

Green entrepreneurship as a lever for enhancing waste management in the Wilaya of Oran

ELMOGHERBI Salima,

Graduate School of Economics, Oran (Algeria), salima.elmogherbi@gmail.com

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Abstract:

In Algeria, the government is increasingly relying on entrepreneurship to diversify its economy and thus create enough jobs to meet the challenges of demographic growth. When it comes to green entrepreneurship, the interest is twofold, both in its socio-economic and environmental dimensions. In this context, this article focuses on the potential of green entrepreneurship in job creation and waste management improvement. Our methodological approach is descriptive and analytical, it involves SOAR analysis of waste management in the Wilaya of Oran. The research aims, through this analysis, to propose a mapping of waste management in the Algerian context, with the objective of identifying investment needs and highlighting entrepreneurial potential in this field.

Keywords: *Green entrepreneurship, waste management, entrepreneurial potential, environment. .*

1. Introduction

Due to its economic and social role, entrepreneurship continues to gain importance worldwide. Considered a lever for economic dynamism that stimulates innovation, growth, and job creation, entrepreneurship offers opportunities to solve economic and social problems on a global scale.

In Algeria, the government is increasingly focusing on entrepreneurship for several reasons. On the one hand, to diversify an economy that remains heavily dependent on hydrocarbons, and on the other, to address the challenges of demographic growth and to create sufficient employment opportunities.

The government's recent enthusiasm for entrepreneurship reflects its willingness to encourage young entrepreneurs to start businesses and contribute to the national economy. Several aid and support mechanisms for business creation have recently been established, such as Incubators, Entrepreneurship Development Centers (CDE), the National Agency for Entrepreneurship Support and Development (ANADE), among others.

It is in this context of encouraging entrepreneurship, that we considered it necessary to highlight green entrepreneurship in the field of waste management in Algeria; especially since *"The potential for job creation in this field is significant but little known"* (Firlas & Amokrane, 2019). In fact, waste management, with its various stages (collection, sorting, recovery, and disposal) represents a real investment field and offers numerous job opportunities.

To better understand the reality of waste management in the Wilaya of Oran, we approached the Public Industrial and Commercial Establishment in charge of managing the Technical Landfill Centers of Oran (EPIC CET of Oran)ⁱ. This establishment is primarily responsible for the landfilling (burial) of waste throughout the entire Wilaya but also carries out waste recovery activities (selective sorting, recovery of valuable waste, and composting).

Despite the resources deployed and the multitude of stakeholders, waste management in the Wilaya of Oran faces many problems and remains far from international standards, especially in terms of sorting and recovery (GIZ, 2020). This led us to raise a crucial question around which our work was structured, namely:

« To what extent can green entrepreneurship act as an effective lever for enhancing waste management? »

Our methodological approach is descriptive and analytical, using the SOAR analysis framework to examine the potential of green entrepreneurship in waste management in the wilaya of Oran. This framework allows a structured analysis of strengths and opportunities while aligning them with aspirations and measurable results. It provides a structured means of understanding how

ⁱ In French : Établissement Public à caractère Industriel et Commercial chargé de la gestion des Centres d'Enfouissement Technique d'Oran (EPIC CET d'Oran).

internal capabilities (resources) and external prospects can be mobilized to drive sustainable transformation, aligned with long-term environmental and economic goals.

First, we will introduce the various fields of green entrepreneurship, particularly waste management in the Algerian context. Subsequently, the research aims, through this analysis, to propose a mapping of waste management in the wilaya of Oran, the objective of which is to identify investment needs and highlight the entrepreneurial potential in this field.

2. Green entrepreneurship:

It is difficult to find a definition of green entrepreneurship that encompasses or delineates all the facets that it can take. The use of the term "green entrepreneurship" emerged in the 1980s as part of a broader movement to raise awareness of the environmental impact of economic activities and to seek sustainable solutions. *Sustainable development aims to find a balance between the economic, social, and environmental dimensions which are considered pillars for the construction of a fairer, more prosperous, and more environmentally friendly world.* It was defined by the (United Nations) Brundtland Commission in 1987 as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*"

Several concepts are used to describe the types of entrepreneurships that are environmentally conscious and adhere the principles of sustainable development: green entrepreneurship, eco-entrepreneurship, socially responsible business, etc. The most common approaches to defining green entrepreneurship are those that define it according to the types of production of companies and their links with the environment.

In his conception of the circular economy, (Stahel, 2016) presents two models of companies. The first model includes companies that promote *reuse and extend the service life of products through repair, refurbishment, upgrades and renovations.* The second model includes those that *transform old goods into near-new resources through material recycling.*

The organisation for economic co-operation and development/Eurostat (1999) proposes the following definition of the environmental industry: " *The environmental goods and services industry includes activities that produce*

goods and services that are used to measure, prevent, limit, minimize or correct environmental damage, such as water, air and soil pollution, as well as waste, noise and ecosystem problems. This industry includes cleaner technologies, products and services that reduce environmental risks, minimize pollution and conserve resources ». (OCDE, 2011, p. 27)

These definitions give us a list of environmentally related activities that can be considered as descriptions of the sectors involved in green entrepreneurship. Indeed, green entrepreneurship covers a wide range of areas: renewable energy, energy efficiency, sustainable agriculture, green construction, clean technologies and water management, eco-tourism, waste management, and more.

Despite these different fields or forms that green entrepreneurship can take, in Algeria, the number of entrepreneurs choosing this path remains very low, even though the need is clear since the Algerian market is almost virgin in terms of green projects. This was affirmed by (Firlas & Amokrane, 2019, p. 46), who analyzed projects financed by the National Agency for Youth Employment Support (ANSEJ) in this field: *« Since its establishment in 1997, ANSEJ has financed more than 5,000 projects at the national level in the areas of environment and renewable energy for the benefit of university and vocational training graduates. This represents just 1.34% of the agency's total funding ».*

In recent years, a lot of studies have focused on green entrepreneurship in the waste management sector in Algeria. These works were mainly focused on the motivations of green entrepreneurs or tried to identify the difficulties they encounter. (Firlas & Amokrane, 2019) (Benmessaoud, 2022) (Medkour & Chenane, 2019) (Zibouche & Smaili, 2019). Instead, we will focus on the possibilities and opportunities that green entrepreneurship can have as a lever for improving waste management.

3. Waste management in Algeria

Waste management is defined according to the (Dictionnaire sur l'environnement, s.d.) as: *“the set of operations and resources implemented to limit, recycle, recover, or eliminate waste, including activities such as prevention, pre-collection, collection, transportation, sorting, treatment, and storage.”* Effective waste management is part of achieving the sustainable

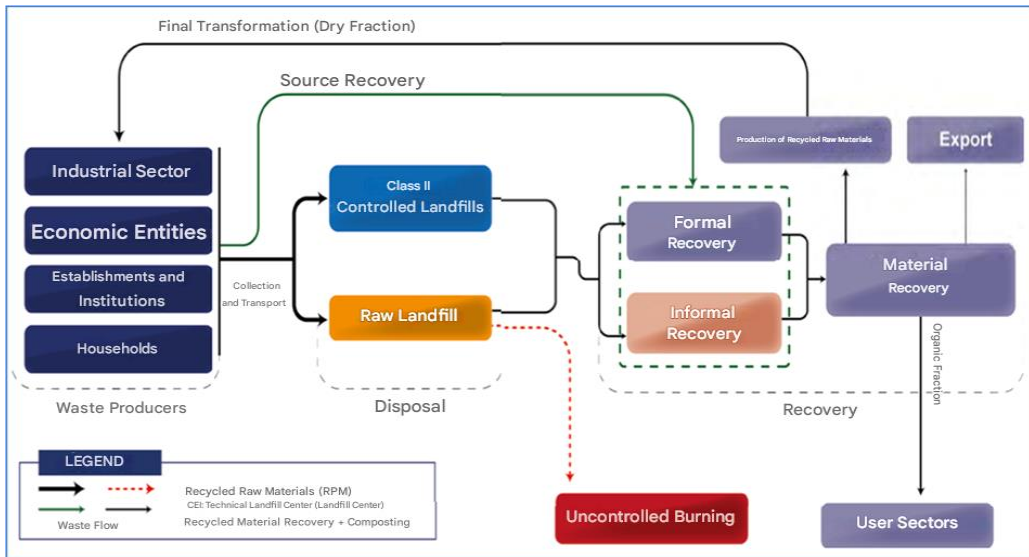
development goals. It is at the heart of efforts to reduce the quantities of waste produced and improving waste recovery processes.

Not all waste is treated in the same way. In fact, waste is classified into several categories according to its nature or degree of dangerousness and each category of waste requires specific treatment. In Algeria, classification is based on the official nomenclature provided in article 5 of law n° 01-19 of December 12, 2001, concerning the management, control, and elimination of waste. According to this law, three categories are identified: Household and similar waste (HSW), Special waste (including hazardous waste), Inert waste. According to the German International Development Cooperation agency (GIZ, 2020), the volume of waste is increasing by about 6% each year in Algeria and almost all of this waste is sent to landfill. Moreover, the recycling rate remains very low and waste recovery channels are very poorly developed. *Only 5-7% of household and similar waste is recycled, the recycling rate of plastic packaging waste is below 1%.*

In this study, we will mainly focus on HSW due to the very large quantities generated and the difficulties related to their management. The choice of this category was made because it offers significant investment opportunities to young entrepreneurs in all stages of waste management. Additionally, the expected contribution of waste recovery on the economic level is not negligible, the benefits are considerable for companies, as (Lupton, 2018) explains: *“Once reintegrated into the production process, waste serves as a secondary raw material. This use allows businesses to reduce production costs.”*

The following figure, developed by the National Waste Management Agency (AND), gives us a general overview of the organization of waste management in Algeria from the generation of waste to its disposal or recovery.

Figure 1: synoptic diagram of the Household Waste Management in Algeria



Source : (Agence Nationale des Déchets, 2020, pp. 32-33) (A translated version).

From this figure, we can identify three main steps:

- i. **Collection and transport:** this stage concerns the activities of collecting waste from its source and of depositing it at the landfill site. Several actors can be involved in this stage:
 - The municipality, using their own material and human resources.
 - Public Industrial and Commercial Establishments specialized in collection (EPIC).
 - Subcontractors (public or private).
- ii. **Waste disposal:** This is primarily done through landfilling or incineration. These activities are mainly handled by technical landfill centers (CETs), with the possibility of subcontracting certain activities to private companies.
- iii. **Waste recovery (Valorization):**
 - Recovery and selective sorting: one upstream (by companies or households sorting at the source) and downstream (on-site at CETs and sorting centers). These activities are managed jointly by public and private actors.
 - Recycling or composting: these activities mainly carried out by private companies.

4. Waste management in the wilaya of Oran: analysis of the Oran CET

The city of Oran is among the most populous cities in Algeria. A large population means massive quantities of waste that must be treated. Waste management planning is the responsibility of the municipality. Each municipality must propose a waste management plan that covers the entire communal territory and aligns with the Wilaya's development plan, subject to the approval of the territorial Wali (governor). According to Law No. 01-19, Article 33: *"The municipality may concede, according to standard specifications, all or part of the waste management..... to natural or legal persons governed by public or private law, in accordance with the legislation governing local authorities "*.

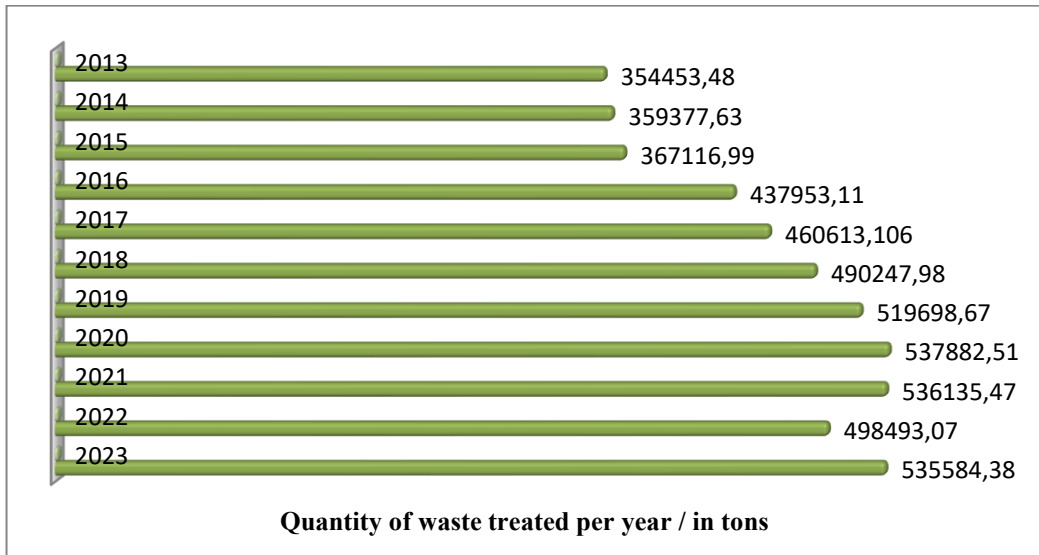
The public strategy for managing household and similar waste relies mainly on the technical landfilling of waste (Aoudia & Abrika, 2019). That is what lead us to focus in our study on the EPIC CET of Oran, being one of the main players in the management of household waste. We analyzed the results of the waste treatment recorded by this institution since its creation in 2012. The EPIC CET of Oran has three landfill centers, namely: CET Hassi Bounif, CET El Ançor and CET d'Arzew.

The volume of waste produced in the wilaya of Oran continues to increase. This is due to the strong population expansion, rapid urbanization and growth in economic activities. All these factors make waste management a serious challenge for local authorities. To address these issues, an analysis of the current situation will help identify strengths and weaknesses, which will help proposing development pathways.

The following graph shows the evolution of the quantities of household waste treated by the CETs throughout the wilaya of Oran from 2013 to 2023.ⁱ

ⁱ Some of the presented data do not include the creation year or the most recent two years due the limitations of the source material. This limitation is not due to our methodology, but to the fact that our analysis is based exclusively on the available statistics provided by the CET

Figure 2: Σ Quantities of household waste treated by the Oran CETs 2013-2023



Source: information from the Oran CET

Table 1: Quantities of household waste treated by the different CET centers 2013-2023

Year	CET HassiBounif	CET ElAnçor	CET Arzew	Quantities treated in tons
2023	446197,64	48225,33	41161,41	535584,38
2022	402560,58	53327,56	42604,93	498493,07
2021	440535,79	51976,22	43623,46	536135,47
2020	436407,73	45953,76	55521,02	537882,51
2019	412620,44	49066,36	58011,87	519698,67
2018	389306,56	42882,73	58058,69	490247,98
2017	372379,35	42207,47	46026,286	460613,106
2016	378809	34129,64	25014,47	437953,11
2015	331780,68	35336,31	-	367116,99
2014	325804,15	33573,48	-	359377,63
2013	318615,84	35837,64	-	354453,48

Source: CET of Oran

From this data, we notice that the quantity of waste treated is increasing from year to year. Over 10 years, the quantity treated has increased by 181131 tons, an increase of nearly 50%.

In October 2016, the Oran's CET in collaboration with the GIZ carried out a household waste characterization in three neighborhoods of Oran city: Haï Ennour, Les Palmiers, and Akid Lotfi. A second characterization was

conducted in March 2019 in the municipalities of El Kerma, Bir El Djir, and Benfreha. The results of these characterizations are presented in the following table:

Table 2: The physical characterization of household waste at the Hassi Bounif CET Year 2019

No.	Fraction	%
01	Organic fraction	54.9
02	Wood	1.5
03	Paper & cardboard	10.8
04	Plastic	10.7
05	Ferrous and non-ferrous metals.	1.8
06	Diapers & sanitary items	6.1
07	Glass	2
08	Textile	1.2
09	Leather & Rubber	2.1
10	Hazardous waste	0
11	Sand/dust...	8.9
Total		100%

Source: CET of Oran

From this table, we can notice that the nature of the waste generated in Oran is mainly organic (54.9%). According to CET officials, less than 1% of this waste is recovered, and that despite the availability of different means and techniques to recover organic waste such as compostingⁱ, biomethanizationⁱⁱ, energy productionⁱⁱⁱ. Given the very low valuation rate in this category, we can say that there is a real need for investment in this niche.

In second place, we find plastic, paper& cardboard, representing nearly 22% of Oran's waste. This recyclable waste is, unfortunately, landfilled with the

ⁱ Composting involves the decomposition of organic waste by microorganisms to produce a natural fertilizer called compost. This compost can then be used to improve soil health and stimulate plant growth.

ⁱⁱ Biomethanization consists of decomposing organic waste in the absence of oxygen to produce biogas, mainly methane. This biogas can be used as an energy source to produce electricity and heat, or even as fuel for vehicles.

ⁱⁱⁱ Organic waste can be used as a source of biomass to produce thermal or electrical energy. Organic waste landfills can be used to produce biogas, while agricultural waste can be used to produce biofuel.

rest of the waste. What is recovered in Algeria by CETs or the sorting centers remain around 1%. (GIZ, 2020)

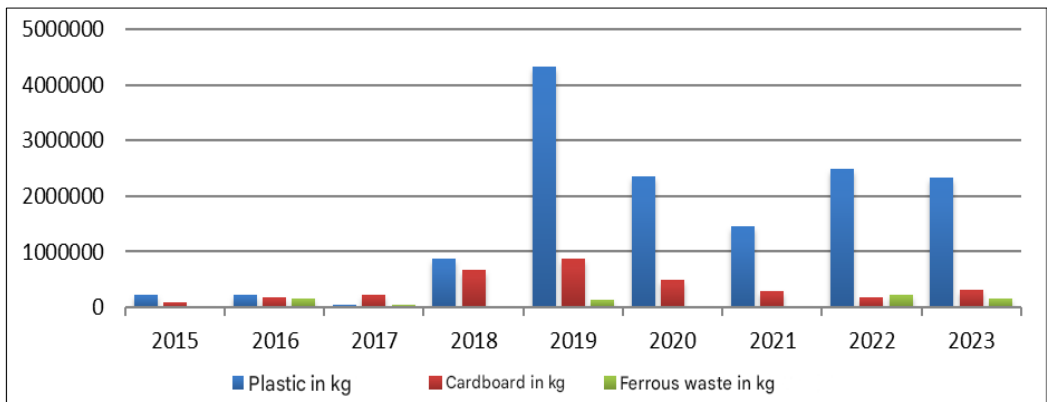
The Oran CETs carries out selective sorting and recovery activities. In fact, the CET manage a sorting center at CET Hassi Bounif and two other urban sorting centers. The sorted and recovered waste is then sold to recyclers at the national level. To get a more precise idea of these activities, we present, below, a summary table of the recovered quantities evolution from 2015 to 2023.

Table 3: Recovery of recycble products in kg from 2015 to 2023

Recyclable dry waste			
Product/Quantities	Plastic(kg)	cardboard (Kg)	Ferrous waste (Kg)
Year 2015	231 275	94 641	27 720
Year 2016	234 380	174 010	149 500
Year 2017	54 443	236 417	48 220
Year 2018	869 520	678 200	11 773
Year 2019	4 337 320	874 800	129 560
Year 2020	2353 740	490 060	15 880
Year 2021	1448 680	304 340	34 020
Year 2022	2499 360	171 980	216 020
Year 2023	2342 646	306 780	165680

Source: CET of Oran

Figure 3: Recovery of recycble products in kg from 2015 to 2023



Source: CET of Oran

From the diagram and table above, we notice a spike in the quantities of plastic and cardboard recovered in 2019, reaching an exceptional tonnage. To have an explanation, we approached the officials of the CET.

The official, in charge of the selective sorting and recovery project at the Oran's CET, explained to us that 2019 has seen an exceptional revenue and tonnage levels following a call for tenders to subcontract downstream sorting activities at the landfill center. This initiative led to a collaboration with two recycling companies. These two recyclers deployed their own human and material resources, operating continuously at a high pace (24 hours/day in 3 shifts).

This experience was exceptional and profitable for both parties. For the CET, because it was financially profitable while reducing the amount of waste to be disposed of. For the recyclers, it allowed them to recover the material to be recycled from the source without quantity limitation or price constraint since they had to be the best bidder among the service offers to benefit from this landfill recovery contract. This win-win situation was, unfortunately, interrupted in 2020 because of the Covid-19 pandemic. Both recyclers changed operations due to the speed of contamination among sorting agents, especially in the waste sector where sorting is done manually.

The Oran CET has tried to revive the experience by launching other calls for tenders but, unfortunately, after COVID there are no longer any large recycling companies in Oran. This leads us to confirm the existence of great potential and a real need for investment in this very profitable field. The profitability of this field was confirmed by the survey conducted by (Benmessaoud, 2022) on green entrepreneurs in the wilaya of Oran. When questioning the determining factors for choosing to undertake in this sector, nearly 74% of respondents stated that their choice was determined mainly by the high rate of profitability.

4.1 SOAR analysis of green entrepreneurship and waste management in Oran:

The following SOAR matrix is designed to clarify the strategic vision of this study; it outlines the aspirations and defines the expected results if green entrepreneurship is mobilized effectively in the waste management sector in Oran. This approach not only aligns with the goals of sustainable development but also offers a concrete roadmap for entrepreneurs, public institutions, and policymakers to collaborate in transforming waste into value.

Strengths	Opportunities
• The wilaya of Oran already has a significant operational infrastructure for waste management: three Technical Landfill Centers (Hassi Bounif , El Ançor , Arzew), managed by the EPIC CET of Oran. This constitutes a solid basis for considering the integration of new actors, particularly private ones, in sorting, recovery or recycling initiatives. • Algeria, faced with the need for economic diversification, has set up several support mechanisms for entrepreneurs (incubators, ANADE, CDE, etc.), reflecting a favorable context to the emergence of green entrepreneurship. • Large volume of waste is generated, the raw material to be recovered is abundant, in particular organic, plastic and paper waste which represents nearly 75% of the total.	• Less than 1% of waste (especially organics, paper, plastic) is currently valorized presenting a major opportunity for green entrepreneurs. • Composting, biomethanization, and energy recovery from organic waste remain underutilized. • Encouraging youth entrepreneurship could fill gaps in collection quality and recovery efficiency. • The shift to sustainable models and interest from development organizations can bring funding, training, and networks.
Aspirations	Results
• Oran could become a national model for ecological transition through the integration of young entrepreneurs, the modernization of sorting, and the upskilling of local stakeholders. • The objective could be to move from a recovery rate of 5-7% to more than 30% in a decade, through better organization of sorting at source and the multiplication of specialized treatment structures. This could significantly reduce the landfill rate. • Positioning green entrepreneurship as a dual lever: economic and ecological The idea would be to build a new generation of entrepreneurs who create jobs while responding to environmental emergencies with a strong local presence.	• Job creation, especially among youth and local communities, through startups in collection, recovery, recycling, composting, and eco-design. • Higher recycling rates by increasing material recovery from key waste fractions (organics, plastics, paper, metals). • Lower environmental impact by reducing in illegal dumping and pressure on landfills. • job creation and local economic development.

The SOAR analysis of waste management in the Wilaya of Oran highlights a significant potential for the emergence of a dynamic green entrepreneurship sector, capable of providing concrete solutions to the region's environmental

and economic challenges. Despite the existence of a structured institutional framework and a substantial volume of waste to be treated, the recovery rate remains extremely low, creating a wide range of opportunities for innovative project developers.

4.2 Identification of green entrepreneurial potential in the field of waste management in the wilaya of Oran

The table below presents a detailed mapping of green entrepreneurial potential across the key stages of waste management in the Wilaya of Oran. It distinguishes between public and private stakeholders while assessing the degree of entrepreneurial opportunity at each level.

Table 4: The potential of green entrepreneurship in the field of waste management in the wilaya of Oran

Mission	Actors		Description of entrepreneurial potential (High/Low)
	Public	Private	
Collection	•Epic Oran Propreté •Municipalities • Military Unit	Private operators	Relatively High: Despite the many public stakeholders, collection is largely handled by private operators. However, the quality of service remains problematic. Any new business offering high-quality waste collection could make a significant positive contribution and can easily have a good market share.
Disposal (burial)	EPIC CET	/	Relatively low: because waste disposal is mainly carried out by the Epic CET. Yet, certain operations can be subcontracted to private companies.
Recovery	• EPIC CET • Municipalities	Private companies	Very high: the sorting and recovery rate is very low and remains far from the standards. Which represents an opportunity for entrepreneurs to easily integrate the market.
Valorization (recycling / composting)	/	Private companies	High: Mainly handled by private actors. The need for waste valorization is critical and increasing. For example, glass is not recycled at all in Algeria. According to CET Oran, no recycler is currently accepting glass, which has led sorting centers to stop sorting and storing it. Entrepreneurs entering the glass recycling market would face no competition.

Source: compiled by the author

This table clearly demonstrates that waste recovery and valorization represent the most promising areas for entrepreneurial development. Private initiatives are not only welcomed but essential to improve efficiency, diversify the waste sector, and create employment. Glass recycling, in particular, offers a rare first-mover opportunity in a virtually untapped niche.

5. CONCLUSION

This work aims to highlight the potential of green entrepreneurship in improving waste management. In Algeria, the organization of collection, sorting and transformation of waste reflects the great efforts made by the competent authorities to achieve a more efficient waste management system. Nevertheless, several shortcomings remain. They are, essentially, due to a lack of mastery of new techniques and unqualified human resources in new sustainable management methods.

A description of the organization and evolution of waste management at the wilaya of Oran enlightened us on the inadequacies and shortcomings in the current waste management system. The analysis of waste treatment data recorded by the Oran CET reveals major weaknesses in terms of waste sorting and recovery. Despite the enormous work CET is doing in terms of awareness, sorting and recovery, this remains insufficient and very far from the potential offered by the quantity and the quality of waste of Oran. Collaboration with private companies is more than necessary, the exceptional recovery results recorded in 2019 are concrete proof of this.

It is in this perspective of concentrating efforts in favor of the environment and the economy that we believe that green entrepreneurship can be a real lever for improving waste management. In fact, the multiplication of players in waste recovery (private and public) can only be beneficial. In addition to creating wealth and jobs for recyclers, waste recovery helps preserve the environment by reducing the amount of waste and thus extend the life of landfill lockers. Moreover, as the (GIZ, 2022) underlines: "*The waste sector, but more precisely the recovery sector, offers interesting financial possibilities.*"

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