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A qualitative Comparative Study of the Circular Economy and the Green Pyramid Rating System for Construction and Demolition Waste Management in Algeria

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Abstract This study provides a qualitative comparative assessment of the Circular Economy (CE) framework and the Green Pyramid Rating System (GPRS) as emerging approaches for improving construction and demolition waste (CDW) management in Algeria. The research aims to examine the advantages, limitations, and contextual applicability of both systems, and to explore their potential integration into a coherent sustainability model suited to the Algerian construction sector. A descriptive–comparative qualitative methodology was adopted, combining a systematic literature review, a case study of Algeria, and expert input collected from 21 professionals representing engineering, environmental management, and policy sectors. Data were analysed thematically and synthesised using a structured SWOT matrix.

Findings show that CE offers strong potential for resource efficiency, waste minimisation, and job creation, yet remains constrained by limited recycling infrastructure and high initial investment requirements. In contrast, the GPRS provides measurable sustainability criteria at the project level and strengthens energy and resource efficiency, but suffers from low national adoption, limited professional capacity, and competition from global rating systems. Results also indicate that integrating CE's macro-level material circularity with GPRS's micro-level performance standards could enhance environmental outcomes and support Algeria's transition toward sustainable construction practices.

The study recommends expanding recycling infrastructure, developing regulatory incentives for green construction, localising GPRS criteria for the Algerian context, and adopting a hybrid CE–GPRS implementation roadmap to advance national CDW management strategies.

Keywords: Circular Economy, Green Pyramid Rating System, Constructional Waste Management, Environmental Sustainability.

دراسة مقارنة نوعية للاقتصاد الدائري ونظام تصنيف الهرم الأخضر لإدارة نفايات البناء والهدم في الجزائر

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المستخلص: تقدّم هذه الدراسة تقييماً نوعياً مقارناً لإطار الاقتصاد الدائري ونظام تصنيف الهرم الأخضر بوصفهما نهجين ناشئين لتحسين إدارة نفايات البناء والهدم في الجزائر. ويهدف البحث إلى دراسة مزايا كل من النظامين وقيودهما ومدى قابليتهما للتطبيق في السياق الوطني، إضافة إلى استكشاف إمكان دمجهما ضمن نموذج استدامة متماسك يناسب قطاع البناء الجزائري. وقد اعتمدت الدراسة منهجية نوعية وصفية مقارنة جمعت بين مراجعة منهجية للأدبيات العلمية، ودراسة حالة للجزائر، إلى جانب آراء الخبراء المتخصصين التي جُمعت من واحد وعشرين خبيراً يمثلون مجالات الهندسة والإدارة البيئية وصنع السياسات. وخضعت البيانات لتحليل موضوعي وتوليف منهجي في إطار مصفوفة تحليل نقاط القوة والضعف والفرص والتهديدات، تشير النتائج إلى أنّ الاقتصاد الدائري يوفر إمكانات كبيرة لتعزيز كفاءة الموارد وتقليل النفايات وخلق فرص عمل جديدة، إلا أنّ تطبيقه ما يزال مقيداً بضعف البنية التحتية لإعادة التدوير وارتفاع متطلبات الاستثمار الأولي. وفي المقابل، يوفّر نظام تصنيف الهرم الأخضر معايير استدامة دقيقة وقابلة للقياس على مستوى المشروع، ويسهم في تحسين كفاءة الطاقة والموارد، غير أنّ انتشاره الوطني يبقى محدوداً بسبب نقص القدرات المهنية والمنافسة مع أنظمة التصنيف العالمية. كما تُظهر النتائج أنّ دمج المبادئ الدائرية على المستوى الكلي للاقتصاد الدائري مع معايير الأداء على المستوى الجزئي للهرم الأخضر يمكن أن يعزّز النتائج البيئية ويدعم انتقال الجزائر نحو ممارسات بناء أكثر استدامة. بناء على النتائج توصي الدراسة بتوسيع قدرات إعادة التدوير، ووضع حوافز تنظيمية للبناء الأخضر، وتكييف معايير الهرم الأخضر مع الخصوصيات الجزائرية، واعتماد خارطة طريق تكاملية بين الاقتصاد الدائري ونظام الهرم الأخضر لتعزيز الاستراتيجيات الوطنية لإدارة نفايات البناء والهدم.

الكلمات المفتاحية: الاقتصاد الدائري، نظام تصنيف الهرم الأخضر، إدارة النفايات الإنشائية، الاستدامة البيئية.

1. Introduction

1.1 Background

The construction industry is a major driver of economic growth but also a leading source of environmental degradation due to high levels of construction and demolition waste (CDW). Globally, CDW represents a significant share of total solid waste (Ginga et al., 2020; Soyinka et al., 2023; Zhao et al., 2022). In Algeria, rapid urbanisation and extensive infrastructure programmes have intensified CDW generation, exposing persistent challenges in waste reduction, material recovery, and sustainable resource management (Saidi et al., 2023; Merzouk et al., 2025). These conditions underscore the need for strategies that promote circular material flows and resource efficiency (Caldera et al., 2020; Su et al., 2023).

Within this context, the Circular Economy (CE) has gained attention as a transformative model that supports material reuse, recycling, and lifecycle extension (Ginga et al., 2020; Aryee, 2024). In parallel, green building rating systems such as the Green Pyramid Rating System (GPRS) provide project-level sustainability criteria related to material efficiency, energy performance, and waste reduction (Tebbouche et al., 2017; Merzouk et al., 2025). However, while CE and GPRS each contribute to sustainable construction, their combined relevance for CDW management in Algeria remains insufficiently explored (Soyinka et al., 2023; Caldera et al., 2020). Addressing this gap, the present study compares CE and GPRS to assess their complementarities, limitations, and potential integration into a national strategy for sustainable CDW management.

1.2 Research Questions

1- What are the main advantages and limitations of the Circular Economy framework for CDW management in Algeria?

2- What are the key strengths and weaknesses of the Green Pyramid Rating System in improving CDW management in Algeria?

3- How do CE and GPRS compare, and what potential exists for integrating these systems into an effective national strategy for sustainable construction waste management?

1.3 Research Objectives

1. To analyse the advantages and limitations of applying Circular Economy principles to CDW management in Algeria.
2. To evaluate the strengths and weaknesses of the Green Pyramid Rating System within the context of Algerian construction practices and waste management challenges.
3. To compare both systems and explore opportunities for integrating CE and GPRS into a coherent strategy adapted to Algeria's socio-economic and environmental conditions.

2. Methodology

This study adopts a qualitative, descriptive–comparative research design to examine the applicability of the Circular Economy (CE) framework and the Green Pyramid Rating System (GPRS) in managing construction and demolition waste (CDW) in Algeria. The methodology integrates three complementary components: a systematic literature review, a case study of Algeria's construction sector, and expert elicitation.

2.1 Research Design

The research follows a qualitative approach, which is appropriate for exploring conceptual frameworks, institutional dynamics, and context-specific challenges in the Algerian construction sector. The study compares CE and GPRS across environmental, economic, institutional, and practical dimensions.

A descriptive–comparative case study design was adopted to analyse how both systems operate conceptually and how they could be adapted to the Algerian context. This design allows for the examination of national conditions, sectoral characteristics, and stakeholder perceptions relating to CDW management.

2.2 Expert Sample

The study used a purposive sampling strategy to select experts with relevant experience in construction, environmental management, waste management, and sustainability. A total of 21 experts participated in the study. The sample included:

- Engineers (civil, environmental, and construction),

- Architects and urban planners,
- Academics specialising in sustainability and waste management,
- Professionals from governmental institutions and private construction firms.

The inclusion criteria required at least five years of professional experience in their field and direct involvement in construction projects, CDW management, or sustainability initiatives. This ensured that expert opinions were grounded in practical knowledge and sector-specific familiarity.

2.3 Data Collection Tools

Data were collected using semi-structured interviews and expert questionnaires designed to elicit perspectives on CE, GPRS, and CDW management challenges.

The interview guide covered themes such as:

- CDW generation and current practices in Algeria,
- Awareness and applicability of CE strategies,
- Relevance and limitations of GPRS criteria,
- Barriers to adopting sustainability frameworks,
- Opportunities for integrating CE and GPRS.

The tool was validated through expert review and a preliminary pilot test to ensure clarity and relevance. Data collection was conducted in person and via digital communication platforms when necessary.

2.4 Data Analysis Procedure

A thematic analysis was conducted to interpret data collected from experts and literature sources. The analysis followed several steps.

- Initial coding. The transcripts and responses were coded line-by-line to identify emerging concepts.
- Categorisation, the codes were grouoed into thematic clusters (e.g., infrastructure, awareness, regulatory gaps, economic feasibility).
- Cross-comparison, the themes were compared across expert responses and literature findings.
- Synthesis. The themes were synthesised into system-level observations for both CE and GPRS.

2.5 Construction of the SWOT Matrix

The SWOT analysis played an important role in the comparative evaluation between CE and GPRS.

This study develops the SWOT matrix through:

- Extracting themes from the literature review (global trends, regional studies, technical findings),
- Coding expert responses into strengths, weaknesses, opportunities, and threats,
- Cross-validating themes with secondary data from Algerian case studies,
- Structuring each SWOT category based on repeated expert consensus and documented evidence.

This approach ensures that the SWOT table draws on empirical data rather than subjective interpretation.

2.6 Integration of Data Sources

The three methodological components were integrated as follows:

- The literature review provided the theoretical foundation for CE and GPRS.
- The case study contextualised the findings within Algeria's institutional and environmental realities.
- The expert insights validated and enriched the analysis, ensuring that the results reflected practical conditions.

This multi-layered integration strengthened the study's overall reliability and analytical coherence.

2.7 Ethical Considerations

Ethical procedures were observed throughout the study. All participants provided informed consent, participation was voluntary, and anonymity was assured. Data were treated confidentially and used solely for academic purposes. No identifying information was collected or disclosed. The study adhered to standard research ethics for qualitative investigations involving human participants.

3. Literature Review

A systematic review of scientific publications, policy documents, and international reports was conducted to establish the theoretical foundation of the study. This process enabled the identification of best practices, global trends in CDW management, and prior applications of CE and GPRS in comparable contexts.

3.1. Global Perspectives on CDW Management

The literature on construction and demolition waste (CDW) management has expanded considerably over the past decade, reflecting global concern about sustainability challenges in the built environment. Studies consistently show that CDW forms a major share of total solid waste and requires comprehensive strategies for prevention, recycling, and material recovery (Ginga et al., 2020; Soyinka et al., 2023; Zhao et al., 2022). Research from developed and developing countries highlights the need for integrated frameworks addressing environmental, economic, and social dimensions across the construction lifecycle.

3.2. Circular Economy in the Construction Sector

Within this broader discourse, the Circular Economy (CE) has emerged as a central paradigm promoting regenerative resource flows. CE replaces the traditional linear "take–make–dispose" model with practices prioritising material reuse, recycling, and lifecycle extension. Applications of CE in construction include selective demolition, urban mining, recycled aggregate production, and eco-design (Caldera et al., 2020; Su et al., 2023). Evidence shows that CE can reduce CDW by 30–50%, lower emissions, and create new economic opportunities (Ginga et al., 2020; Jauhar et al., 2023).

3.3. Green Building Rating Systems and GPRS

Parallel research has focused on green building rating systems—such as LEED, BREEAM, and regionally adapted frameworks like the Green Pyramid Rating System (GPRS) which enhance project-level sustainability performance (Tebbouche et al., 2017; Merzouk et al., 2025). These systems promote responsible material selection, energy efficiency, indoor environmental quality, and integrated waste management. Developed in Egypt, GPRS is particularly suited to MENA climatic and socio-environmental conditions (Saidi et al., 2023). Adoption, however, depends on regulatory support, incentives, and professional awareness (Olawumi & Chan, 2022).

3.4. Environmental Implications and the Algerian Context

In Algeria, the construction sector accounts for roughly 31% of national greenhouse gas emissions. Valorisation studies show that reusing construction-derived materials in infrastructure (e.g., road subgrades) can reduce energy consumption by up to 40% and GHG emissions by about 28% (Saeed et al., 2023; Su et al., 2023). These findings highlight both the environmental burden of current CDW practices and the potential benefits of adopting CE-based strategies and structured recycling systems.

3.5. The Intersection of CE and GPRS

Although the literature recognises the importance of CE and green rating systems, these frameworks are rarely examined together, especially in developing contexts such as Algeria. This gap creates uncertainty about how CE and GPRS may complement each other in addressing CDW challenges at macro and micro levels (Wu et al., 2024; Caldera et al., 2020).

Consequently, the present study aims to comparatively analyse CE and GPRS within the Algerian construction context and assess their respective advantages, limitations, and potential synergies (Merzouk et al., 2025; Saidi et al., 2023).

3.6 Research Gap

Despite extensive global literature on CE-based waste reduction and green building rating systems, three gaps remain evident:

- Lack of integrated studies examining CE and GPRS together as complementary frameworks for CDW management in developing contexts.
- Limited empirical research on adapting CE principles and GPRS criteria to Algeria's regulatory, economic, and institutional environment.
- Scarce expert-based evidence assessing the feasibility and operational integration of CE and GPRS within Algeria.

This gap is critical given Algeria's growing interest in sustainable construction practices.

3.7. Contribution of the Study

3.7.1. Theoretical Contribution

The study provides one of the first comparative analytical frameworks linking the Circular Economy (CE) with the Green Pyramid Rating System (GPRS) in the context of CDW management. Its originality lies in:

- Conceptually bridging CE and GPRS to demonstrate complementarity between macro-level circularity and micro-level building sustainability.
- Introducing a dual-level analytical model where CE informs national waste flows, while GPRS operationalises sustainability at project level.
- Offering a structured SWOT-based synthesis that highlights synergies, gaps, and potential conflicts between the frameworks.

This represents a significant theoretical contribution for sustainability research in Algeria and the broader MENA region.

3.7.2. Practical / Applied Contribution

The study generates actionable insights for policymakers, engineers, architects, and environmental agencies by:

Providing a policy-oriented interpretation of CE and GPRS tailored to Algeria's context.

- Developing a hybrid CE–GPRS roadmap for integrating material circularity with building rating requirements.
- Designing a decision-support matrix to evaluate the applicability of CE strategies and GPRS categories in various construction scenarios.
- Offering expert-informed recommendations that reflect local constraints, market realities, and institutional capacities.

3.7.3. Conceptual Framework (Integrated Model)

The study introduces an integrated CE–GPRS conceptual model that:

- Aligns national circularity strategies with project-level sustainability criteria.
- Supports the transition to selective demolition, material recovery, and responsible construction practices.
- Provides coherence between macro-level regulatory reforms and micro-level implementation tools.
- Creates a foundation for an evidence-based national strategy for CDW management.

4. The Results

Case Study: Evolution, Regulatory Framework, and Current Realities of CDW Management in Algeria

Algeria has undergone major socio-economic transformations over recent decades, characterised by rapid urban expansion, large infrastructure projects, and growing demand for housing and public services. These developments have led to a sharp rise in construction and demolition waste (CDW), now recognised as one of the country's most pressing environmental challenges. The trajectory of CDW generation has been shaped by demographic pressures, economic reforms, institutional changes, and shifting national development priorities (Saidi et al., 2023; Merzouk et al., 2025).

4.1 Evolution of CDW Generation in Algeria

Algeria has undergone significant socio-economic transformation over recent decades, characterised by rapid urban expansion, major infrastructure projects, and increased demand for housing and public services. These developments have contributed to a notable rise in construction and demolition waste (CDW), now recognised as one of the country's most pressing environmental challenges (Saidi et al., 2023; Merzouk et al., 2025). The evolution of CDW management has been influenced by demographic growth, economic reforms, and shifts in national development priorities.

The trajectory of CDW production is closely linked to Algeria's development phases. During the post-independence reconstruction period, construction activities intensified to address housing shortages and deteriorated infrastructure. Between the 1980s and early 2000s, large public investment programmes—particularly in housing, transport, and public facilities—generated substantial CDW. However, these construction booms were not accompanied by advances in selective demolition, recycling, or material recovery practices (Tebbouche et al., 2017; Saidi et al., 2023).

Current estimates indicate that Algeria produces 8–12 million tonnes of CDW annually, representing nearly 30% of the national solid waste stream (Merzouk et al., 2025). Most CDW is disposed of in open dumps or mixed with municipal waste due to limited sorting platforms, weak enforcement, and the absence of dedicated recycling facilities. Broader waste studies show that only around 7% of municipal waste is recycled nationally, suggesting equally limited CDW recovery rates (Saidi et al., 2023).

From an environmental perspective, the construction sector contributes approximately 31% of Algeria's greenhouse gas emissions. Research also shows that reusing mineral waste in infrastructure (e.g., road subgrades) could reduce energy consumption by up to 40% and GHG emissions by roughly 28% (Merzouk et al., 2025). These findings highlight both the environmental burden of current CDW practices and the untapped opportunities associated with circular material use.

Overall, the literature underscores the urgent need for structured CDW management and demonstrates the relevance of adopting Circular Economy strategies and project-level sustainability tools—such as GPRS—to improve waste recovery and reduce environmental impacts in Algeria (Ginga et al., 2020; Soyinka et al., 2023; Wu et al., 2024).

Recent assessments indicate that Algeria generates 8–12 million tonnes of CDW each year, accounting for nearly 30% of national solid waste (Soyinka et al., 2023). This volume continues to rise due to ongoing housing programmes, industrial expansion, and urban rehabilitation. However, most CDW is still disposed of in open dumps or mixed with municipal waste, highlighting persistent gaps in governance, enforcement, and recycling infrastructure (Zhao et al., 2022; Caldera et al., 2020).

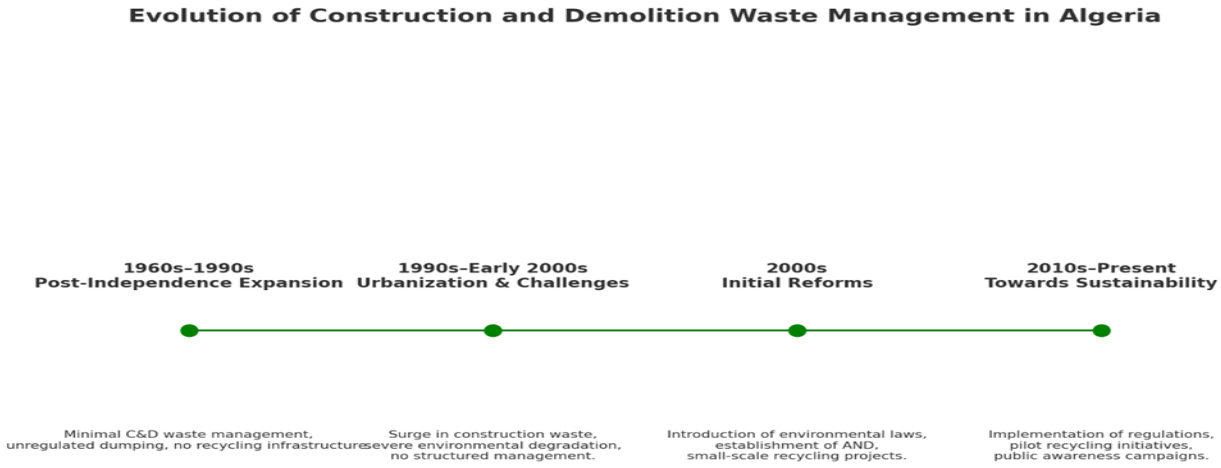

Figure 1. Evolution of Construction and Demolition Waste Management in Algeria, Author's field documentation (2025)

4.2 Regulatory and Institutional Framework

Recent estimates indicate that Algeria produces between 8 and 12 million tonnes of CDW annually, representing nearly 30% of national solid waste (Soyinka et al., 2023; Merzouk et al., 2025). This volume continues to rise due to ongoing housing programmes, industrial expansion, and the rehabilitation of ageing structures. However, most CDW is still disposed of in open dumps or mixed with municipal waste, reflecting persistent gaps in governance, selective demolition, and recycling capacity (Zhao et al., 2022; Ginga et al., 2020; Caldera et al., 2020).

The national approach to waste management has gradually evolved towards more structured systems. Law 01-19 (2001) established the legal foundation for environmental protection and waste management, emphasising prevention, reduction, and recycling. The creation of the National Waste Agency (AND) strengthened this framework by assigning institutional responsibility for planning, monitoring, and coordinating waste-management activities (Saidi et al., 2023).

4.3 Current Challenges in CDW Management

Experts identified several recurring obstacles that limit Algeria's ability to adopt sustainable CDW management systems.

First, Algeria lacks adequate sorting platforms, recycling stations, and selective demolition facilities. Contractors rarely recover valuable materials such as concrete, steel, wood, or bricks because the national market for recycled construction products remains underdeveloped.

Second, weak enforcement of environmental regulations allows illegal dumping and inconsistent compliance with waste-related obligations. Many small and medium construction firms do not implement structured waste plans or record disposal quantities.

Third, awareness of sustainable construction practices remains limited. Engineers, site managers, and local authorities often prioritize cost reduction over environmental performance, which prevents the adoption of circular approaches or green certification requirements.

High levels of informality in the sector also contribute to unregulated practices, as many temporary or undocumented workers lack training in sustainable waste handling.

4.4 Relevance to CE and GPRS Implementation

Algeria's construction industry contains both constraints and opportunities for introducing Circular Economy (CE) principles and the Green Pyramid Rating System (GPRS).

Experts emphasised that the absence of standardised waste protocols, combined with insufficient recycling infrastructure, limits the country's capacity to apply CE strategies at scale. However, they also noted that Algeria's large construction market and ongoing modernisation projects offer strong potential for circular material practices, selective demolition, and the development of recycled-material industries.

At the same time, GPRS provides structured criteria that align with Algeria's sustainability priorities. These criteria—such as waste management plans, material efficiency, and energy and water conservation—can guide construction projects towards better environmental performance. Experts indicated that adopting GPRS in Algeria could establish the foundation for a broader transition towards CE principles at both project and national levels.

5. Findings

The findings address the research questions that guide this study. The analysis integrates expert insights, literature findings, and contextual evidence from the Algerian case study. This section presents results related to the comparative and integrative potential of the Circular Economy (CE) and the Green Pyramid Rating System (GPRS) for improving CDW management in Algeria.

5.1 Advantages of CE in the Algerian Context

Experts consistently identified CE as a promising model for managing CDW in Algeria.

Sixteen of the twenty-one experts indicated that CE promotes material reuse, recycling, and lifecycle planning, thereby reducing CDW generation and improving resource efficiency. They emphasised CE's potential to support selective demolition, material recovery, and urban mining practices that could be progressively implemented in Algeria as infrastructure and market conditions improve.

Experts also underscored the economic benefits of CE. They noted that circular strategies can stimulate new recycling industries, create green jobs, and lessen dependence on imported raw materials. Given the rapid growth of Algeria's construction sector, the experts agreed that the country is well positioned to develop small- and medium-scale enterprises specialising in material recovery and recycling services.

Environmental benefits emerged as another major theme in expert responses. Experts observed that CE could reduce pressure on landfills, limit illegal dumping, and decrease emissions associated with raw material extraction and waste transport. They linked CE-based strategies to improved environmental protection and enhanced urban conditions.

5.1.1 Limitations and Barriers to CE Adoption

Although CE presents clear advantages, experts also identified several obstacles to its application in Algeria.

Experts consistently highlighted the lack of CDW recycling infrastructure across Algerian cities. Most areas do not have dedicated sorting platforms or crushing facilities, which prevents contractors from recovering valuable materials such as concrete, bricks, and metals. Transporting waste to distant facilities increases operational costs and further discourages recycling.

Financial barriers also constrain CE implementation. Many construction companies—particularly SMEs—cannot afford investments in selective demolition, material recovery equipment, or circular technologies without financial support. Respondents stressed that the absence of subsidies, tax incentives, or dedicated grant schemes significantly limits the adoption of CE practices.

Institutional challenges add an additional layer of complexity. Experts pointed to regulatory gaps, inconsistent enforcement, and unclear distribution of responsibilities between municipalities, private contractors, and environmental agencies. These weaknesses reduce accountability and hinder progress towards circular construction practices.

Finally, cultural preferences for new materials, coupled with limited awareness of the benefits of recycled products, continue to inhibit the transition to CE-based approaches.

5.2 Strengths of GPRS in the Algerian Construction Sector

Experts recognized GPRS as a structured and practical sustainability framework with several advantages.

Experts agreed that GPRS provides clear and structured criteria for waste management, material selection, and environmental performance. These guidelines can help project teams reduce, sort, and properly manage CDW. As one expert stated, "GPRS gives designers and contractors a checklist—finally something concrete to follow" (Expert 8).

They also highlighted that GPRS promotes resource efficiency through requirements for recycled materials, efficient water systems, and energy-conscious design choices. These measures indirectly reduce CDW by improving material planning and construction methods

Several experts commented on the market advantages of GPRS certification, noting that certified buildings tend to achieve higher value and stronger investor confidence. One respondent mentioned, "A GPRS certificate signals quality; it attracts clients and investors" (Expert 16).

5.2.1 Weaknesses and Barriers to GPRS Implementation

The experts identified several weaknesses that may limit the adoption of GPRS in Algeria. Most respondents stated that GPRS remains relatively unknown among Algerian engineers, contractors, and developers. As one expert explained, "Most professionals here have never even heard of GPRS" (Expert 9). This limited awareness prevents practitioners from integrating rating criteria during the design and execution phases.

Experts also noted that the certification process can be complex and costly. In the absence of government incentives, many companies are unlikely to pursue certification voluntarily. One participant emphasised this point, noting that "No contractor will pay for certification unless the state provides financial support" (Expert 12). Small and medium-sized enterprises, in particular, perceive the process as financially unfeasible.

Furthermore, experts highlighted that international systems such as LEED and BREEAM remain more widely recognised than GPRS, especially among multinational firms. As another expert remarked, "Large companies prefer LEED because investors know it—GPRS is almost invisible in the market" (Expert 16). This lack of visibility reduces GPRS uptake and slows its integration within Algeria's competitive construction sector.

5.3 Comparative Insights between CE and GPRS

The comparative analysis reveals distinct but complementary characteristics. Experts explained that CE operates at the macro level by transforming supply chains, material flows, and industrial practices. As one interviewee noted, "CE works on the national system; it changes how materials move across the whole sector" (Expert 6). In contrast, GPRS functions at the project scale and provides practical criteria for sustainable building design, construction, and waste management. Another participant stated, "GPRS tells you exactly what to do at the project level—materials, waste plans, efficiency measures" (Expert 12).

Experts also emphasised that CE delivers long-term environmental and economic benefits through system-wide changes. As one expert explained, "CE takes time, but once it is in place, it transforms the whole construction value chain" (Expert 3). Meanwhile, GPRS offers more immediate improvements at the project level by guiding architecture, engineering, and construction practices towards

sustainability. One respondent highlighted this difference, noting that "GPRS gives quick, measurable improvements on site, even if the larger system is not yet circular" (Expert 17).

Although CE requires advanced infrastructure and strong institutional coordination, GPRS depends on professional training, market incentives, and policy support. As one expert summarised, "CE needs infrastructure; GPRS needs capacity. They are different but they complete each other" (Expert 20). These differences highlight their complementary nature rather than a competitive relationship.

5.3.1 Integration Opportunities

Experts identified multiple opportunities for aligning CE principles with GPRS criteria.

The majority of experts (17 out of 21) believe that GPRS can serve as a platform for embedding CE strategies at the project level. They explained that CE principles such as design for disassembly, recycled content and material loops could integrate naturally into GPRS material and waste categories.

Experts also emphasized that GPRS-certified projects can act as demonstration cases for broader national circular transitions. These projects can test, document, and refine CE-oriented practices, eventually scaling them to the national level.

Finally, respondents stressed that a hybrid CE–GPRS model can help Algeria bridge its institutional gaps by combining systemic goals (CE) with operational tools (GPRS). This integration reflects a strong consensus among experts and aligns with global sustainability trends.

Table 1. Decision-Support table for CE–GPRS Integration in CDW Management in Algeria. (Table created by authors (2025)

Lifecycle Stage	Relevant CE Strategies (Macro Level)	Relevant GPRS Criteria (Micro Level)	Feasibility in Algeria	Priority Actions	Expected Impact
Design Phase	Eco-design; design for disassembly; modularity; selection of recyclable materials.	Sustainable material selection; durability; GPRS Material Credits.	Medium (limited awareness among architects).	Training programmes; national design guidelines; incentives for recycled materials.	Reduced CDW at source; improved material efficiency.
Construction Phase	Waste minimisation; selective demolition planning; on-site segregation.	Construction waste management plan; site practices; storage and recycling requirements.	Medium–High (feasible if enforced).	Mandate GPRS-aligned site-waste plans; monitoring tools.	Higher recycling rates; reduced landfill disposal.
Material Procurement	Industrial symbiosis; recycled aggregates; local supply chains.	Credits for local materials; high-recycled-content products.	Low–Medium (due to weak recycling market).	Develop Algerian recycling industries; require recycled-content benchmarks.	Market development for recycled materials.
Operation & Maintenance	Lifecycle extension; repair & reuse networks.	Energy & water efficiency credits; performance audits.	High (policy-ready).	Promote GPRS in public buildings; establish CE repair/refurbishment services.	Sustainable building operation.
End-of-Life / Demolition	Urban mining; reverse logistics; material recovery.	Waste diversion, salvage & reuse credits.	Medium (requires regulation).	Create CDW sorting hubs; enforce demolition audits.	Maximised recovery of CDW materials.

This table operationalises the proposed framework by offering a structured reference for decision-making in the Algerian construction context. It helps stakeholders evaluate which CE strategies and GPRS performance categories are most applicable for enhancing waste reduction, material recovery, and sustainable construction practices.

5.4 SWOT Analysis of CE and GPRS implementation in the Algerian Construction Sector

This section synthesises insights from the literature review, expert interviews, and the Algerian case study through a structured SWOT analysis. Its purpose is to present a consolidated view of the internal strengths and weaknesses of the Circular Economy (CE) and the Green Pyramid Rating System (GPRS), as well as the external opportunities and threats shaping their implementation in Algeria. This integrated SWOT provides a clear basis for the comparative evaluation and informs the subsequent recommendations.

Table 2. SWOT Analysis table of CE and GPRS implementation in the Algerian Construction Sector. (Created by authors (2025)

Category	Circular Economy (CE)	Green Pyramid Rating System (GPRS)
Strengths	• Promotes resource efficiency and minimization of CDW. • Aligns with global sustainability transitions and low-carbon agendas. • Stimulates local recycling industries and green job creation. • Encourages systemic, long-term transformation of construction practices.	• Provides structured, measurable sustainability criteria at project level. • Enhances energy and water efficiency. • Improves building performance and market value. • Includes waste management requirements adaptable to MENA conditions.
Weaknesses	• Limited national recycling infrastructure and selective demolition capacity. • High initial investment costs for CE technologies. • Fragmented governance and weak enforcement mechanisms. • Low awareness among contractors and limited availability of recycled materials.	• Limited national recognition and low practitioner familiarity. • Complex and sometimes costly certification procedures. • Competition from international systems (LEED, BREEAM). • Insufficient national incentives and lack of trained auditors.
Opportunities	• Potential for international funding for circular construction initiatives. • Growing demand for recycling industries and material recovery. • Increasing public interest in environmental sustainability. • Alignment with national goals to modernize the construction sector.	• Government interest in sustainable construction and energy efficiency. • Potential to localize and adapt GPRS to Algeria's climatic and socio-economic context. • Increasing awareness of green buildings and environmental performance. • Opportunity to integrate GPRS into public procurement policies.
Threats	• Economic instability may hinder investment in CE infrastructure. • Resistance from traditional construction practices and informal sector. • Absence of a robust supply chain for recycled materials. • Risk of slow policy implementation.	• Low demand for certification due to weak regulations. • Limited institutional support for sustainability assessment tools. • High reliance on international systems reduces GPRS adoption. • Risk of stagnation without trained professionals and national mandates.

5.5 Interpretation of the SWOT Results

The SWOT analysis highlights that CE and GPRS operate at different yet complementary levels:

- CE provides a macro-level, systemic transformation pathway by addressing national policies, resource flows, and industrial practices.
- GPRS offers a micro-level, operational tool for improving sustainability at the building and project scale.

Their strengths reinforce one another: CE creates the structural conditions needed for material circularity, while GPRS provides measurable performance criteria that help operationalise these principles.

The main weaknesses—such as limited infrastructure, weak enforcement, and low awareness—underscore the need for national capacity-building, financial incentives, and regulatory reforms.

Both systems also present significant opportunities in Algeria's current context, especially with growing attention to sustainability issues and emerging market demands.

However, several external threats may hinder adoption, including economic constraints, resistance to change, and competition from global rating systems. These risks highlight the importance of strong policy support to ensure effective implementation.

The SWOT analysis demonstrates that CE and GPRS operate at different but highly complementary scales. CE enables systemic, nationwide transformation by reshaping resource flows and waste generation patterns. In contrast, GPRS provides operational tools that guide sustainability performance at the building and project level.

A dual CE–GPRS strategy can therefore address both macro-level and micro-level challenges. CE can support national goals for circularity and waste reduction, while GPRS can institutionalise sustainable practices within individual projects.

6. Discussion, Limitations.

6.1 Discussion

This study examined the applicability of Circular Economy (CE) principles and the Green Pyramid Rating System (GPRS) as complementary frameworks for improving construction and demolition waste (CDW) management in Algeria. The discussion interprets the findings in relation to the research objectives and the existing literature, while integrating perspectives from 21 experts working in engineering, environmental management, and policy sectors. Overall, the results show that Algeria is at a pivotal stage in its transition towards sustainable construction, and that both CE and GPRS offer valuable—but distinct—pathways for supporting this transformation.

6.1.1 CE as a Driver of Systemic Waste Reduction

Sixteen experts (out of 21) agreed that CE promotes material reuse, recycling, and lifecycle planning, helping to reduce CDW generation and improve resource efficiency. They highlighted CE's capacity to support selective demolition, material recovery, and urban mining—practices that Algeria could adopt progressively as supportive infrastructure develops.

Representative quotations include:

- "CE pushes us to recover materials instead of wasting them." (Expert 4)
- "Selective demolition should become the norm; CE gives us the framework." (Expert 11)

There was strong consensus regarding CE's environmental value, and no experts expressed disagreement about its relevance for reducing waste.

6.1.2 GPRS as a Tool for Operationalizing Sustainability at Project Level

Consistent with the literature, experts highlighted that green building rating systems such as GPRS offer structured and measurable tools for integrating sustainability into construction projects. GPRS emphasises material selection, indoor environmental quality, and waste management, aligning with key dimensions of sustainable construction. The experts agreed that GPRS could help standardise environmental performance, particularly in relation to project-level waste minimisation.

However, a recurring theme was the limited awareness and low adoption of GPRS among Algerian professionals. As one expert explained, "Most engineers and architects here have never heard of GPRS" (Expert 9). Several experts also stressed that government endorsement and financial incentives are needed to overcome market hesitancy and professional unfamiliarity. A minority of respondents expressed a preference for international systems such as LEED and BREEAM because of their stronger global recognition.

6.1.3 Complementarity between CE and GPRS

A central contribution of this study lies in demonstrating how CE and GPRS can complement each other within the Algerian context. CE provides a macro-level, system-wide pathway for transforming material flows, infrastructure, and regulatory incentives. In contrast, GPRS offers micro-level, project-based mechanisms through which sustainability can be operationalised.

Experts widely affirmed this complementarity. One expert observed, "CE addresses the national waste system; GPRS focuses on the project. They complete each other" (Expert 3). Another added, "Integrating CE principles into GPRS credits would strengthen both

frameworks" (Expert 20). These perspectives reinforce the literature's call for multi-scalar approaches that bridge national resource strategies with building-level performance tools.

6.1.4 Systemic Barriers to Implementation in Algeria

The discussion also reveals that neither CE nor GPRS alone can address all structural constraints in Algeria. CE requires well-developed regulatory frameworks, economic incentives, and recycling infrastructure, while GPRS depends on institutional endorsement, capacity building, and the adaptation of criteria to local conditions. Experts unanimously emphasised the lack of incentives and localised standards as major obstacles to adoption. One expert stated, "Contractors will not change their behaviour without financial benefits or obligations" (Expert 10). Another highlighted the absence of national material standards, noting, "We urgently need Algerian standards for recycled aggregates and eco-materials" (Expert 15).

6.1.5 Toward a Hybrid CE–GPRS Model for Algeria

Taken together, the findings support the development of a hybrid CE–GPRS model that combines systemic circularity with project-based sustainability certification. CE can establish national-level mechanisms such as recycling markets, selective demolition regulations, and extended producer responsibility (EPR) schemes. GPRS, in turn, can translate these priorities into building-level requirements related to waste segregation, recycled content, and environmental performance.

This integrated approach would enable Algeria to pursue long-term structural transformation while achieving measurable progress at the project level. It is consistent with emerging scholarship that advocates multi-layered sustainability strategies in developing countries, where infrastructure, policy, and professional capacity remain unevenly developed.

6.2 Limitations

While the study provides important insights, several limitations influence its generalisability and analytical scope. First, the qualitative expert sample, although diverse, is not statistically representative of the entire Algerian construction sector. Small contractors, informal builders, and local municipal waste operators may hold differing perspectives that are not captured in this study.

Second, the study does not include quantitative measurements of CDW flows or technical assessments of recycling infrastructure. Such data would enhance understanding of the operational and technological requirements for CE implementation.

Third, the focus on CE and GPRS—while necessary for depth—excludes other green certification systems (e.g., LEED, BREEAM, EDGE) that may also influence Algeria's sustainability landscape.Despite these limitations, the study offers a robust foundation for understanding CE–GPRS integration in Algeria's construction sector.

7. Conclusion & Recommendations

7.1. Conclusion:

- This study examined the contribution of the Circular Economy (CE) and the Green Pyramid Rating System (GPRS) to construction and demolition waste (CDW) management in Algeria by integrating expert perspectives, literature evidence, and contextual analysis. The findings show that CE provides a long-term transformative framework capable of reshaping material flows, supporting selective demolition, and encouraging the development of recycling industries, although its implementation remains constrained by limited infrastructure, financial barriers, and regulatory weaknesses.
- GPRS, in contrast, offers structured and measurable project-level criteria that can guide waste reduction, resource efficiency, and improved design performance. However, its adoption is hindered by low awareness, insufficient incentives, and the perceived complexity and cost of certification.
- The comparative analysis demonstrates that CE and GPRS function at different but complementary scales. CE supports systemic, national-level transition, whereas GPRS enables operational improvements at the building level. Integrating both frameworks can therefore create a coherent model linking macro-level circularity goals with micro-level project certification.
- The study concludes that Algeria can strengthen CDW management by adopting a dual CE–GPRS approach. Policymakers should promote CE principles through regulatory and economic instruments, while the construction sector incorporates GPRS criteria into project development. Implementing this combined model will require institutional coordination, investment in infrastructure, and capacity building. With these conditions in place, Algeria can make measurable progress toward circular and sustainable construction practices.

7.2. Recommendations for Future Research

a. Future studies should broaden the expert sample to include contractors, building inspectors, recycling operators, and municipal waste authorities to capture more diverse operational realities.

b. Quantitative material flow analyses (MFA), CDW audits, and spatial mapping of waste streams are recommended to support evidence-based policy design and infrastructure planning. Such data would help determine recycling feasibility, market potential, and the environmental benefits of CE interventions.

c. Pilot projects that test CE–GPRS integration in public housing, infrastructure developments, or university campuses would provide practical evidence for feasibility and cost-effectiveness. Comparative studies examining GPRS alongside international systems such as LEED and BREEAM could also guide Algeria in selecting or adapting a national certification strategy.

References

- Aryee, R. (2024). Conceptualising the circular ecosystem: An analysis of multiple definitions. Business Strategy & Development, 7(4), e70050. https://doi.org/10.1002/bsd2.70050
- Caldera, S., Ryley, T., & Zatyko, N. (2020). Enablers and barriers for creating a marketplace for construction and demolition waste: A systematic literature review. Sustainability, 12(23), 9931. https://doi.org/10.3390/su12239931
- Çetin, S., De Wolf, C., & Bocken, N. (2021). Circular digital built environment: An emerging framework. Sustainability, 13(11), 6348. https://doi.org/10.3390/su13116348
- Ebekozien, A., Thwala, W. D., & Samsurijan, M. S. (2025). Appraising circular economy business model adoption in construction projects to achieve Sustainable Development Goal 11. International Journal of Building Pathology and Adaptation. https://doi.org/10.1108/IJBPA-06-2023-0111
- Ginga, C. P., Ongpeng, J. M. C., & Daly, M. K. M. (2020). Circular economy on construction and demolition waste: A literature review on material recovery and production. Materials, 13(13), 2970. https://doi.org/10.3390/ma13132970
- Jauhar, S., Pratap, S., Paul, S., & Gunasekaran, A. (2023). Internet of things-based innovative solutions and emerging research clusters in circular economy. Operations Management Research, 16, 1968–1988. https://doi.org/10.1007/s12063-022-00314-4
- Merzouk, M., Zhao, J., & Xu, Z. (2025). Sustainable building project management in Algeria: Challenges, strategies, and future directions. Buildings, 15(6), 883. https://doi.org/10.3390/buildings15060883
- Olawumi, T. O., & Chan, D. W. (2022). Cloud-based sustainability assessment (CSA) system for automating sustainability decision-making processes of built assets. Expert Systems with Applications, 188, 116020. https://doi.org/10.1016/j.eswa.2021.116020
- Saeed, F., Mostafa, K., Rausch, C., & Hegazy, T. (2023). Environmental impact and cost assessment for reusing waste during end-of-life activities in building projects. Journal of Construction Engineering and Management, 149(10), 04023099. https://doi.org/10.1061/(ASCE)CO.1943-7862.0002440
- Saidi, F. A., Phinzi, K., & Molnár, E. (2023). Urbanisation in Algeria: Toward a more balanced and sustainable urban network? Social Sciences, 12(3), 174. https://doi.org/10.3390/socsci12030174
- Soyinka, O. A., Wadu, M. J., Lebunu Hewage, U. W. A., & Oladinrin, T. O. (2023). Scientometric review of construction and demolition waste management: A global sustainability perspective. Environment, Development and Sustainability, 25(10), 10533–10565. https://doi.org/10.1007/s10668-022-02330-3
- Su, Y., Yao, Y., Wang, Y., Zhao, X., Li, L., & Zhang, J. (2023). Modification of recycled concrete aggregate and its use in concrete: An overview of research progress. Materials, 16(22), 7144. https://doi.org/10.3390/ma16227144
- Tebbouche, H., Bouchair, A., & Grimes, S. (2017). Towards an environmental approach for the sustainability of buildings in Algeria. Energy Procedia, 119, 98–110. https://doi.org/10.1016/j.egypro.2017.07.049
- Wu, H., Chen, R., Yuan, H., Yong, Q., Weng, X., Zuo, J., & Zillante, G. (2024). An evaluation model for city-scale construction and demolition waste management effectiveness: A case study in China. Waste Management, 182, 284–298. https://doi.org/10.1016/j.wasman.2023.10.004
- Zhao, X., Webber, R., Kalutara, P., Browne, W., & Pienaar, J. (2022). Construction and demolition waste management in Australia: A mini-review. Waste Management & Research, 40(1), 34–46. https://doi.org/10.1177/0734242X211067180
- Zheng, X., Sun, Q., Jing, X., Yang, D., & Jia, H. (2023). Evolution of pore structure and radon exhalation characterisation of porous media grouting. Science of the Total Environment, 865, 161352. https://doi.org/10.1016/j.scitotenv.2022.161352