

Analyzing the Evolution of the Recycling Sector in Algeria within the Circular Economy Framework: A Quantitative Analysis of National Waste Agency Data

تحليل تطور قطاع إعادة التدوير في الجزائر في إطار الاقتصاد الدائري: تحليل كمي لبيانات الوكالة الوطنية للنفايات

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Abstract

This study aims to analyze the development path of the recycling sector in Algeria according to the circular economy approach during the period 2018–2023. The descriptive approach was relied upon and the method of analyzing statistics collected from reports of the National Waste Agency was used, in accordance with the standards specified by it. The results showed that the amount of recycled waste increased by more than 180% within five years. Despite this significant improvement, the 11% turnover rate remains below global averages. The study concluded that Algeria is witnessing a gradual shift towards a circular economy model, and that green entrepreneurship helps create economic value and reduces environmental impact. The paper recommends improving sorting infrastructure and strengthening partnerships between universities and institutions to encourage innovation in environmental valuation.

Keywords: Circular Economy, Recycling, Green Entrepreneurship, National Waste Agency.

JEL Classification : Q55, Q57, Q58

ملخص

تهدف هذه الدراسة إلى تحليل مسار تطور قطاع إعادة التدوير في الجزائر وفق مقاربة الاقتصاد الدائري خلال الفترة 2018–2023. تم الاعتماد على المنهج الوصفي واستخدام أسلوب تحليل الإحصائيات المجمعة من تقارير الوكالة الوطنية للنفايات وهذا وفقاً للمعايير المحددة من قبلها، وقد أظهرت النتائج أن كمية النفايات المعاد تدويرها ارتفعت بنسبة تفوق 180% خلال خمس سنوات. رغم هذا التحسن الملحوظ، فإن نسبة التدوير 11% ما تزال دون المعدلات العالمية. خلصت الدراسة إلى أن الجزائر تشهد تحولاً تدريجياً نحو نموذج الاقتصاد الدائري، وأن ريادة الأعمال الخضراء تساعد على خلق القيمة الاقتصادية وتقلل الأثر البيئي. توصي الورقة بضرورة تحسين البنية التحتية للفرز، وتعزيز الشراكات بين الجامعات والمؤسسات لتشجيع الابتكار في مجال التثمين البيئي.

الكلمات المفتاحية: اقتصاد دائري، إعادة تدوير، ريادة الأعمال الخضراء، وكالة وطنية للنفايات.

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Introduction

The recycling sector in Algeria is one of the vital sectors that plays an increasingly important role, as it is an important part of achieving sustainable development goals and protecting the environment, especially in light of the environmental challenges, both global and national, resulting from the continuous increase in the volume of waste produced annually, which reached about 12 million tons in 2022. The recycling sector aims to transform waste from mere harmful residues into economic resources with added value, by reusing and processing it in ways that ensure reduced environmental impact and achieve economic and social returns. This is what has become known as the circular economy, which the world has adopted as an alternative to the traditional development model based on consumption and linear production.

At the national level, the recycling sector has seen growing interest, but the waste recovery rate remains low, reaching around 9.83% of total waste according to the latest indicators from the National Waste Agency, reflecting significant challenges in terms of infrastructure, financing, and the legislation needed to make this sector work efficiently. On the other hand, the private sector points to significant investment opportunities thanks to the economic potential offered by the market value of waste, which is around 250 billion Algerian dinars per year, of which around 66 billion dinars includes the value of ongoing recycling activities. Plastic and paper waste account for the largest proportion of materials recovered for recycling, highlighting the need to develop supportive policies and legislation to promote environmental and economic sustainability. The National Waste Agency is one of the most important bodies contributing effectively to providing a picture of the reality of recycling in Algeria and the Algerian circular economy. Based on its digital indicators, we find that it provides a comprehensive and objective picture of the current reality of the recycling sector. and helps to identify the future paths needed to support the circular economy in Algeria, including improving waste collection and sorting mechanisms, increasing investment in modern technologies, activating the role of civil society to raise awareness of the importance of waste recycling, and establishing legal frameworks to regulate this sector. This study aims to shed light on the development of this sector in detail, based on indicators from the National Waste Agency, and to examine the challenges and

opportunities facing Algeria in achieving an integrated circular economy that promotes sustainable development.

In light of the above, this research paper addresses the following research question:

1. Research Question

How has the recycling sector in Algeria developed in light of the principles of the circular economy, and to what extent has the National Waste Agency contributed to supporting entrepreneurship in Algeria?

2. Hypotheses

- The recycling sector in Algeria has experienced remarkable quantitative growth in recent years.
- Current indicators reflect Algeria's shift towards a circular economy model through the initiatives of the National Waste Agency.
- The National Waste Agency contributes significantly to supporting entrepreneurship through various mechanisms.
 - The entrepreneurship sector faces significant challenges in waste recycling in the Algerian business environment.

3. Objectives of the Study

- To examine the recycling sector in Algeria in light of the principles of the circular economy;
- To analyze the reality of the recycling sector in Algeria based on indicators from the National Waste Agency for the period 2018-2023;
- Identify the main trends (quantitative and qualitative) in waste management and resource conversion;
- Explore the relationship between national recycling efforts and the principles of the circular economy.
- Present economic and environmental policies and legislation supporting the recycling sector;

- Identify the challenges facing the sector at the technical, economic, administrative, and social levels;
- Provide recommendations to strengthen the role of the recycling sector within the circular economy framework to achieve sustainable development goals and principles.

4. Importance of the Study

The study provides a recent analysis of national indicators in the environmental and economic fields. It also contributes to filling a research gap on the assessment of the actual performance of the recycling sector in Algeria by providing decision-makers with realistic quantitative indicators for the development of sustainable environmental and economic policies.

5. Circular Economy Circular Economy and Business Management: Theoretical Framework

5.1. Definition of the Circular Economy

The circular economy is defined as "the recycling and optimal use of materials, products, and services for a longer period of time. It is an economy that uses a systems-focused approach and includes industrial processes and economic activities that are renewable by design. and aims to eliminate waste through the superior design of materials, products, and systems by extracting resources and converting them into products and remanufacturing waste as a resource for manufacturing new materials and products" (Belkhadir & Bin Abdulaziz, , 2023).

The circular economy has also been defined as an industrial system that is restored or renewed through structure and design, creating a system that replaces the concept of "end of life" with a shift towards renewable energy use, eliminates the use of toxic chemicals that hinder reuse, and aims to eliminate waste and transform waste from a financial burden into a new economic resource (The Ellen MacArthur Foundation , 2022).

From the above, we can conclude that the circular economy is the conversion of waste and residues into investment opportunities through their renewal and recycling in a way that serves the economy on the one hand and preserves the environment on the other.

5.2. Definition of Waste Recycling

Waste management can be defined as “the processes and practices aimed at collecting, transporting, and disposing of garbage, sewage, and other waste products.” The goal of waste management is to increase product life cycles and reuse and recover materials wherever possible in order to reduce the total amount of waste going to landfills and lessen the environmental burden. The ultimate goal of this practice is to re-create a valuable resource from waste disposal, which is why waste management plays a crucial role in supporting sustainable development and the transition to a circular economy (Karam Al-Bakl & Metwally, ., 2023)

It can also be defined as “the process of monitoring, collecting, transporting, treating, recycling, or disposing of waste generated by human activities. This procedure is primarily adopted to reduce harm to human health and the environment”. (Abdullah Qasim, 2025, p. 576).

Therefore, waste recycling is a management process that involves a set of operations to dispose of residues and waste to create new value from garbage, thereby reducing the damage it causes to both human health and the environment.

5.3. Entrepreneurship and Innovation in the Circular Economy: Real Opportunities

The circular economy is an economic model that offers many real opportunities for both entrepreneurs and consumers. As it directly affects the environmental, economic, and social aspects of any society, many entrepreneurs who wish to contribute to investments in the waste management and recycling sector and take advantage of promising job opportunities are entering the circular economy sector. (Karam Al-Bakl & Metwally, ., 2023, p. 172).

Entrepreneurship in circular economy sectors can also contribute in many ways: economically, environmentally, and socially. The following are the most important drivers of integration between entrepreneurship and the circular economy (Andrew , , Frithjof , & Peter, 2023):

- **Reducing environmental impact:** As mentioned above, the circular economy is a model for producing goods and services with limited environmental impact. Therefore,

companies that adopt circular practices can help reduce their environmental impact and contribute to the fight against climate change.

- **Ability to meet the needs of environmentally conscious consumers:** Many consumers today are looking to reduce their environmental impact through sustainable alternatives. Relying on the circular economy model can meet this growing demand by offering environmentally friendly products and services to customers.

- **Contributing to job creation:** The circular model creates new jobs in many sectors, such as recycling, construction, reuse, logistics, transportation, and sustainable product design.

Accordingly, pioneering initiatives within the circular economy are working to transform waste into economic opportunities by adopting circular business models based on (OCDE, 2020):

- Extracting valuable resources from waste instead of relying on new raw materials;
- Developing value chains based on reuse and extending product life;
- Creating paid recycling/recovery services (collection, sorting, processing, and sale of secondary industrial inputs).

6. Recycling as a Tool for Achieving a Circular Economy: The Place of Recycling Within the Circular Economic Chain

Recycling is a key link in the circular economy pyramid, but it remains insufficient; it is classified as a recovery mechanism within a policy mix that prioritizes reduction, reuse, and then recycling in a practical sense. Recycling provides the secondary materials needed to operate circular resource-based industries and contributes to reducing dependence on raw materials, but it achieves the best impact when combined with reusable product designs and the promotion of circular supply chains. Therefore, recycling waste within the circular economy contributes effectively to achieving many values, most notably:

6.1. Economic Value: Recycling reduces the initial cost of materials, generates revenue from the sale of recycled materials, and creates new entrepreneurial and logistical services (collection, sorting, conversion) (Batista-Canino, 2025).

6.2. Social Value: By creating local job opportunities (especially in the collection and sorting sector), enabling social projects and youth start-ups working with local solutions, and promoting the economic integration of vulnerable groups (e.g., waste sellers/collectors in cities). (Abdullah Qasim, 2025, p. 542).

6.3. Environmental Value: Reducing greenhouse gas emissions by replacing fossil fuels, reducing the depletion of natural resources, and reducing landfilling and incineration. Multiple case studies (in cities and developing countries) have shown that recycling activities contribute significantly to reducing emissions and improving waste management when supported by appropriate policies and infrastructure. (Belkhadir & Bin Abdulaziz, 2023, p. 95).

7. A Look at The Initiatives and Indicators of The National Waste Agency and Its Support for Entrepreneurship

7.1. The Regulatory Framework and Tasks of the National Waste Agency

The National Waste Agency was established by Executive Decree No. 02-175 of May 20, 2002, under the supervision of the Ministry of the Environment and Renewable Energy, and is responsible for "planning, guidance, technical assistance, and the creation of a national database on waste." One of the most important tasks of the National Waste Agency is to provide technical assistance to small and emerging enterprises, as well as project leaders in the waste sector. One of the most important achievements of the National Waste Agency is the development of a guide to setting up businesses for project leaders, which outlines the steps for setting up a company, financial models, incentives, incubators, ... etc.

7.2. Entrepreneurship and Innovation in the Circular Economy

Entrepreneurship is one of the key drivers for implementing the principles of the circular economy, as entrepreneurial initiatives provide fertile ground for transforming waste into economic opportunities by developing business models based on reuse, recycling, and extending the life cycle of products. Contemporary entrepreneurial companies seek to invest in waste as a

resource of economic value through what is known as urban mining, i.e., extracting secondary raw materials from urban waste and reintegrating them into production chains (Kirchherr, 2023).

Recent experiences show that these approaches contribute to reducing dependence on primary natural resources, while generating new economic activities and sustainable employment opportunities (Mohapatra, 2024).

7.3. Integration of Entrepreneurship, Innovation, and Recycling in Achieving a Circular Economy in Algeria

Entrepreneurship, innovation, and recycling are complementary pillars of the circular economy system. Together, they form a complementary triad that contributes to building a sustainable development model based on material efficiency, economic flexibility, and environmental justice. Entrepreneurship is the driving force for change through the creation of new business models capable of transforming waste into resources of economic value, while innovation, in its technological, organizational, and social dimensions, is the tool that enables the redesign of processes and products to become more compatible with circularity principles (Mohapatra, 2024). (Kirchherr, 2023).

Recycling is the practical infrastructure that translates these initiatives into tangible results, closing the loop of material flow by recovering and reintegrating materials into value chains. Recent studies show that the integration of these three components produces multiplier effects; It promotes environmental innovation by developing technologies and design techniques that reduce waste, supports social innovation by integrating local communities into recycling chains, and stimulates sustainable economic growth by creating new markets and green jobs. Therefore, the circular economy is not achieved simply by implementing recycling or efficiency policies, but through a dynamic system in which entrepreneurship, technical innovation, and circular infrastructure interact within an institutional and legislative framework that stimulates innovation and long-term sustainability. The initiatives and achievements of the National Waste Agency in supporting entrepreneurship and the circular economy in Algeria can be summarized in three interrelated dimensions: (Environment and Renewable Energies

- **Economic dimension:** Recycling creates added value by reducing raw material costs and opening up new markets for secondary materials, as well as stimulating local entrepreneurship and small and medium-sized enterprises.
- **Social dimension:** Recycling contributes to the creation of direct and indirect jobs, especially in the collection, sorting, and processing stages, and promotes the integration of marginalized groups into the labor market. Social dimension: Recycling contributes to the creation of direct and indirect job opportunities, especially in the collection, sorting, and processing stages, and promotes the integration of vulnerable groups through the organized informal economy.
- **Environmental dimension:** Recycling contributes to reducing greenhouse gas emissions and the volume of waste sent to landfills or incinerators, which helps to rationalize the consumption of natural resources.

Data published in reports by the National Waste Agency and data from the Algerian Ministry of Environment on the quantities of waste produced and recycled, and the number of institutions active in the sector during the period (2018–2023) were used.

Table 1: Development of the Waste Recycling Sector in Algeria during the period 2018–2023 (million tons).

Year	Amount of waste produced	Amount recycled Recycling	Rate	Number of companies
2018	13.5	0.6	4.4%	180
2019	13.8	0.8	5.8%	220
2020	14.0	0.9	6.4%	250
2021	14.5	1.1	7.5%	280
2022	15.0	1.4	9.3%	320
2023	15.5	1.7	11.0%	360

Source: Report on National Waste Agency indicators and REVADE 2023 reports.

The table above shows that the amount of waste in Algeria rose from 13.5 million tons in 2018 to 15.5 million tons in 2023. This increase reflects population growth and urbanization, but it also highlights a growing environmental challenge. The evolution of the amount of recycled waste indicates an increase in its quantities, which rose from 0.6 million tons to 1.7 million tons

during the same period, a significant development that signals the beginning of a real shift towards a circular economy.

As for the type of waste recycled at the end of 2023, the agency's reports indicated:

Table 2: Analysis by type of waste from total recycled waste (2023).

Type Waste	Rate	Main Economic Outputs
Plastic	35%	Plastic pellets, packaging materials, plastic furniture
Metals	25%	Scrap metal, construction materials, industrial tools
Paper and cardboard	20%	Recycled paper, packaging cardboard
Glass	10%	Bottles, construction materials
Organic waste	10%	Organic fertilizer (compost)

Source: Report on the indicators of the National Waste Agency and REVADE 2023 reports.

Returning to the data in the table analyzing the agency's indicators by type of recycled waste, the most important thing to note is that the relative increase in recycling and the number of institutions reflects a gradual shift from “waste management” to “resource recovery.” The sector has begun to generate real economic value by creating jobs and local investment. Thus, every ton recycled reduces emissions and saves primary resources. According to National Waste Agency estimates, every ton of recycled plastic saves about 1.5 tons of carbon dioxide emissions. On the other hand, the expansion of waste recycling companies reflects the rise of a green entrepreneurship culture, especially among young people. However, financing and legislation remain a major obstacle. From a strategic perspective, it can be said that the sector has not yet reached the stage of a “fully integrated circular economy,” but it is moving in the right direction.

The challenge is to move from partial initiatives to an integrated system that includes sustainable design, reuse, and manufacturing from waste (National Waste Agency (AND), 2023).

In the same vein, the National Waste Agency contributes to the development of the circular economy by connecting it directly or indirectly with entrepreneurs. Its most important achievements include the following:

- **Industrial Waste Exchange Platform**

One of the most prominent mechanisms of the National Agency for Recycling is an electronic platform known as Industrial waste exchange, which aims to connect waste generators with new producers and investors in recycling or conversion into secondary raw materials. Through this platform, small and medium-sized entrepreneurs can register as waste “recyclers” or “processors” to obtain raw materials at relatively low prices, or start their own projects using these inputs. The platform is therefore an investment opportunity that includes setting up a recycling workshop, collecting and sorting industrial or commercial waste, or converting waste into secondary materials (upcycling) using inputs obtained through the platform (National Waste Agency (AND), 2023).

- **The “Eco Jem” Packaging System**

The National Waste Recycling Agency, in collaboration with relevant authorities, launched the Eco Jem system for managing packaging waste. Small companies can join this system, obtain licenses, and participate in a range of services for collecting, sorting, and recycling packaging. This step is considered an opportunity for entrepreneurs to set up small businesses specializing in the collection and processing of packaging (plastic, paper, metal) and to provide services to packaging or supply companies.

- **Regulatory and Financial Incentives**

Among the agency's most important offerings in this area are tax exemptions and financial incentives to stimulate activity in the sector, including Executive Decree 25 - 62, which provides tax exemptions for up to five years for those who organize and register their activities.

- **Awareness and training: The agency Awareness and training**

The National Waste Agency conducts training programs, study days, and workshops to support technical and entrepreneurial skills in the waste sector. The table below highlights the most important achievements and initiatives of the National Waste Agency:

Table 3: National Waste Agency Indicators.

Indicator	Value	Content
Number of companies and start-ups in the recycling sector	>5,000 establishments by the end of 2023.	Includes the collection, sorting, recycling, and conversion of household and similar waste.
Potential market value of waste	207 billion Algerian dinars (2023).	Reflects the scale of economic opportunities in the sector.
Potential employment opportunities	19,321 operators (14,471 individuals + 4,850 institutions)	Includes operators in recovery and treatment
Amount of waste recycled	Between ~10% and 11% Government targets to increase recycling to ~30% in the 2025–2029 plan.	“Recovery/recycling” of household waste.
Recycling rate of total waste	Recovery rate of approximately 9.83% for 2024–2025.	Varies depending on what is counted: local recovery/industrial recovery/total categories.
Opportunities	Estimate: >300,000 jobs possible when the sector is fully developed.	According to National Waste Agency statements, includes waste collection, sorting, treatment, and recycling.
Challenges	Lack of infrastructure, limited funding, poor technical training, uneven geographical distribution, poor integration of small and large enterprises.	Extracted from National Waste Agency reports and local research.

Source: Prepared by The Researcher Based on Data from the National Waste Agency.

According to the data in the table, there will be over 5000 companies by the end of 2023, and the number of operators/institutions registered in the field of waste valuation and treatment will reach 19,321 operators (14,471 individuals + 4,850 companies) in November 2023. The market value of waste in Algeria was estimated at 207 billion Algerian dinars for 2023, reflecting the economic opportunity for the recycling sector. The agency's reports show that Algeria produces more than 13 million tons of household waste annually, very little of which is actually treated, meaning there is significant scope for establishing treatment and recycling companies.

In order to facilitate the process for entrepreneurs, opportunities for investment have been opened up through:

- Collecting recyclable waste (plastic, paper, metal) in neighborhoods or from commercial companies;
- Pre-sorting and collection services for packaging factories or small industrial facilities;
- Recycling or converting secondary materials into innovative products (e.g., converting PET plastic into pellets for new plastic products);
- Consulting or technical services (white label) for companies in the field of waste management and the circular model (establishment of collection/sorting/recycling operations);
- Participation in the industrial waste exchange platform as an intermediary or small collector/processor;
- Institutions working in the field of packaging through the Eco Jem system, as promoters/installers/distributors of recycled packaging services.

8. Challenges Facing the Waste Recycling Entrepreneurship Sector in the Algerian Business Environment

The entrepreneurship sector faces several challenges to investment in waste recycling, the most important of which are:

8.1. Lack of Detailed and Accurate Data: The lack and absence of detailed statistics on the geographical distribution of companies, types of waste treated, and the efficiency of recycling institutions makes it difficult to plan new projects or accurately assess investment needs, and affects the ability to measure the environmental and economic impact of emerging projects.

8.2. Need for Financing and Financial Resources: The difficulty of obtaining financing to establish workshops or purchase specialized equipment is a challenge for many small and emerging enterprises. In addition, traditional financing is scarce and, when available, is subject to difficult guarantees, which limits the expansion of emerging projects and slows the growth of the sector.

8.3. Weak Technical Training and Specialized Skills: The lack of technical expertise in waste treatment and recycling and in designing new products from recycled raw materials has resulted in poor training, which in turn has led to inefficient operations, increased production costs, and reduced competitiveness for small enterprises.

8.4. Environmental and Regulatory Challenges: Among the most prominent environmental and legislative challenges are weak oversight of certain unlicensed activities, delays in issuing legislation on the circular economy, and uneven compliance with environmental standards. This results in entrepreneurs facing an uneven playing field among enterprises, which reduces their confidence in investing in this area.

9. Promoting Entrepreneurship and Supporting the Circular Economy in Algeria

- Encourage tax and financial incentives: by granting temporary tax exemptions to start-ups in recycling, reducing registration and licensing fees, and providing low-interest financing lines or financial support to small and medium-sized green projects.
- Support project incubators and innovation: Establish or support incubators specializing in waste management to provide technical guidance, legal advice, and laboratories for testing recycled materials; connect start-ups with industrial waste exchange platforms to facilitate access to raw materials.
- Enhance technical training and entrepreneurial skills: Organize specialized training courses in recycling, project management, innovative product development, and environmental marketing; involve universities and research centers in applied educational programs to support youth competencies and entrepreneurship.
- Strengthen legislation and oversight: Develop clear laws to support the circular economy and encourage investment in the recycling sector; enforce oversight of service quality and environmental practices to ensure sustainability and resource protection.

Conclusion

The waste recycling sector is considered one of the fundamental pillars in building a circular economy, as it provides innovative economic and investment opportunities. In this context,

environmental entrepreneurs have become strategic actors in transforming waste from a material and environmental burden into a productive resource with added value, through innovative projects that combine economic considerations with social responsibility. The contributions of these pioneering initiatives to the creation of new business models that are reshaping the relationship between business and the environment in Algeria cannot be denied.

Despite the many national efforts, led by the National Waste Agency, which plays a central role in reorganizing waste management and recycling and moving towards a circular economy, the sector still faces a number of structural challenges, notably a weak culture of sorting among citizens, limited funding for green projects, and a lack of coordination between various public and private actors. There is also a scarcity of advanced sorting and treatment technologies and a lack of a legislative framework that defines the duties and protects the rights of actors in the sector. However, these challenges do not obscure the fact that Algeria is experiencing a new dynamic towards greater integration between environmental leadership, waste recycling, and the circular economy, with the emergence of an integrated system involving the state through the National Waste Agency, start-ups through green innovation, and civil society through awareness campaigns. This integration could bring about a qualitative shift if it is supported by incentive legislation, flexible financing, and incubation and networking programs between entrepreneurs and public institutions.

In light of this, the study reached a number of results, most notably:

- The recycling sector in Algeria is gradually developing but still falls short of its potential.
- Entrepreneurs are seeking to invest in the sector, but the scarcity of data and the lack of training and education remain challenges that many of them have been unable to overcome.
- Current efforts show the beginning of a transition towards a circular economy, but they need to accelerate the regulatory, legislative, and investment framework.
- There is a lack of awareness and sensitivity to the importance of sorting, especially for household waste, which is the first step in organizing the recycling chain.

Recommendations

- Create tax and legislative incentives for institutions active in recycling.
- Develop a national system for tracking and reusing waste.

- Integrate the circular economy into university entrepreneurship programs.
- Implement training programs and develop qualified personnel to work in the waste recycling sector in the correct manner.
- Work to raise awareness on a regular basis about the dangers of waste that is not recycled and reused on society and the environment, while reminding people of the economic, social, and environmental benefits of recycling.
- Support environmental innovation and green project incubators.

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