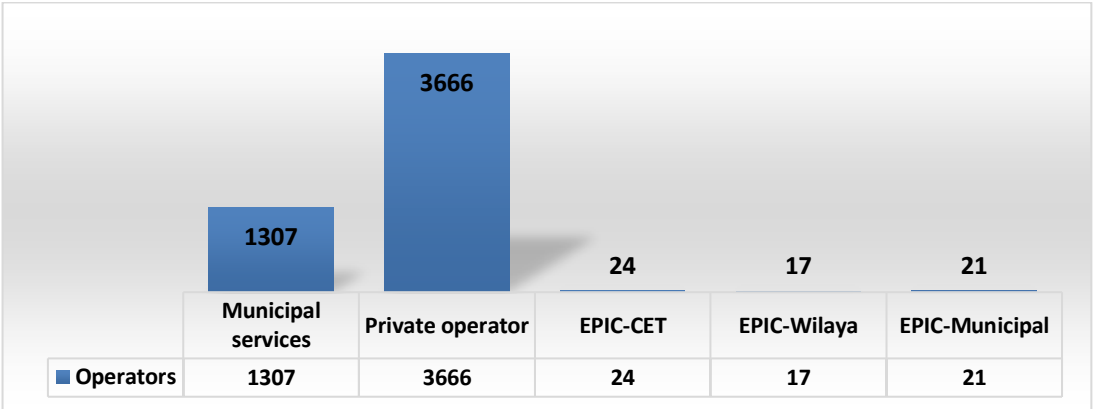
- **Transportation**

From collection to disposal, waste is transported using trucks and other vehicles. Transportation in the field, however is often impeded by old equipment; lack of maintenance and poor road infrastructure exist in many remote areas (AND, 2020). Which then causes delays and more price to higher the bar with failing waste management.

- **3. Disposal**

The disposal process of HSW in Algeria is totally landfilling with more than 90% of waste sent to uncontrolled / semi-control landfills (Khelil, Cherif, & Benzina, 2018). They are usually not lined with a liner, leachate management and gas collection systems, causing environmental contamination and risk for public health. There is little scope for recycling and composting, as lesser than a fifth of waste processed via formal recycling channels (Khelil, Cherif, & Benzina, 2018). Although efforts to bring the waste management practices in sync with modernization like development of engineered landfills and waste-to-energy plants are being made, these are not adequate to deal with escalating waste crisis.

Figure 5. Breakdown of operators responsible for collecting (2020)



Source: SNID, Op.Cit., 2020

2.3. Existing policies and regulations

According to a waste crisis which is slowly getting worse, National Waste Management Strategy of Algeria was brought out. The strategy aims at waste minimization, improved recycling rates and alternative disposal options. It also highlights the need of public education and community engagement for waste management (AND, 2020).

This Special waste management policy is included under the National Environmental Strategy (SNE) and the National Plan for Environmental Action and Sustainable Development (PNAE-DD) and Sustainable Development (PNAE-DD).

This came to life legislature in the statute law 01-19 of 12 December 2001; relative to the management, control, and elimination of waste, concerning management included waste nature-specific.

Law No. 01-19 (2001)

Household waste management policy is based on the National Program for the Integrated Management of Solid Household Waste (PROGDEM), adopted in 2002. This integrated, gradual and progressive approach was instituted by law 01-19 of 12 December 2001. (CDD 19, 2011)

"Law 01-19" sets out the reference framework for the management, control and elimination of waste. It is based on universally accepted principles, namely prevention and precaution to reduce waste at source, the polluter pays principle, the concept of the waste producer as recycler, and the citizen's right to information on risks and their impact on health and the environment (Tahar, Aurore, & Youcef, 2020). This law was the starting point for the implementation of an operational program for household and similar waste (HSW) called the National Program for the Integrated Management of Household and Similar Waste (PROGDEM). (Tahar, Aurore, & Youcef, 2020)

In addition, a fiscal framework governing eco-taxes in general, and those relating to household waste management in particular, has been enacted. However, the financing of waste management still depends on the State budget, mainly through decentralized programs (intended for the wilayas and communes) at 95.5% (Tahar, Aurore, & Youcef, 2020), but also through various local authority funds and foreign financing.

For the period 2002-2016, expenditure on waste management ranged from 0.06% of GDP in 2002 to 0.03% of GDP in 2016, which is insufficient to cover the expenditure required to reduce the cost of unavoidable long-term waste resulting from environmental degradation, which is rising from 0.32% in 1999 to 0.76% of GDP in 2015. (MEER, 2018)

National Waste Information System (NWIS)

National Waste Information System (*Système National d'Information sur les Déchets /SNID*), is an initiative established in Algeria to improve waste management at the national level. This system aims to collect, organize, and disseminate data related to waste generation, collection, transportation, treatment, and disposal. (AND, 2020)

Objectives

- Create a national waste database to facilitate decision-making.

Provide accurate information to optimize waste collection, treatment, and disposal processes.

Enable real-time tracking of waste management performance indicators.

Make data accessible to local authorities, researchers, and the public.

Features

Gather information on waste quantities, composition, and management methods.

Produce reports and statistics to evaluate the effectiveness of waste management policies.

Identify critical areas and collection points for better planning.

Collaborate with existing systems related to the environment, energy, and urban planning.

3. Valorization of HSW

3.1. Quantity of HSW recovered

The recovery of household waste in Algeria represents a crucial challenge in terms of reducing pollution and promoting sustainable development. Currently, most household waste ends up in landfill, with a recycling rate of less than 10% (Boudjemaa et al., 2020). This situation is leading to saturation of landfill sites and a loss of precious resources.

Figure 6. Quantity of waste recycled (2020) (tons/year)

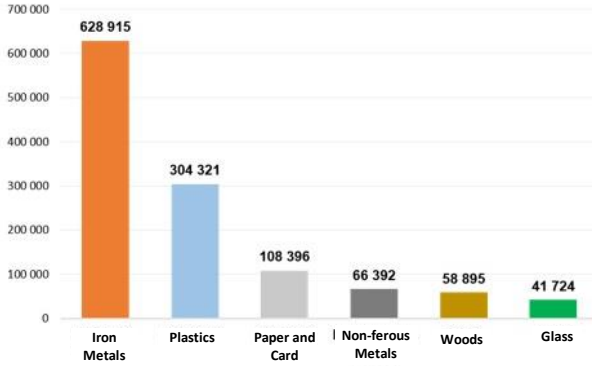
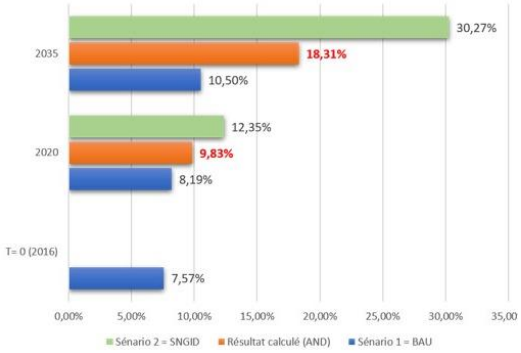


Figure 7. Recycling rate (2020)



Source: SNID, Op.Cit., 2020

3.2. Challenges and Prospects

3.2.1. Challenges

Lack of Infrastructure: There is virtually no waste sorting, **recycling** and **treatment** facilities countrywide that emphasize to have landfill over anything else.

Weak Regulatory Framework: The existing system for waste management is largely **non-functional** and the incentive to recycle as well as re-use does not exist.

Low Public Awareness: Most of the rationale citizens are **unaware** of the liter of why waste sorting and recycling benefits them to maintain sustainable waste practices.

Dominance of the Informal Sector: Informal waste collection and recycling make up a big chunk, which in turn is **not performing efficiently and very unsafe**.

Economic and Financial Constraints: Investment in **modern waste processing technology** remains low, and funding for circular economy initiatives is **limited**.

High Waste Generation Rates: Rapid **urbanization and population growth** contribute to increased household waste, putting further pressure on waste management systems.

Main Construction of Informal Sector: Informal waste collection and recycling make up a big chunk, which in turn is **not performing efficiently and very unsafe.**

Low Level of Economic/Financial Constraints: **Cost** of modern waste processing technology remains **high** and investment in circular economy is minimal.

Increased Waste Generation: High (household) waste generation rates due to the rapid urbanization and population growth is exacerbating a waste management problem from growing more quickly.

3.2.2. Prospects

Development of Recycling Industries: Larger plastic-metal-organic waste recycling are ways to generate employment and reduce landfill dependency

Implementation of Circular Economy Strategies: Changing the **model of waste to resource** will enhance sustainability and economy

Strengthening Public-Private Partnerships (PPPs): Partnerships with private companies could be used to **reinforce efficiency in waste collection, sorting and treatment**

Integration of the Informal Sector: Formalizing and supporting **waste pickers** through long-term programs can improve waste recovery.

Advancements in Waste-to-Energy Solutions: **Composting, production of biogases and incineration** with energy recovery could play an important part managing organic waste.

Policy and Legislative Reforms: Enhancing the **regulatory** aspects in place on waste management as well **incentivizing** investments for recycling businesses.

Education and Public Awareness Campaigns: Sensitizing on the importance of **sorting waste** and **sustainable practices** will certainly boost recycling rates.

Conclusion

Algeria needs to mitigate the Circular Economy Approach in household and similar waste (HSW) management to accomplish sustainable development and minimize adverse on environment. Challenges like limited infrastructure, weak regulatory enforcement and low public awareness have been in places but these are areas where we can significantly improve by way of policy changes, recycling industries investment and community engagement. Algeria has all tools to move from linear to circular, ensuring valuable waste is handled in low degradation waste streams and enhancing waste valorization, supporting recycling efforts and waste management strategies.

The transformation will require support from local authorities, businesses and government entities in a win-win state, and backed by effective policies, new technologies.

In short, weaving circular economy thinking in the waste management in Algeria not only helps mitigate environmental pollution but can also bring some economic opportunities and better public health on sustainable and adaptable way forward.

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