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The impact of solid waste recycling on environmental security of countries according to the Environmental Performance Index (EPI) 2022: A study of leading international models

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***Abstract*---**Sustainable development requires a deep understanding of the environment and the growing environmental challenges facing all countries. The Environmental Performance Index (EPI) ranks countries on a sustainability scale based on a weighted aggregate of several relevant environmental indicators. Solid waste recycling is considered one of the modern and safer methods that, if adopted, can transform solid waste into a new resource, thereby reducing the risks associated with the unsafe disposal of solid waste and ultimately achieving environmental security. This means ensuring the ability to

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mitigate the effects of environmental pollution from waste, which has a positive impact on air and water quality and agriculture, thereby reducing the effects of global warming and climate change, as reflected in the 2030 Sustainable Development Agenda. Numerous global environmental and academic institutions have focused on studying and evaluating countries' performance in this regard by establishing indices, including the Environmental Performance Index (EPI), published biennially by Yale University and Columbia University, which aims to strengthen the Sustainable Development Goals for the 2015-2030 Agenda. Global waste is expected to increase to 3.40 billion tonnes by 2050, more than twice the rate of population growth. Daily waste generation per capita is expected to increase by 19% in high-income countries by 2050, compared to around 40% or more in low- and middle-income countries. In addition, the total amount of waste generated in low-income countries is expected to more than triple by 2050. This study aims to demonstrate the impact of solid waste recycling on the environmental security of countries according to the EPI 2022, with a review of the experiences of some countries.

***Keywords*---**Waste, waste valorisation, recycling, sustainable development, quality of life.

JEL Classification: Q01, Q53, M130 eywords, Waste, waste valorisation, recycling, sustainable development, quality of life
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1. Introduction

Effective waste management systems are essential for building a circular economy. By adopting a circular economy, national and local governments can implement smart and sustainable waste management practices that promote efficient economic growth while minimising environmental impacts. According to the World Bank, if urgent action is not taken, global annual waste generation will rise to 3.4 billion tonnes by 2050, a 70% increase from 2018 levels. While high-income countries recycle and compost a third of their waste, only 4% of waste is recycled in low-income countries.

Tackling recycling could also help drive solutions to the climate crisis and the associated loss of valuable habitats. The more raw materials we use, the more we harm our planet. The World Economic Forum (WEF) estimates that “resource extraction and processing alone is responsible for over 90% of global biodiversity loss, water stress and almost half of global climate change impacts”.

Solid waste recycling is considered one of the modern and safer methods that, when implemented, turns solid waste into a new resource. This approach can reduce the risks associated with unsafe solid waste disposal, thereby achieving environmental security. It ensures the ability to mitigate the effects of environmental pollution from waste, positively impacting air and water quality

and agriculture, while also reducing the effects of global warming and climate change, as articulated in the 2030 Sustainable Development Agenda.

Many global environmental and academic institutions have focused on studying and evaluating countries' performance in this area by creating various indices, including the Environmental Performance Index (EPI), published biennially by Yale University and Columbia University. This index aims to strengthen the Sustainable Development Goals for the 2015-2030 Agenda.

This study aims to demonstrate the impact of solid waste recycling on the environmental security of countries according to the EPI 2022, and to examine the experiences of several countries.

Research question:

In order to uncover the truth of the matter, the study is framed around the following question:
To what extent does solid waste recycling affect the level of environmental security of countries according to the Environmental Performance Index (EPI) 2022?

1.1 Significance of the study
The importance of this study is underscored by a World Bank report which indicates that global waste risks are expected to increase by 70% by 2050. The extraction, processing, transport and disposal of raw materials are associated with environmental pressures such as climate change, air and water pollution. Currently, 60% of the world's major ecosystems are either degraded or used unsustainably. Based on these trends, two Earths would be needed to support global economic activity by 2050. To mitigate these risks, the world is moving towards solid waste recycling to increase environmental security and achieve the Sustainable Development Goals for 2030.

1.2 Objectives of the study
This study aims to achieve several key objectives, including:
- Identify the main methods of waste recovery and recycling.
- Propose appropriate solutions to eliminate waste problems and minimise their negative impacts.
- Clarify the impact of solid waste recycling on the level of environmental security in 180 countries according to the EPI 2022.

1.3 Methodology
In order to address the research problem and comprehensively cover the sub-questions, this study uses a descriptive and analytical methodology appropriate to the nature of the subject.

1.4 Previous studies
*** Study by Chinedu (2011**):
Improving Energy Efficiency in the Steel Industry through Scrap Recycling
The aim of this study was to investigate the energy consumption in steel production through scrap recycling and to compare the energy savings achieved with those of other production methods. Key findings include the conservation of

natural resources by recycling raw materials such as iron, coal, limestone and water. The study also highlighted the environmental benefits of recycling as it reduces pollution from the extraction and refining of raw materials, minimises the environmental impact of discarded steel and provides financial savings to those involved in the scrap industry.

*** Study by Zahia Bourfiss and Mouna Ghabouli (2021): The Role of Environmental Security in Achieving Sustainable Development under National Legislation and International Agreements**

This study emphasises the need to protect and preserve the environment and address the effects of pollution. To achieve this goal, countries have implemented various reform measures and environmental regulations to enhance environmental security, which is seen as a key to sustainable development, ensuring citizens' right to a healthy and safe environment.

*** Study by Safwat Hamidat et al. (2022): Solid Waste Management in the Context of Circular Economy in the MENA Region**

This study aimed to analyse and identify the national solid waste management practices in the MENA region, including Algeria. It examined the existing management mechanisms and strategies for the transition to a circular economy, as well as the role of policies and technologies in this transition. The findings showed that most of the issues related to urban waste management stem from political factors and the decentralisation of waste management in these countries. This study shares common ground with our research by specifically analysing waste management mechanisms in Algeria.

2. General framework for sustainable development

2.1 Definition of sustainable development

Sustainable development is a comprehensive model endorsed by the United Nations and defined in the 1987 Brundtland Commission Report as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Najati, 2014).

2.2 Goals of sustainable development

Sustainable development aims to achieve a number of goals, which can be summarised as follows:

- Improving the standard of living:Sustainable development aims to improve the quality of life of individuals in various areas, focusing on quantitative aspects of growth while ensuring equity.
- Rational use of natural resources: It promotes the rational use of natural resources without causing environmental damage or wasting resources, treating them as finite.
- Linking modern technology to community goals: This involves raising awareness among the population about the types of technology available to achieve desired goals without negatively impacting the environment (Mohoub, 2020).
- Fighting poverty: Sustainable development aims to combat poverty, which is one of the greatest challenges facing humanity.

2.3 Evolution of sustainable development

Table 01: Evolution of sustainable development according to international initiatives and conferences

Years	Organisations, Bodies and Conferences	Perspectives on Sustainable Development
1915	Canadian Committee for the Protection of the Environment	Transferring natural capital to future generations
1923	International Conference on Nature Conservation in Paris	Preserving the environment and making rational use of available resources
1960	Rome Conference: Enough GrowthStockholm Conference	Warning against the risks of economic development and population growth
1972	Stockholm Conference	Emergence of environmentally sound development concepts
1980	World Organisation for Nature	Conservation of nature and biodiversity
1984	International Conference on Environment and Economy	The need to give equal attention to economic and environmental issues.
1987	International Commission on Development and Environment	The publication of the report “Our Common Future” and the emergence of the concept of sustainable development.
1992	Earth Summit in Brazil	Establishment of the concept of sustainable development among the general public
1997	Kyoto Protocol	Reducing greenhouse gas emissions
2002	Johannesburg Summit	Conservation of natural resources and biodiversity
2009	Copenhagen Summit	Combating global warming
2017	Paris Summit	Reducing greenhouse gas emissions
2020	Glasgow Summit	Strengthening the implementation of the Paris Agreement through actions that can put the world on a more sustainable and less carbon-intensive path.

Source: Prepared by the researcher, and from Ben Zekoura Al-Aounia, previous reference, p. 231.

2.4 Dimensions of sustainable development

A. Economic dimension

The economic dimension of development focuses on the material aspect, which includes the increase in the volume of goods and services and the growth of capital investment in various economic sectors, including agriculture, industry, finance, and commerce (Al-Din, 2018). This dimension aims at achieving sustainable economic growth, capital efficiency, meeting economic needs, and achieving economic justice.

B. Social dimension

The social dimension of sustainable development is reflected in the relationships between individuals, communities, institutions, and the systems and values that govern interactions. This includes different social contracts, religions, constitutions, laws and political transformations (Fouad, 2020, p. 142). Key elements of the social dimension include (Rachida, p. 15)

- Equity in income distribution and improvement of living standards.
- Social mobility and civic participation.
- Cultural diversity and institutional sustainability.

C. The environmental dimension

The relationship between development and the environment was established at the United Nations Conference on the Human Environment in 1972. Since then, a balanced approach to environmental management has become essential for achieving development. Environmental concerns have received considerable attention at both international and national levels, as sustainable development is linked to avoiding environmental degradation caused by excessive economic activity (Harizi, 2013/2014).

The environmental dimension of sustainable development includes the conservation of natural resources and wealth as a vital foundation, along with their rational and sustainable use without depletion or waste (Al-Din M., October 2020, p. 174).

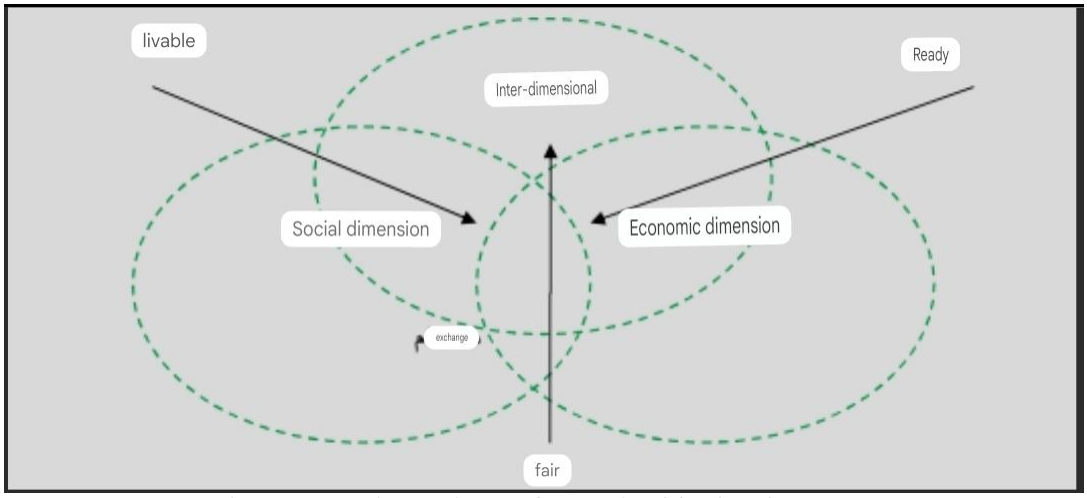

Figure 01: Dimensions of sustainable development

Source: J. Ernult, A. Ashta, 2007. *Sustainable Development, Corporate Social Responsibility, Stakeholder Theory: Evolution and Perspectives, Cahiers du CEREN, 21, p. 14.

3. Conceptual relationship between waste recycling and environmental security

3.1 Introduction to waste management and valorisation and their importance

Today, waste is a source of income for many countries through recycling processes. Recycling is considered the third element in the waste hierarchy, as shown in Figure 02. This hierarchy ranks waste management options according to their environmental benefits, with prevention at the top. When waste is generated, the hierarchy emphasises waste preparation for reuse, followed by recycling, recovery (repair) and finally waste disposal (landfilling) (Feit, J., 2013).

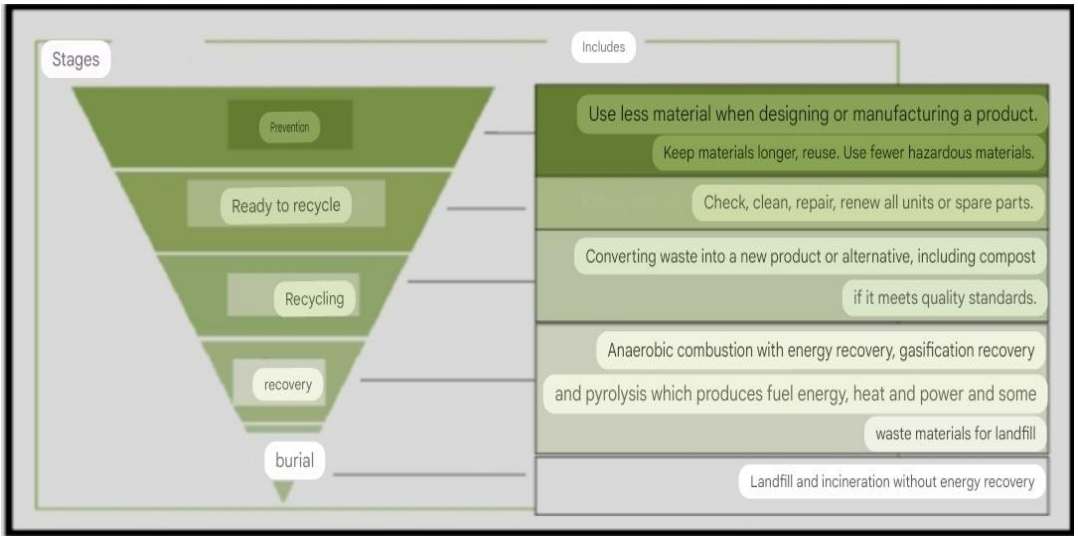

Figure 02: Waste hierarchy
Source: www.defra.gov.uk.2011

3.1.1 Definition of waste valorisation

Waste valorisation is defined as any "process that allows... energy recovery... finding new uses for the materials that make up the waste... extracting useful secondary raw materials for the production of the same product (such as recycled paper or glass), finding new uses for waste... using waste as it is by other parties (second-hand markets)" (Ngnikam, 2006).

3.1.2 Types and methods of waste valorisation

Types of waste valorisation are categorised based on the outputs of the valorisation processes, which can be either energy, materials or compost. There are three main types, each associated with different processing and valorisation methods, which will be discussed below.

3.1.2.1 Types of waste valorisation

1. Energy recovery from waste (La valorisation énergétique)

Known in English as "waste to energy", this involves using the energy contained in waste to produce electricity, heat or steam through various methods and treatments.

2. Material valorisation of waste (La valorisation matière)

This involves using all or part of the waste to replace a component or material in production processes.

3. Organic valorisation of waste (La valorisation organique)

This refers to the use of organic waste to produce compost through biological treatment:

These three types have led to the emergence of three sub-sectors or markets within the waste market. Although each type plays an important role in the valorisation and use of waste, they compete for the same volume of waste, in particular between energy and material valorisation on the one hand and energy and organic valorisation on the other. Most types of waste are suitable for

incineration (energy recovery), some can be materially recovered and bio-recovery is limited to organic waste. Several factors influence the growth of one market over the other, including national policy priorities and objectives regarding valorisation processes.

3.1.2.2 Waste valorisation methods

- The energy recovery process can recover between 65% and 80% of the energy contained in organic waste. According to a report on the waste-to-energy market, its size will reach $33 billion in 2020 and is expected to increase to $54.8 billion by 2027, with a compound annual growth rate of about 7.4%.
- Waste recovery contributes to environmental and social justice by avoiding the export of waste to less developed countries that may have less capacity to manage it effectively.
- It reduces pollution and greenhouse gas emissions that contribute to global warming. For example, converting one tonne of solid waste into compost produces 10% fewer greenhouse gases than landfilling one tonne. In the United States, converting 152 billion kilograms of food waste into compost reduced carbon dioxide equivalent emissions by 128.7 million tonnes (Faraz, 2022).

3.2 Defining environmental security

The concept of environmental security is one of the most important emerging concepts, reinforced by international measures highlighting the need to establish strategies and mechanisms to combat environmental degradation. Moreover, the efforts of some scholars and researchers have enriched the field of security studies by addressing the issues of environmental degradation and climate change (Dair, 2019).

3.2.1 Environmental Security: Definition and Dimensions

According to Barry Buzan, environmental security in its broadest sense encompasses two meanings: “the securitisation of the environment”, ranging from ecosystems and biomes to the entire biosphere, and the relationship between the environment and civilisation. The first meaning is concerned with understanding environmental issues increasingly as security issues, while the second is concerned with the survival of human civilisation itself (Tajine, 2020).

Each type of valorisation mentioned uses different methods and treatments - manual, physical, chemical or biological - depending on the nature of the waste and the outputs of the valorisation process, as well as the priorities of each country in terms of the returns and costs associated with each method. Widely used approaches within the framework of sustainable waste management include the well-known waste management hierarchy methods, known as the 4Rs:

- Reduce: Minimise waste generation.
- Reuse: Finding new uses for items without significant processing.
- Recycle: Processing materials to make new products.
- Recovery: extracting valuable materials from waste.

The last three of these methods are integral to waste valorisation, along with composting (Ahmadi, 2020).

3.1.3 Importance of waste valorisation

Numerous scientific studies in various economic, social, physical, biological, mechanical and chemical disciplines, as well as practical applications of waste

valorisation, have produced encouraging results that underline its significant importance. Below are some quantitative aspects that reflect this importance:
- Annual revenues from recycling exceed $500 billion, of which about 10% is invested in new technologies and research and development, creating highly skilled jobs and making recycling more economically and environmentally efficient.
- Creation of institutions and jobs, as well as government tax revenues. A recent study by the U.S. Environmental Protection Agency found that waste recovery, reuse and recycling will generate 681,000 jobs and $37.8 billion in wages in the United States in 2020, along with $5.5 billion in tax revenues. In addition, another study on composting found that composting facilities in Maryland employ twice as many people as landfills and four times as many as incinerators (Faraz, 2022).
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3.2.2 Threats to environmental security from unsustainable waste management

Branches of environmental security link core processes affecting the biosphere that are directly related to human activities. Key sectors include:
- Food Environmental security
- Air environmental security
- Water environmental security
- Health environmental security

- Economic environmental security
- Community environmental security
- Cultural environmental security

The environmental threat level can be divided into three main aspects:

1. Threat to air and climate:

One of the most significant forms of environmental pollution from solid waste is the phenomenon of global warming, along with the depletion of the ozone layer. Both of these issues pose a threat to climate change.

2. Threat to water:

Pollution reaches surface waters when solid waste is dumped into them, transferring all pollutants - such as chemicals, heavy metals and microbes - to living organisms. Groundwater is also polluted when waste is buried without certain conditions being met.

3. Threat to soil:

The introduction of foreign materials into the soil changes its properties, making it unsuitable for agriculture. Although micro-organisms present in the soil may help to mitigate some of the damage caused by certain types of solid waste, the overall impact remains detrimental.

3.3 Conceptual relationship between solid waste recycling and environmental security

Understanding the relationship between solid waste recycling and environmental security, particularly through Goal 12 (Responsible Consumption and Production), involves promoting coordination between consumption and production processes. This coordination is essential for a more sustainable use of resources, especially energy and water sources. Thus, recycling solid waste improves resource efficiency and reduces air, water and soil pollution throughout the product life cycle.

- Link between solid waste recycling and air quality/climate change:

Solid waste recycling contributes directly to the achievement of Goal 7 by converting waste into energy through the use of landfill gas, thereby minimising its harmful effects.

- Relationship between waste recycling and water quality/agriculture:

The process of recycling and treating solid waste prevents solid waste from entering surface and groundwater, thereby supporting Goal 14. It also supports Goal 15 by preventing the degradation of agricultural land and forests. The higher the percentage of materials recycled from solid waste, the less landfill space is required.

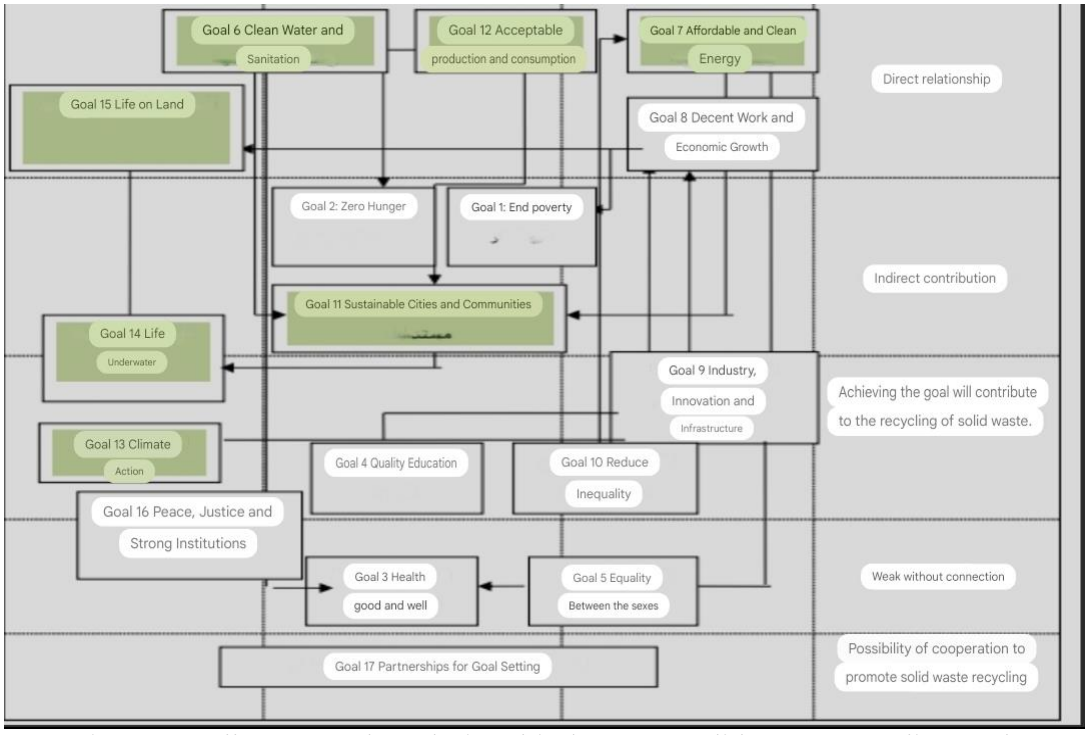

Figure 03: Illustrates the relationship between solid waste recycling and environmental security.
Source; Schroeder, P2018

4. Presentation of leading international models in waste management and valorisation

The generation and management of waste are key contributors to the overall carbon footprint of the economy, and are aspects that countries are increasingly seeking to mitigate in order to reduce their contribution to climate change. Biodegradable waste such as food waste, paper, cardboard and garden waste all emit methane - a potent greenhouse gas that contributes to global warming and climate change.

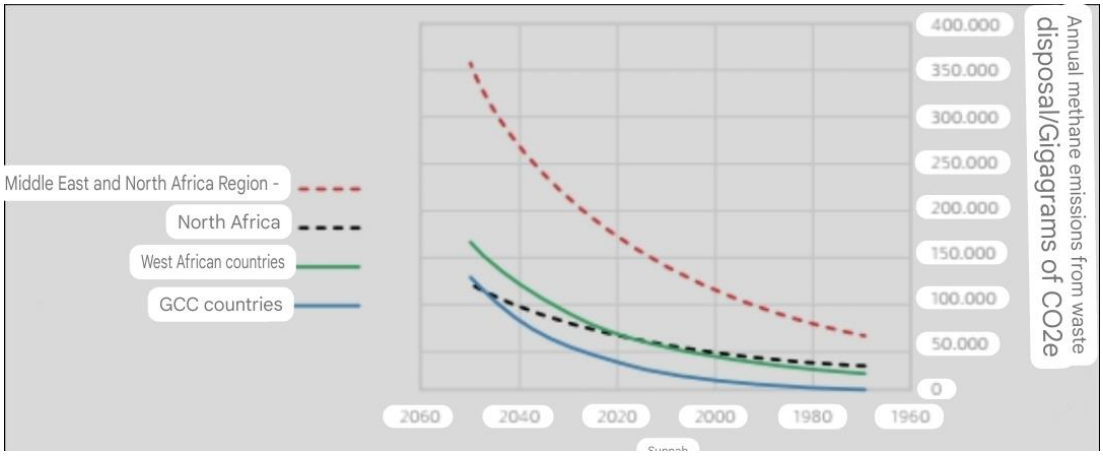

Figure 04: Methane emissions from waste in the MENA region
Source: DAMBLE 2017

4.1 Waste management and valorisation in Germany

Germany is a global leader in waste management and recycling, having achieved the highest recycling rate since 2016. In 2021, the country managed to recycle 71% of its waste through the implementation of a number of strategies, the most notable being the mandatory waste sorting policy imposed on both producers and consumers. As a result, Berlin reduced its plastic waste exports to 745,100 tonnes in 2022, the lowest level in the last decade.

Table 02: Packaging waste recovery policy targets (recycling and sustainability) in Germany and the European Union (2025-2030)

2035	2025	Packaging Type
55	50	Of plastic
30	25	Of wood
80	70	Of ferrous metals
60	50	From aluminum
75	70	Of glass
85	75	Of paper and cardboard

Source: Laura Schroeder, Kim Jeonghyun2019, GERMANY'S WASTE MANAGEMENT POLICY DEVELOPMENT A Focus on Municipal Solid Waste, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Beijing, PR China, p24

The following figure shows the total volume of waste generated in Germany, categorised by type of waste, for the period 2011-2020.

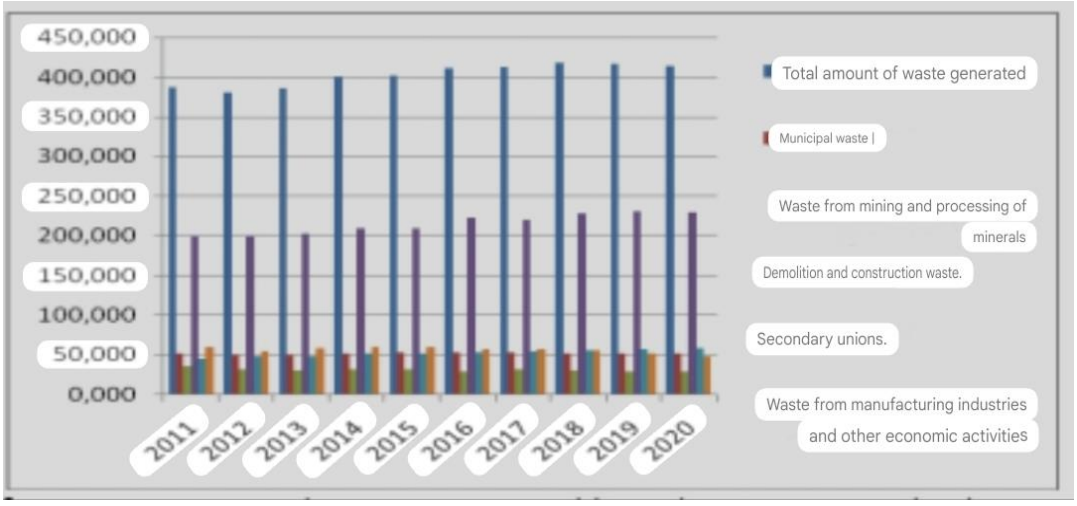

Figure 05: Volume and composition of waste in Germany (in thousands of tonnes, 2011-2020)
Source: based on data in : German Federal Statistical Office2022, Waste balance, in site web :https://www.destatis.de/EN/Themes/Society-Environment, see :(24/10/2022

The figures and data show that total waste generation in Germany continues to increase, with construction waste being the largest contributor. This sector is also on the increase, despite being a target area for reduction under the Waste Reduction Plan. A similar trend has been observed for secondary waste, while the volumes of mining waste, industrial waste and municipal waste have decreased. This shows the effectiveness of economic instruments, in particular the extended producer responsibility adopted in Germany. It also shows that the country is continuing its efforts to meet the target of halving food waste by 2030, given that food waste represents a significant proportion of municipal waste.
This is reflected in several indicators for which numerical data are available, including the total recovery rate as a percentage of total waste by type, the recycling rate, the energy recovery rate, the landfill disposal rate and the thermal treatment rate without energy recovery, as well as the methods used for waste disposal.

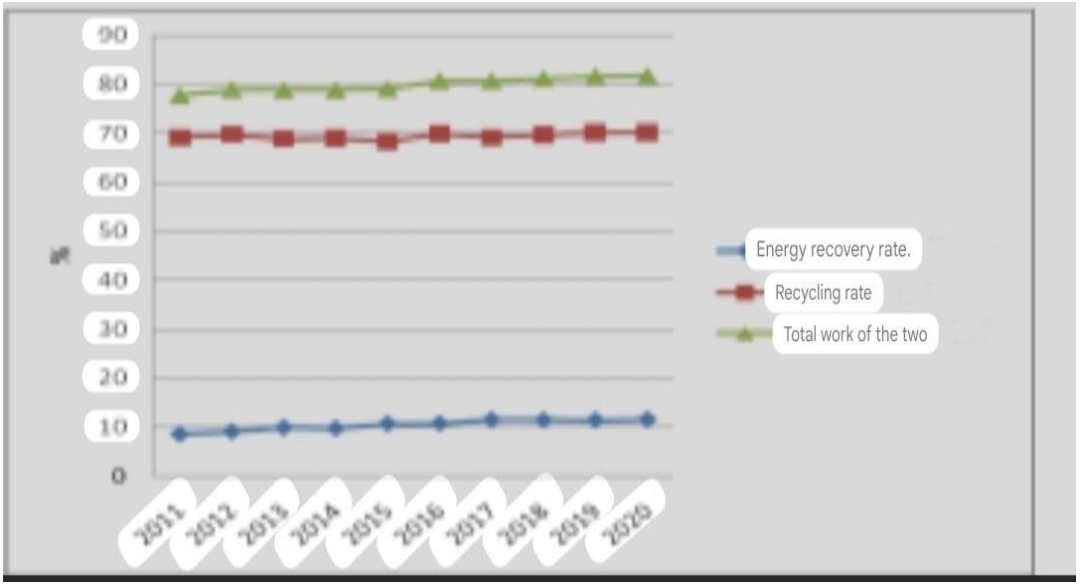

Figure 06: Waste valorisation rates in Germany (2011-2020).
Source: based on data in: German Federal Statistical Office2022, Waste balance, in site web: https://www.destatis.de/EN/Themes/Society-Environment, see :(24/10/2022)

Germany has a strong focus on following the waste hierarchy according to the European Directive (2008), with high valorisation rates of over 80% overall. This is mainly due to the increase in valorisation through recycling, which has reached 70% over the last decade from 2011 onwards. The same trend applies to energy recovery methods, which have shown a continuous increase over this period, in contrast to the steady decrease in the disposal rates aimed at by the policy, especially for thermal treatment without energy recovery.

These high valorisation rates confirm Germany's success, over almost 50 years since the first waste law in 1972, in using waste and turning it from a crisis into a valuable tool and resource for valorisation. This is also supported by the economic importance of the sector, as indicated by the Federal Environment Ministry.

4.2 The waste-to-energy industry in China

The waste-to-energy market in China is expected to grow at an average annual rate of over 4.75% during the forecast period. In the long term, favourable government policies and increased investment in the country are expected to drive market growth.
On the other hand, the emission of harmful gases from waste-to-energy plants and the ash produced by these plants, which needs to be disposed of safely - usually in landfills - can also lead to groundwater contamination, which may hinder market growth.
However, daily per capita waste generation in the region is projected to increase by nearly 40% by 2050. Therefore, the growing volume of municipal waste and the

increasing demand for energy in the region are expected to create opportunities for the waste-to-energy market in China in the future.
In 2019, China will become one of the leading countries to install the largest incineration plant in the world (the East Shenzhen waste-to-energy plant). This facility can process 2.7 million tonnes of waste per year and generate 1.5 billion kilowatt-hours of energy per year.
Combined heat and power plants are expected to achieve optimal efficiencies of 80% in addition to electricity generation. Currently, incineration is one of the most popular technologies for converting municipal solid waste (MSW) into energy. However, waste-to-energy technologies, particularly incineration, generate pollution and pose potential health and safety risks.
To reduce emissions of particulate and gaseous pollutants, incinerator operators have introduced a number of treatment units to clean the flue gas stream, resulting in significant improvements in environmental sustainability.
The table below shows the world's top 10 producers of electronic waste, based on the total amount produced (measured in kilotons).

Table 03: Top 10 producers of electronic waste in the world

Recycling rate	Electronic waste produced (kilotons)	Country	Rank
%16	10.129	China	1
%15	6.918	USA	2
%1	3.230	India	3
%22	2.569	Japan	4
%0	2.143	Brazil	5
%6	1.631	Russia	6
unavailable	1.618	Indonesia	7
%52	1.607	Germany	8
%57	1.598	UK	9
%56	1362	France	10

2021 Source: World Bank

Electronic waste contains many rare and valuable raw materials, most of which are not currently recovered. As a result, the global e-waste management market is expected to grow, driven by both financial and environmental factors. The market was valued at $49.88 billion in 2020 and is expected to nearly triple to $143.87 billion by 2028.

5. Current status of waste management and valorisation in Algeria and growth opportunities based on international experience

5.1 Waste valorisation

The average production of municipal waste and similar categories (including bread waste and that of economic and administrative units) has been estimated at 0.68 kg per person per day in 2021, compared with 0.67 kg per person per day in 2020. This calculation is based on a population of 44.5 million and a total of 186,263 economic and administrative units in 2021 (AND, 2022, p. 30).

This decrease is mainly due to the COVID-19 pandemic, which significantly affected the operations of economic and administrative entities and influenced consumer behaviour. The production of municipal solid waste in Algeria is estimated at approximately 14 million tonnes per year (Netherlands Enterprise Agency, 2018), which corresponds to an average of 1 kg per person per day in urban areas and 0.6 kg per person per day in rural areas. This is a result of urbanisation, population growth and economic development. This is expected to increase to around 20 million tonnes per year over the next decade, with an urbanisation rate of 88%.

Source: (The Nethelands Entreprise Agency, 2018, p. 9)

Figure 07: Evolution of waste generation in Algeria

Figure 12: Evolution of waste generated in Algeria

The valorisation process includes waste recovery, recycling or composting. Through the National Waste Management Strategy for 2035, the State has set targets to achieve 30% valorisation of waste and to move towards sustainable waste management. The National Waste Agency has identified only 700 economic operators involved in waste valorisation nationwide as of 2021 (Boudrah, 2022).

6. Conclusion

The sector faces a number of challenges and obstacles that hinder the effective implementation of integrated or sustainable waste management according to the performance indicators discussed in our study. The current situation in the management of municipal waste and similar categories is characterised by weak or ineffective performance, which could have a negative impact on waste management services from an economic, social and environmental perspective. Therefore, it has become essential to address the existing deficiencies in the waste management sector by supporting investments by economic entities.
The study reached several conclusions, which are summarised below:
- The waste management and valorisation sector in Algeria suffers from significant weaknesses, despite the growing volume of waste and the considerable financial burden it represents for the State, amounting to 0.76% of GDP. This is due to the lack of renewal of the legal framework, its laxity and the ineffectiveness of economic instruments, as well as the weak participation of the private sector and the low public awareness of the importance of valorisation activities.
- At present, the waste management and valorisation sector in Algeria has a significant untapped economic potential in terms of the annual financial waste incurred by the State in managing this sector, as well as the expected investments and returns it could generate.
- The inefficiency of the mechanisms for the valorisation of domestic waste in Algeria persists, despite the significant financial and non-financial benefits of this process, with a recovery rate of no more than 10% of the total domestic waste and similar categories.
- The methods and systems currently used in the waste management phases are outdated and inadequate, creating opportunities for emerging companies to invest in smart and innovative systems in the valorisation process.

Suggestions

In general, we can make several key suggestions:
- Use the German experience: It is essential to draw on the German experience in implementing guidelines and economic mechanisms aimed at establishing a system that directly links waste producers, under the principle of extended producer responsibility, with institutions operating in the valorisation sector.
- Promoting funding for youth projects: There is a need to promote the funding of youth projects in the waste management sector in order to reduce the burden on public institutions
- Facilitating investment for start-ups: There is a need to provide incentives and support for start-ups to invest in the waste management sector. This is crucial to meet the needs of the sector and the important role these start-ups can play in driving development and accelerating growth. Given the opportunities available, they can adopt innovative ideas in modernising management systems and conversion processes to generate renewable energy and diversify the national economy.
- Leverage successful international experience: It is important to benefit from the technical, technological and management experience of successful international models.

Reference

Faraz Farhidi, K. M. (2022). How the US Economy and Environment can Both Benefit. Environmental Health Insights,SAGE , 16, 03

A. Ahmadi, F. E. (2020). Benefits and Limitations of Waste-to-Energy Conversion in Iran. Renewable Energy Research and Application, , 01 (01), 28

Feit.J. 2013. "Curbside Trash and Recycling Collection in Lenox,Massachusetts: A Cost –Benefit Aalysis" https://www.academia.edu/6921269/Curbside_Trash_and_Recycling_Collection_in_Lenox_Massachuse tts_A_Cost-Benefit_Analysis

Laura Schroeder, Kim Jeonghyun2019, Germany's Waste Management Policy Development A Focus on Municipal Solid Waste ,Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Beijing, PR China, p24

Ngnikam, E., & Emile, T. (2006). Les viLLes d'Afrique fAce à Leurs déchets. Belfort: Yves-Claude Lequin,UTBM.(Université de Technologie de Belfort-Montbéliard).

Odysseas N. Kopsidas, S. D. (2021). Economics of Recycling and Recovery. Natural Resources (12), 76.

Kaza, S. L.-T. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management. Washington: Urban Development Series, World Bank based on data in: German Federal Statistical Office2022, Waste balance, in site web: https://www.destatis.de/EN/Themes/Society-Environment, see (24/10/2022)

Nations United. (2014). using indicators for green economy policymaking. Environment Program,.

SSEI. (2017). How Stock Exchanges Can Grow Green Finance -A Voluntary Action Plan.

UNEP FI. (2020). Promoting Sustainable Finance & Climate Finance in the Arab Regio.

Coven‹ J. G. and. And Wales W. J.2011. The Measurement of EntrepreneurialOrientation. Entrepreneneuship theory and practice‹ [e-journal] published online.Available through: willey onlione Library [Accessed2 November 2011]

Abdul Haseeb Ansari & Parveer Jamal & Umar A. Oseni, "sustainable Development: IslamicDimension With Special Reference to Conservation of the Environment", Advances in Natural andApplied Sciences, 6(5), 2012, p: 609

Brahim Chikh TOUAMI, The role of green Islamic Sukuk to the promotion of sustainable development objectives, Journal of New Economy, volume 01,number 20, 2018, P P 098- 195

H., & Sayed Nagla. (2019). SUSTAINABLE BONDS: MAPPING THE FUTURE OF.

Keshmindera J.S & Singhb Gurmit (2019), Green Sukuk: Malaysia akingthe Lead, malaysian journal of consumer and family economics, vol 22 - s2.

ESCWA. (2011). Review of productivity and sustainable development activities in the ESCWA region. United Nations: Issue No. 1.

Belakil, N. (2018). The impact of local government intervention mechanisms on achieving local development: A field study in M'Sila and Batna provinces. Doctoral thesis in economics, specialisation in economics, Faculty of Economics, Commerce and Management Sciences, University of M'Sila.

Ben Zakoura, A. (2018). Small and medium enterprises and the achievement of sustainable development: Between performance requirements and future aspirations. Al-Afaq for Economic Studies, Issue No. 5, 230.

Abdullah bin Mohammed Al-Mutlaq. (2010). Sukuk: Islamic Sukuk Conference (Presentation and Evaluation), King Abdulaziz University, Jeddah, Saudi Arabia, 24-26 May, p. 14.

Bouderah, A. (2022). Waste Management in Algeria: Current Status and Future Perspectives. Presentation at the Scientific Symposium on the Reality of Waste Management in Algeria. University of Constantine 2 Abdelhamid Mehri, Faculty of Economic, Commercial and Management Sciences.

Najati, H. (2014). Green economy and its role in sustainable development. *Planning and Development Issues Series*, No. 251, National Planning Institute, Cairo.