The contribution of Integrated Solid Waste Management to achieving the Sustainable Development Goals 2030 in Algeria

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Summary: The aim of this research paper was to study and analyze how integrated solid waste management contributes to achieving the Sustainable Development Goals 2030, using Algeria as a case study. The study concluded that the application of Integrated Solid Waste Management contributes to preserving the environment, reducing environmental pollution, and harnessing the value of waste by transforming it into an economic resource, thereby contributing to the achievement of the Sustainable Development Goals 2030 related to waste management and reduction.
Keywords: solid waste, integrated waste management, sustainable development, Sustainable Development Goals 2030.
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I-Introduction:

In recent years, Algeria has experienced a significant and continuous increase in the amount of waste resulting from population growth, improvements in the standard of living, and diversification of consumption patterns. This increase has had serious economic, environmental, and social consequences, which necessitates seeking effective solutions to address this growing phenomenon.

Given the negative effects of this increase on the environment and on natural elements such as air, water, and soil—and in light of international agreements, notably the Paris Agreement on climate change, which outlined a set of goals represented by 17 objectives to achieve sustainable development by 2030—many of these goals are directly or indirectly related to waste management. The state has therefore enacted legislation and adopted environmental protection strategies in this area and is seeking effective ways to reduce waste. Algeria has adopted a national strategy for Integrated Waste Management to achieve sustainable development. Integrated Waste Management is one of the systems that can contribute to achieving the 17 Sustainable Development Goals, as it can directly or indirectly help achieve specific targets related to waste reduction.

I.1.Problem statement: Integrated Waste Management is a contemporary strategy that provides a clean and healthy environment, enables the recovery of value from waste by turning it into an economic resource, and contributes to sustainable development and the realization of its goals. Thus, the research problem can be formulated as follows: How does Integrated Solid Waste Management contribute to achieving the Sustainable Development Goals 2030 in Algeria?

I. 2.Study hypotheses: In light of the study topic and its objectives, the following hypotheses are proposed:

• The amount of solid waste produced in Algeria has increased significantly, prompting the state to adopt plans and programs for its efficient management and utilization.
• Integrated Solid Waste Management is one of the most effective strategies for improving waste management and optimizing utilization.

• Integrated Solid Waste Management plans and programs support the achievement of a set of Sustainable Development Goals related to the reduction of solid waste in Algeria.

I. 3.Objectives of the study: This study aims to:

• Present the theoretical literature on Integrated Solid Waste Management and the Sustainable Development Goals 2030;

• Identify the stages on which Algeria relies for the integrated management of its solid waste;
• Determine how integrated solid waste management can contribute to achieving the Sustainable Development Goals 2030 in Algeria.

1.Integrated Solid Waste Management

1.1. The concept of solid waste

Solid waste has several definitions, including:

- "Solid waste is a material that has become waste not necessarily because it is worthless, but because the owner intends to dispose of it. (Abbas, Al-Rekabi, & Yousif, 2016, p. 666)
- Solid waste is defined as materials resulting from human, institutional, or commercial activity that are discarded, including paper, plastic, glass, wood, metal, and food waste. (Abd Al-Kareem, 2014, p. 163)

1.2. Classification of solid waste

Solid waste can be classified into: (Abbas, Al-Rekabi, & Yousif, 2016, p. 668)

- **Ordinary solid waste**: produced during daily activities at homes, schools, offices, or hospitals;
- **Biodegradable solid waste**: decomposes quickly into organic matter; examples include food residues, fruits, and vegetables;
- **Inert solid waste**: resists decomposition and takes a long time to break down, such as certain types of cardboard and paper;
- **Recyclable solid waste**: can undergo processes that enable reuse, such as glass, textiles, some plastics, and paper.

Additionally, solid waste can be grouped into organic and inorganic waste: (Poch, 2025)

- **Organic waste**: typically biodegradable waste;
- **Inorganic waste**: materials that decompose very slowly due to their chemical properties;many of these can be recycled through complex processes (e.g., cans, certain plastics, glass, rubber), while some, like contaminated batteries, cannot easily be recycled.

1.3. The concept and benefits of Integrated Solid Waste Management

1.3.1. Definitions

Several definitions of Integrated Waste Management exist. Notably:

• In 1991, a task force of the Economic Commission for Europe described Integrated Waste Management as a process of change in which the concept of waste management is gradually expanded to include necessary control of gaseous, liquid, and solid flows of substances in the human environment. (Mcdougall, White, Franke, & Hindle, 2001, p. 21)

In 1996, UNEP described integrated waste management as a reference framework for designing and implementing new waste management systems and for analyzing and improving existing systems. (J.K, 2006, p. 3)

1.3.2. Gains from integrating waste management

The inclusion of Integrated Waste Management brings many benefits: (Memon, 2010, pp. 7-8)

First: available resources can be allocated more efficiently to waste collection, material recovery, processing, and disposal through improved scheduling and higher resource utilization.

Second: recovered materials and energy availability can facilitate the creation of industries that use these resources in production.

Third: savings in waste management costs result from reducing the volume of final waste destined for disposal through diversion for material and resource recovery.

Fourth: enhanced coordination among stakeholders can promote collaboration on other development projects.

Fifth, governments can build public trust as integrated waste management delivers tangible results in public health, job creation, recycling industries, and improved sanitation. Thus, Integrated Waste Management optimizes R3 outcomes while improving the overall waste management system.

2.Sustainable Development Goals 2030 related to waste reduction

The concept of sustainable development dates back to the Brundtland Report, which defined it as meeting current needs without compromising the ability of future generations to meet their own needs. (Nations, 1987, p. 41)

The Sustainable Development Goals (SDGs), described as “the roadmap for transforming our world,” comprise 17 interconnected goals within the 2030 Agenda for Sustainable Development, totaling 169 targets.

Many SDGs are directly related to waste management, since solid waste management is essential for sustainable development in both developing and developed countries. SDG indicators have driven solid waste management reforms for decades, particularly in public health, environmental protection, conservation of natural resources, and more recently accounting for greenhouse gas emissions and climate change impacts.

Solid waste management affects living conditions, public health, sanitation, terrestrial and marine ecosystems, and access to natural resources. From social, environmental, and economic perspectives, solid waste management plays a key role in achieving at least seven of the 17 SDGs. (Hondo & Arthur, Solid Waste Management in Developing Asia: Prioritizing Waste Separation, 2020, p. 3)

Table 1 provides an overview of specific SDG targets that improved solid waste management systems can help achieve

Table 1: Specific targets of the Sustainable Development Goals related to solid waste management

Sustainable Development Goals	Specific Targets
SDG 3: Good health and well-being	3.2 End preventable deaths of children under 5 years of age 3.2 End malaria, combat water-borne and communicable diseases
SDG 6: Clean water and sanitation	6.3 Improve water quality by reducing pollution, eliminating dumping, and minimizing release of hazardous chemicals and materials, substantially increasing recycling and safe reuse
SDG 7: Affordable and clean energy.	7.2 Increase renewable energy share in the global energy mix
SDG 11: Sustainable cities and communities	11.6 Reduce environmental impacts of cities, particularly municipal and other waste management
SDG 12: Responsible consumption and production	12.4 Environmentally sound management of chemicals and waste to minimize their adverse impacts on human health and the environment 12.5 Promotion of 3Rs to substantially reduce waste generation
SDG 13: Climate action	13.3 Build knowledge and capacity to meet climate change

Source: (Hondo & Arthur, Solid Waste Management in Developing Asia: Prioritizing Waste Separation, 2020, p. 2)**.**

3.The reality of Integrated Solid Waste Management in Algeria and its contribution to achieving the SDGs

3.1. The reality of solid waste in Algeria

Like other countries, Algeria faces waste-related problems that pollute the environment when not properly managed. Algeria produces about 25 million tons of waste per year, of which approximately 13.5 million tons are household and similar waste; production may increase in the coming years.

Northern wilayas generate more waste—ranging between 400,000 and 600,000 tons per year—while central regions produce between 200,000 and 300,000 tons per year. Southern regions

produce less, between 100,000 and 200,000 tons per year, reflecting population density differences between north and south. (Déchets, 2020, pp. 30-33)

Household and similar waste are predominantly organic (54%), followed by plastics (15%), diapers (12%), and paper and cardboard (7%). Glass, metals, textiles, and other types represent smaller proportions.

Approximately 60%–65% of household and similar waste is disposed of in uncontrolled landfills, while 35%–40% goes to engineered landfills, according to Reda Ter, head of the National Economic, Social and Environmental Council. (Déchets A. N., p. 34)

3.2. National strategy for Integrated Waste Management

Solid waste management has been a key priority for the Ministry of Environment. The Algerian state has established a legislative and regulatory framework to implement its policy. Within this framework, a national strategy for Integrated Waste Management until 2035 was developed to advance the circular economy and reduce waste generation. The waste sector identified key steps clarified through the national municipal waste management program (PROG-DEM) and the national plan for special waste management (PNAGDES), which serve as planning and decision-support tools focusing on modern waste-control and disposal methods.

Thanks to these programs, Algeria has eliminated many of the roughly 2,000 uncontrolled dumpsites across the country, including 20 classified as major landfills, which were significant sources of environmental pollution, especially of surface water and groundwater.

The national strategy (SNGID-2035), developed by the Ministry of Environment, planned to close or rehabilitate all existing dumps and landfills by 2024. To date, more than 20 large dumps have been rehabilitated or are under implementation (e.g., Oued Smar in Algiers; Karma in Oran; sites in Annaba, Tiaret, Skikda), and 1,700 of the 3,000 identified unauthorized municipal landfills have been closed. (بوجمعة, 2021, p. 4)

Additionally, 191 facilities have been built to treat household and similar waste, including 101 engineered landfill centers and 90 controlled landfills equipped with 22 sorting centers and 36 leachate-treatment stations. However, engineered landfills are not a complete solution, as they can produce greenhouse gases—primarily methane and carbon dioxide—through anaerobic decomposition of organic substances in household and similar waste. The waste sector is a contributor to greenhouse gas emissions; according to the Intergovernmental Panel on Climate Change, the waste sector is the third-largest emitting sector, accounting for 10% in Algeria. (Déchets A. N., Ibid, p. 134)

Despite Algeria's efforts to eliminate uncontrolled dumps and establish landfill centers across the country, uncontrolled dumping remains a significant source of soil and ecosystem pollution and landscape degradation. The long-term disposal of waste in engineered landfills increases greenhouse gas emissions, which negatively affects the climate and undermines full achievement of Goal 13 (Climate Action). Nonetheless, improved collection and landfill management contribute to Goals 3 and 6 by reducing water and soil pollution.

3.3. Collection and transportation of solid waste

According to Algerian legislation, municipal authorities are responsible for collecting and transporting various types of waste. Household waste is collected and transported to treatment facilities across municipalities and residential areas. In city centers, collection occurs at least once daily; in suburbs, every two days; and in areas with fewer than 500 inhabitants, at least every two days. The average collection rate is 87% in urban areas and 67% in rural areas.

The waste logistics chain includes several links: pre-collection, collection of sorted or unsorted waste by contracted collectors, and transport to transfer centers or directly to treatment facilities. Transportation methods vary by geography and waste characteristics and include compactor trucks, open vans, oversized trucks, pickup trucks, and towable containers. (Déchets A. N., Ibid, pp. 46-48)

The National Agency for Waste Management has also used technology to improve waste management and promote recycling through the launch of a “Clean” application, which allows citizens to report issues such as uncontrolled dumping or collection delays. (Seddiki, Abdedaïm, & Abdelkrim, 2020, p. 253)

Marine solid waste is harder to characterize and monitor. In 2018, the Ministry of Environment launched a campaign to classify marine waste as part of implementing the Barcelona Convention, particularly the protocol on land-based sources of marine pollution, covering 14 coastal wilayas and 28 beaches. In 2019–2020, the National Waste Agency conducted follow-up monitoring campaigns for marine and coastal waste with local authorities, based on collection and classification campaigns. These campaigns helped determine waste quantities, composition, sources, and classification of materials found on beaches, particularly plastics, which are among the most prevalent materials in seas and on beaches.

Reports showed that plastics accounted for more than 87% of all materials collected on beaches, followed by cardboard and metal parts (Déchets N. W., pp. 122-127).

Plastic materials account for 87% of total waste collected; the remaining proportions are paper and cardboard (7%), metal (3%), glass (2%), and textiles (1%). Organic materials were largely absent from the collected marine waste.

Overall, Algeria has made significant efforts to implement integrated and sustainable waste management. However, shortcomings remain, particularly in waste collection in major cities, despite the introduction of modern reporting technologies. These shortcomings hinder full achievement of Goal 11 (Sustainable Cities and Communities) because services do not reach some areas. Improvements in beach and marine waste management, driven by awareness and cleanup campaigns, may contribute to achieving Goal 14 (Life Below Water) in the future.

3.4. Solid waste valorization and recycling

Waste valorization includes processes for recovering, recycling, or composting waste and is essential for sustainable development for economic and environmental reasons.

Reducing the amount of waste sent to landfills and recovering raw materials contributes to reducing environmental impact and supporting economic growth. In Algeria, valorization remains limited. The National Waste Management Strategy for Horizon 2035 set strategic targets to

enhance source separation and reach 30% valorization of household and similar waste to move toward sustainable and integrated waste management.

At the national level, annual amounts of some recovered materials were reported as follows: ferrous metals approximately 915,628 tons/year; plastic 321,304 tons/year; paper/cardboard 396,108 tons/year; non-ferrous metals 39,266 tons/year; wood 89,558 tons/year; glass 72,441 tons/year. (Déchets N. W., Ibid, pp. 50-75)

Compared with the total annual household and similar waste production of about 13 million tons, the percentage of recycled waste remains modest. According to Samira Hamidi of the National Economic, Social and Environmental Council, the recycling rate does not exceed 7%—a very small proportion relative to total waste produced. Another report cited that Algeria recycles about 45% of certain waste streams, equivalent to 6.1 million tons. (Alarab, 2021)

One ton of household solid waste can produce approximately 750 kWh of electricity or 1,500 kWh of heat. Organic waste, which constitutes 54% of household waste, can be processed by anaerobic digestion to produce biogas that can be converted to methane for use as heat or electricity.

Algeria has begun pilot projects, such as in the municipality of El Kalitos in Algiers and later in El Kharroub (Constantine), where digestion units are planned to treat up to 50,000 tons of recoverable domestic and similar waste. Such projects could significantly contribute to energy savings. Literature indicates that treating 15,000 tons of waste per year could replace the consumption of about 100 landfills or 60 urban buses, provide heating for 700 homes or hot water for 500 homes, and generate electricity for approximately 1,300 homes—thus supporting sustainable development in Algeria. (ouamane & Kahila, 2020)

While waste valorization and recycling in Algeria contribute to achieving the Sustainable Development Goals 2030 related to waste management and reduction, the contribution remains limited due to low recycling rates (estimated at 4%–7% annually). This underutilization means that the potential economic and environmental benefits of waste are not fully realized. Proper valorization and recycling could help achieve waste-reduction goals by recovering energy, reducing landfill emissions, decreasing landfill footprint, and conserving raw materials through recycled substitutes.

4. Conclusion

The quantity of solid waste produced in Algeria is continuously increasing, resulting in negative environmental impacts. Despite efforts and strategic plans for integrated and sustainable solid waste management aimed at reducing waste and exploiting its value to achieve the Sustainable Development Goals 2030, many obstacles remain.

4.1. Key findings of this research include:

- Integrated Solid Waste Management is a comprehensive approach encompassing collection, reduction, reuse, and recycling; imbalance in any step undermines the system.
- Waste is both a threat—causing pollution—and a resource—if properly managed and valorized, it can contribute to economic growth, which has drawn United Nations attention and led to specific SDG targets.
- Population growth and improved living standards in Algeria have increased quantities of solid waste, especially household waste.

- Algeria has made notable efforts, including developing a national Integrated Waste Management Strategy to manage waste sustainably and harness the benefits of valorization and recycling.
- Integrated Solid Waste Management contributes to achieving some Sustainable Development Goals 2030, but the contribution remains limited, particularly regarding climate action (Goal 13) due to low recycling rates and prolonged waste retention in engineered landfills.

4.2. Recommendations

Based on the findings, the study recommends the following:

-Raise public awareness about solid waste and encourage cooperation with relevant authorities to promote proper waste management.
- Develop modern mechanisms for integrated solid waste management to protect the environment and public health.
-Review and update solid waste management strategies.
-Strengthen partnerships with the informal (private) sector in solid waste management, particularly in recycling.

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