

RECYCLING STARTUPS IN THE CIRCULAR ECONOMY TO MITIGATE ENVIRONMENTAL IMPACT: THE CASE OF ECUADOR

Startups de reciclaje en la economía circular para mitigar el impacto ambiental:

Caso Ecuador

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Como citar:

Lovato Torres, S. G., Saltos Santana, G., Coronel Pérez, V. C., & Pozo Benites, K. B. (2026). Startups de reciclaje en la economía circular para mitigar el impacto ambiental: Caso Ecuador. *Revista Internacional de Investigación y Desarrollo Global (RIIDG)*, 5(3), 1-19. <https://doi.org/10.64041/riidg.v5i3.71>

V. 5, N. 3, Año (2026), Pág. 1-19

Fecha de recepción: 15 de mayo de 2026

Fecha de aceptación: 27 de julio de 2026

Fecha de publicación: 27 de julio de 2026

Abstract

The objective of this study is to analyze the role of recycling startups as emerging agents of the circular economy within the Ecuadorian context, from the perspective of solid waste management to mitigate environmental impact. To this end, a qualitative research paradigm with an exploratory and descriptive approach was adopted, developed in two phases: a systematic PRISMA literature review and semi-structured interviews with experts in the field of the circular economy, such as entrepreneurs and academics. Innovative business models, barriers and opportunities for green entrepreneurs, the current state of institutional coordination, and the situation of informal recyclers in terms of labor and social inclusion were identified. The results reveal that startups contribute to waste reduction and job creation, but a regulatory framework must be established to ensure institutional coordination. In addition, the importance of informal recyclers as key players in the recycling value chain is highlighted. It is concluded that startups are catalysts for the transition to the circular economy, but their business model requires strategic alliances with the government and universities to mitigate financial and operational risk, as well as ensuring sustainability through public policies and local innovation.

Keywords: circular economy, recycling startups, waste management.

Resumen

El objetivo de este estudio es analizar el rol de los startups de reciclaje como agentes emergentes de economía circular dentro del contexto ecuatoriano, desde la perspectiva de la gestión de residuos sólidos para mitigar el impacto ambiental. Para esto, se acogió el paradigma cualitativo de investigación con un enfoque exploratorio y descriptivo desarrollado en dos fases, una revisión sistemática PRISMA de literatura y entrevistas semiestructuradas a expertos en el ámbito de la economía circular, como emprendedores y académicos. Se identificaron modelos de negocio innovadores, las barreras y oportunidades del emprendedor verde, el estado actual de la articulación institucional, y la situación de los recicladores informales en la inclusión laboral y social. Los resultados revelan que, los startups contribuyen a la reducción de residuos y generación de empleo, pero es preciso establecer un marco regulatorio para garantizar su articulación institucional. Además, se destaca la importancia de los recicladores informales, como actores clave en la cadena de valor del reciclaje. Se concluye que los startups son agentes catalizadores para la transición hacia la economía circular pero su modelo de negocio requiere de alianzas estratégicas con el gobierno y universidades para mitigar el riesgo financiero y operativo, además de asegurar la sostenibilidad mediante políticas públicas e innovación local.

Palabras clave: economía circular, gestión de residuos, startups de reciclaje.

Introduction

Solid waste management is one of the major environmental and social challenges worldwide, particularly in developing regions such as Latin America, where only a few countries have implemented effective recycling systems. Waste generation in Latin America and the Caribbean continues to show an increasing trend, reaching approximately 541,000 tons per day, while recycling rates remain low, below 20% (ECLAC, 2018). Specifically, in Ecuador, solid waste generation reaches 14,000 tons per day, and only 16% is processed through effective recycling practices (Ministry of Environment, Water and Ecological Transition, 2024). The remainder is disposed of in open dumps, along roadsides, and in streams and rivers (Nieto-Cañarte et al., 2024). This situation, inherited from the linear economy model, directly impacts ecosystems and public health, represents a loss of recoverable resources, and constitutes a significant obstacle to both national and regional economic sustainability.

The need to accelerate the transition toward a circular economy is evident. This paradigm promotes waste prevention and the recovery of materials (ECLAC, 2022) while proposing the closure of production cycles through recycling, reuse, and the redesign of products and services (Kirchherr et al., 2017). This approach has attracted increasing attention within political and academic agendas across Latin America, particularly in Ecuador. However, its implementation faces structural challenges in both the public and private sectors, including fragmented public policies, informality in solid waste management, and limited innovation in business models (ECLAC, 2022; Ferreira et al., 2022).

In this context, recycling-oriented startups have emerged as key drivers of the circular economy due to their capacity for innovation and adaptability to societal needs and environmental conditions. Their potential to transform solid waste into valuable resources through the use of technology, digital platforms, and collaborative schemes involving society, government, and the private sector has been widely documented in the global literature (Tremblay et al., 2010; Xu et al., 2018). In Ecuador, although evidence exists regarding informal recycling practices (Hidalgo-Crespo, 2023), optimization of solid waste management (Nieto-Cañarte et al., 2024), and inter-municipal cooperation for integrated and sustainable waste management (Ferreira et al., 2022), the available research remains limited and fragmented. Furthermore, there is a need for a deeper understanding of the role of startups as agents of environmental and social change.

The rationale for this study lies in addressing the gap in the academic literature concerning green entrepreneurship in Latin American countries. Additionally, the study seeks to provide practical recommendations for policymakers, investors, and entrepreneurs. This research aligns with the Sustainable Development Goals (SDGs), particularly SDG 12, Responsible Consumption and Production, and SDG 13, Climate Action, as well as with the guidelines established by the United Nations Environment Programme and the Global Circular Economy Forum.

Within this framework, the main objective of this study is to analyze the role played by recycling-oriented startups in reducing environmental impacts within the Ecuadorian context. To achieve this objective, a systematic literature review and semi-structured interviews with startup managers were conducted. The specific objectives include identifying the sustainable business models implemented by these startups and recognizing the structural, cultural, and institutional barriers they face.

Litetarure Review

To present the theoretical framework supporting this study, the literature review is organized into four sections covering the concept of the circular economy in the Latin American context, solid waste management in Ecuador, recycling startups, and circular business models.

Circular Economy in the Latin American Context

Over the last decade, the concept of the circular economy has attracted growing interest among academics and professionals as a response to the environmental crisis and the depletion of natural resources. However, only 7.2% of the global economy is currently circular, a situation that continues to worsen each year due to population growth. Over the past 50 years, the global population has doubled, while the extraction of natural resources has tripled (Fraser et al., 2023). This dynamic stems from the linear economic model, based on the extract–produce–use–dispose scheme, which has generated critical consequences such as high levels of pollution and irreversible biodiversity loss. In this regard, it can be argued that circularity decreases as the overall global rate of natural resource extraction increases.

The circular economy is a systemic approach that seeks to maximize the efficient and sustainable use of resources throughout their life cycle through the regeneration of natural

systems and the maximization of material value in order to reduce waste (Geissdoerfer et al., 2017). This approach implies a paradigm shift in the way goods are produced and consumed, moving toward a more regenerative and efficient system. Its philosophy is based on the principles of using less, using longer, producing cleaner, and reusing materials, thereby promoting more efficient and sustainable waste management to mitigate environmental impacts and strengthen economic and social resilience (Fraser et al., 2023).

In Latin America, the implementation of the circular economy remains at an early stage. Approximately 52% of waste generated is organic and suitable for composting or anaerobic digestion, yet less than 5% is recovered. Furthermore, one-third of the waste stream consists of recyclable materials such as plastics, paper, and metals, but the regional recycling rate remains low at only 4.5% (Kaza et al., 2018). The authors highlight four major challenges for advancing the circular economy: increased investment in treatment infrastructure and source-separation systems; formal integration of waste pickers through cooperatives that provide decent working conditions; greater financial support to develop sustainable fee-based models; and reduced dependence on public subsidies.

Countries such as Ecuador face significant challenges in establishing a robust circular economy, mainly due to inefficient waste management, low recycling rates resulting from limited investment in modern waste treatment infrastructure, and an underdeveloped environmental culture among the population (ECLAC, 2022). Although Ecuador enacted the Comprehensive Waste Management Law in 2021 to promote the circular economy, municipalities still lack national guidelines for waste management, leading to fragmented practices that depend on local capacities. Notable initiatives include organized recycling programs in the major cities of Guayaquil and Quito.

Within the literature, Nieto-Cañarte et al. (2023) emphasized the need for comprehensive solid waste management strategies in rural areas of Ecuador. Likewise, Ferreira et al. (2022) highlighted the existence of a hierarchy of intermunicipal cooperation, where more advanced governance arrangements lead to better performance in solid waste management and environmental sustainability. In this regard, Ecuador demonstrates limited effectiveness in cooperative governance, although Jara-Samaniego et al. (2017) documented local efforts in composting and the valorization of specific waste streams, including construction waste (Cabrera & Velasco, 2022). Overall, the implementation of

the circular economy at the urban scale remains a marginal issue in the country.

Solid Waste Management in Ecuador

Efficient and sustainable waste management, guided by circular economy principles, involves reducing the extraction of virgin resources, replacing toxic materials with regenerative alternatives, extending material lifespans, and promoting the use of renewable energy instead of fossil fuels. Such practices not only prevent the excessive accumulation and disposal of waste but also contribute to reducing greenhouse gas emissions, air and water pollution, while enhancing material recovery and recycling, thereby closing resource and raw material loops (Fraser et al., 2023).

Globally, the management of urban and rural solid waste is recognized as a critical environmental issue, particularly in developing countries where its impacts on the environment, public health, and national economies are amplified by rapid population growth, inadequate waste management systems, high poverty levels, and insufficient governmental investment (Jara-Samaniego et al., 2017; Kaza et al., 2018).

In Latin America, according to World Bank estimates (2018), more than 20 million tons of solid waste are generated annually, with an average generation rate of approximately 1 kg per person per day. Most of this waste—around 69%—is disposed of without adequate control, while only 4.5% is recycled (Kaza et al., 2018). According to Ferreira et al. (2022), municipalities are the primary entities responsible for waste management. A few cities, such as Bogotá and Medellín, stand out for recycling approximately 15% of their waste, while countries such as Mexico and Argentina have explored biogas production from sanitary landfills. The authors recommend community-based participatory approaches in urban and semi-urban areas (Nieto-Cañarte et al., 2023).

In Ecuador, approximately 58,829 tons of waste are generated weekly across its 24 provinces, with 70% originating from urban areas concentrated in only ten cities nationwide (Negash et al., 2021). According to these authors, nearly 85% of waste is disposed of improperly, often as mixed waste streams that hinder classification and are ultimately sent to landfills. Conversely, only 15% of waste is properly separated and managed through differentiated collection systems (Ferreira et al., 2022; Negash et al., 2021). Studies reveal that municipal waste management systems remain inefficient due to weak administrative and financial frameworks (Hidalgo-Crespo et al., 2023), insufficient

infrastructure and the absence of national guidelines (Cabrera & Velasco, 2022).

From a practical perspective, Ecuador faces significant challenges in waste management. These include increasing public participation in proper waste separation, implementing appropriate disposal methods, and developing comprehensive national guidelines as a regulatory framework for municipal waste management (Cabrera & Velasco, 2022; Negash et al., 2021). From an academic perspective, although the negative impacts of poor waste management and the challenges faced by developing countries such as Ecuador have been extensively documented, there remains a need for further research on integrated management approaches that combine national policies with community participation.

Green Startups and Circular Business Models

It is projected that by 2050, global waste generation will significantly outpace population growth (Kaza et al., 2018). In this context, green startups provide innovative solutions to environmental challenges, often through the use of digital platforms and collaborative economy schemes (Lieder & Rashid, 2016). These enterprises are considered catalysts of the circular economy due to their adaptability, scalability, and strategic orientation, as well as their implementation of reuse, repair, recycling, and refurbishment strategies that keep resources in productive use for extended periods (Adhikari et al., 2023).

These emerging recycling companies contribute positively to society through waste management, resource recovery, and resource optimization, establishing recycling mechanisms that generate benefits at both microeconomic and macroeconomic levels (Adhikari et al., 2023). They also contribute to environmental preservation, as entrepreneurs often capitalize on ecological opportunities to create economic, environmental, and social value by integrating sustainability into their business models (Kuckertz et al., 2019).

Within the Latin American context, scholars have identified three major challenges faced by these enterprises. First, access to financing remains difficult, as investors are often reluctant to support sustainability-driven innovation projects due to their high costs, uncertain risks, and potentially marginal returns (Hammoda & Durst, 2024). Second, market readiness remains limited, as consumers are often unfamiliar with recycling services and products derived from recycled materials. Consequently, consumption habits and cultural barriers must be considered when designing viable solutions that combine

economic incentives, education, and accessible technologies. Finally, raw material volatility and price fluctuations are critical factors influencing the economic viability of these ventures (Hidalgo-Crespo et al., 2023).

In Ecuador, recycling entrepreneurship has demonstrated significant progress in both social and technological innovation. Research has shown that hydrogen fuel can be produced from solid waste and may substantially contribute to meeting the energy demands of urban transportation systems (Posso et al., 2019). Likewise, compost derived from waste materials can be used as a growth medium for horticultural seedlings, transforming an environmental problem into a strategy for sustainability and cost reduction in agriculture (Jara-Samaniego et al., 2017). Nevertheless, the authors concluded that the scalability and replicability of these initiatives remain constrained by the lack of viable and sustainable business models.

International organizations such as the Organization for Economic Co-operation and Development (OECD, 2024), the World Economic Forum (WEF, 2021), and the United Nations Environment Program (UNEP, 2021) have emphasized the need to create favorable ecosystems for these startups through green financing mechanisms and stronger collaboration between the public and private sectors. They have also highlighted the importance of supporting these ventures, which promote the circular economy and serve as a key pillar of the ecological transition.

Methodology

To investigate this emerging social phenomenon concerning the role of recycling startups in mitigating environmental impacts, this study adopted a qualitative research paradigm with an exploratory and descriptive scope, given the limited research available on this topic within the Ecuadorian context. According to Merriam and Tisdell (2016), when the objective is to generate knowledge in contexts characterized by theoretical gaps and limited empirical evidence, qualitative inquiry provides an appropriate framework for understanding the meanings, practices, and experiences of the actors involved. Accordingly, the research was structured around two complementary components: a systematic literature review and the development of semi-structured interviews with experts operating within the recycling-oriented entrepreneurship ecosystem.

Systematic Literature Review

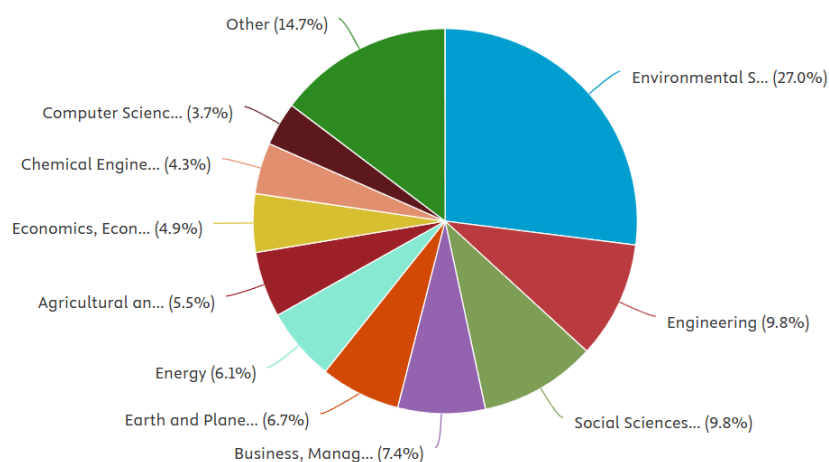
The literature review component was developed following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard, with the aim of addressing the research question: What is the impact of recycling startups on the circular economy in the context of Ecuador? The PICO eligibility criteria were established as follows: Population refers to recyclers, Intervention corresponds to recycling startups, Comparison involves traditional models, and Outcomes include environmental and economic metrics.

For the systematic search, the databases Scopus and the ScienceDirect platform were used, covering the period from 2015 to 2025. Search strategies were applied using Boolean operators to generate combinations of keywords such as: "recycling" and "circular economy". Subsequently, the search was refined by adding the keywords "startups" and "Ecuador". ((TITLE-ABS-KEY("waste management") OR TITLE-ABS-KEY("domestic solid waste") OR TITLE-ABS-KEY("waste sorting") OR TITLE-ABS-KEY("waste pickers")) AND TITLE-ABS-KEY(startups)) AND PUBYEAR > 2014 AND PUBYEAR < 2026

The filtering process, without considering the keyword “startups”, yielded 2,012 documents, which were used for the development of the theoretical framework. Subsequently, when the keyword was included, 80 documents were obtained and selected for an in-depth review, prioritizing the Latin American and Ecuadorian contexts. Among them, studies developed by Ecuadorian universities were included, addressing topics such as construction waste (Cabrera & Velasco, 2022), community composting (Jara Samaniego et al., 2017), waste-derived hydrogen (Posso et al., 2019), and intermunicipal cooperation for waste management (Ferreira et al., 2022).

The concept of circular economy shows a growing trend, with 2024 being the year of the highest scientific production, while the countries with the greatest documented evidence are Italy, China, India, and Spain. The insertion of startups into the circular economy is perceived as an emerging topic; however, over the last decade, it has gained increasing interest among academics and professionals from different fields of knowledge. Environmental Sciences, Engineering, and Social Sciences account for 50% of the contributions, as shown in Figure 1.

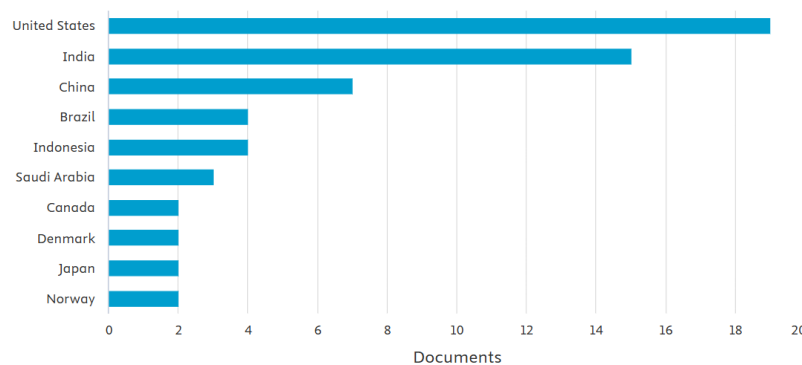
Figure 1: Documents by field of knowledge during the period 2015–2025



Source: Adapted from the analysis of search results obtained from the Scopus platform. Search was conducted in June 2025.

The countries with the greatest interest in waste management and the highest contribution are the United States, India, China, and Brazil, accounting for 56% of the published documents, as shown in Figure 2.

Figure 2: Documents published by country or territory during the period 2015–2025.



Source: Taken from the analysis of search results obtained from the Scopus platform. Query was conducted in June 2025.

Expert Interviews

As a complementary phase to the literature review, three interviews were conducted with experts in the field of green entrepreneurship: two of them were leaders of recycling startups, and one was a researcher involved in projects related to recycling or the circular economy. Although thematic saturation was not reached to confirm the robustness of the identified patterns, an initial data collection was obtained, which will later be confirmed. The profile of the interviewees is as follows:

Interviewee E1, Executive Director of a non-profit organization focused on inclusive recycling at the Latin American level.

Interviewee E2, Founder of an electronic waste recycling company in Ecuador.

Interviewee E3, Researcher of a circular economy outreach project at a public university in Ecuador.

The interviews were conducted virtually under informed consent, ensuring anonymity in the treatment of the data. The duration ranged from 45 to 60 minutes, and they were conducted between April and June 2025, using an interview guide that included questions about the business model, perception of environmental impact, regulatory framework, financial and operational challenges, and the involvement of informal recyclers.

For data processing, three phases were carried out, beginning with preparation and coding, thematic synthesis, and interpretation and communication. The coding stage, which allowed the systematization of emerging categories and their support with findings from the literature, was performed using ATLAS.ti version 23 software.

Results and Discussion

After triangulating the thematic analysis of the interviews with the findings from the literature review, four key categories were extracted: circular economy business models, barriers and opportunities for green entrepreneurs, institutional coordination, and the inclusion of informal recyclers. These categories were validated by external researchers to ensure their reliability. Four key categories were extracted: circular economy business models, barriers and opportunities for green entrepreneurs, institutional coordination, and the inclusion of informal recyclers. These categories were validated by external researchers to ensure their reliability.

Circular Economy Business Models

The literature shows that circular economy business models represent the paradigm to

follow to reduce the environmental impact inherited from the traditional linear model of manufacturing-use-disposal, which leads to an imbalance between resource supply and demand. In this regard, the interviewees described different approaches adopted as strategies for waste management, such as selective collection and material recovery, as well as the digital platformization of the recycling value chain.

One interviewee stated: “Our service is mainly based on agreements with educational institutions from which we receive classified waste, mainly cardboard, paper, and plastic, for recovery and transformation. In addition, we work together with sponsoring companies and brands that finance campaigns to promote recycling and social awareness to expand impact and sustainability.” A similar proposal was theoretically presented by Lieder and Rashid (2016), who highlight the ability of green ventures to redesign value processes through innovative and sustainable solutions.

On the other hand, other ventures have developed technological solutions for recycling processes based on low-cost and high-impact approaches. As indicated by interviewee E2: “The business model is based on an on-demand service for electronic scrap recycling. We have a web portal that connects with the community and the business sector for the collection of electrical and electronic equipment from their homes. We extract and classify recyclable materials and export them to international companies.” This innovation is supported by studies conducted by Posso et al. (2019) and Penafiel et al. (2022), who demonstrated relevant technological efforts by entrepreneurs, although they lack scalability due to limited financing and cooperation alliances with local universities.

In this regard, interviewee E3, as a circular economy researcher, stated that “It is important to develop agreements between recycling startups and public universities because there is a large volume of waste of all kinds that can be used for recycling. In addition, we have highly qualified professional resources in the technological field, who can contribute with comprehensive solutions and provide benefits for both parties.”

Challenges and Opportunities for Green Entrepreneurs

The three interviewees agree that green entrepreneurship has development potential in the coming years. They have shown significant and visible progress for society achieved through self-management, although with a high risk of unsustainability. It is still in an emerging stage and remains fragile in terms of financing, awareness, and public policy.

Regarding opportunities, one interviewee stated: “Recyclable waste such as plastic has a

higher market value because there are public regulations and an established industry; this creates a favorable environment for recycling entrepreneurs in sustainable waste management.” This criterion is supported by the literature from Adhikari et al. (2023), who stated that the mechanisms employed by these emerging companies benefit society at the micro and macroeconomic levels due to the value created and economic sustainability. Likewise, interviewee E2 stated that “the opening of international markets is an opportunity to export recycling raw materials,” which is consistent with UNEP (2021) and CEPAL (2022), which identified opportunities in the expansion of sustainable markets, increased environmental awareness among newer generations of consumers, and the support of international organizations for circular economy initiatives.

Considering the barriers, one interviewee mentioned: “There is limited separation culture and a need for adequate classification and traceability processes; this requires investment in infrastructure and awareness. In addition, there is less regulatory incentive for organic waste management, which limits entrepreneurship”. This idea was supported by interviewee E2, who commented that “limited recycling culture and high initial costs represent a barrier for those who want to undertake ventures in this field.”

Institutional Articulation

Given the awareness of environmental pollution and problems related to landfills, governments worldwide have initiated waste reduction and recycling programs (Lieder & Rashid, 2016). For their implementation, it is relevant to establish joint relationships among emerging companies, government, and private sector industries, in order to achieve a smooth delivery of sustainability benefits and value to society (Adhikari et al., 2023). The authors recommended developing a comprehensive framework that considers the interests of stakeholders, under a systemic perspective of waste and environmental resources, ensuring a successful transition toward the circular economy.

This aspect is consistent with the statements of interviewees E1 and E3, who affirm that “local regulations are ambiguous or simply do not exist; therefore, the incentive to innovate in recycling is nonexistent.” In contrast, interviewee E2 stated: “The government does not see us as allies; we continue to be viewed as marginal initiatives. In other countries, manufacturers are required to finance recycling, but in Ecuador it is voluntary.” This situation is common in the Latin American context, becoming an alternative for theorization and avoiding the adoption of assumptions from developed markets where the

institutional environment is well established (Hammoda & Durst, 2024).

According to Kaza et al. (2018), due to the absence of precise and clear institutional coordination, many cities have established specialized governmental units for solid waste management. Others have agencies or departments dedicated to this management, although responsibility generally remains with environmental ministries, planning institutions, or municipalities. For this reason, interviewee E1 mentioned: “It is important for us to maintain agreements with several public entities such as the Ministry of Environment, the Ministry of Economic and Social Inclusion, and higher education institutions, in order to implement recycling stations and promote joint solid waste management.”

Inclusion of Informal Recyclers

Regarding the inclusion of informal recyclers, Hidalgo-Crespo et al. (2023) stated that 60% of urban recycling is carried out by these agents; however, they lack legal recognition and their operational conditions are precarious. This is consistent with the response from interviewee E3: “The exclusion of these recyclers not only causes socioeconomic inequalities but also prevents achieving higher waste collection rates.” Interviewee E1 also added: “Base or street recyclers face several difficulties related to formalization and working conditions, as well as social protection.”

From interview E2, it can be inferred that recognizing the role of these informal agents in the recycling value chain is essential. Their importance lies in the demanding work of collecting waste from streets, loading and transporting materials without institutional support. Laws such as the tax on recyclable plastic bottles have guaranteed a minimum price for recycled materials, providing some income stability; however, their economy remains fragile. This reflects the need for greater formalization and institutional support to improve their conditions and recognition.

From the perspective of Hidalgo-Crespo et al. (2023), integrating informal recyclers into solid waste management provides significant benefits for the environment, public health, and urban economies. However, these agents face significant obstacles due to distorted social perceptions, such as stigmatization and social marginalization, being considered unpleasant or even criminals; lack of official recognition because they are not regulated or registered as productive economic actors; demanding working conditions; and risks associated with exposure to sharp objects, toxic chemicals, infections, and rabid animals.

In this sense, alliances between recycling startups and municipalities represent an alternative to integrate recyclers into formal and dignified employment, strengthening their key role in the circular economy.

Conclusions

This research provides a significant contribution by confirming conclusions presented in regional and global circular economy literature from the perspective of sustainable entrepreneurship. This aspect remains scarcely explored in the Latin American context and specifically in Ecuador, where the relationship between startups, recycling, and circular economy has not been sufficiently demonstrated. Therefore, the results obtained serve as an input to close the academic gap and design more inclusive public policies.

From the field study with experts, it is concluded that recycling startups are essential for environmental sustainability, providing innovative solutions in solid waste management; however, a solid and favorable regulatory framework is still required to harness the potential of these companies. In Ecuador, there remains a gap in the literature addressing the impact of these ventures on the circular economy; therefore, further empirical studies are needed to document their contribution in terms of waste reduction, employment generation for recyclers, creation of sustainable value, as well as institutional and social barriers.

From a practical perspective, this study concludes that startups are strategic agents for advancing toward a sustainable and inclusive circular model. Nevertheless, a regulatory framework is required to recognize and regulate the participation of these ventures in solid waste management, as well as to establish green investment funds and develop municipal and regional plans with fiscal incentives. It is also concluded that maintaining alliances between startups, government institutions, and universities is relevant to promote incubation programs for the validation of circular business models.

References

- Adhikari, D. R., Shrestha, P., & Adhikari, B. R. (2023). New perspectives on people management dimensions in recycling startups. *Journal of Small Business and Enterprise Development*, 30(7), 1396-1422. <https://doi.org/10.1108/JSBED-09-2022-0400>
- Hidalgo-Crespo, J., Amaya-Rivas, J. L., Ribeiro, I., Soto, M., Riel, A., & Zwolinski, P. (2023). Informal waste pickers in Guayaquil: Recycling rates, environmental benefits, main barriers, and troubles. *Heliyon*, 9(9).
- Cabrera, J. D., & Velasco, P. (2022). Construction and demolition waste in Tungurahua: A case study from Ecuador. *Environmental Research and Technology*, 5(4), 315-324. <https://doi.org/10.35208/ert.1150943>
- CEPAL. (2018). *Perspectiva de la Gestión de Residuos en América Latina y el Caribe*. CEPAL. (2022). *Economía circular en América Latina: Avances y desafíos*.
- Geissdoerfer, M., Savaget, P., Bocken, N. M., & Hultink, E. J. (2017). The Circular Economy—A new sustainability paradigm. *Journal of cleaner production*, 143, 757-768. <https://doi.org/10.1016/j.jclepro.2016.12.048>
- Ferreira, M. V., Dijkstra, G., Scholten, P., & Sucozhañay, D. (2022). The effectiveness of inter-municipal cooperation for integrated sustainable waste management: A case study in Ecuador. *Waste management*, 150, 208-217. <https://doi.org/10.1016/j.wasman.2022.07.008>
- Fraser, M., Haigh, L., & Soria, A. C. (2023). *The circularity gap report 2023*.
- Hammoda, B., & Durst, S. (2024). *Contemporary Entrepreneurship: Global Perspectives and Cases*. Taylor & Francis.
- Hidalgo-Crespo, J., Amaya-Rivas, J. L., Ribeiro, I., Soto, M., Riel, A., & Zwolinski, P. (2023). Informal waste pickers in Guayaquil: Recycling rates, environmental benefits, main barriers, and troubles. *Heliyon*, 9(9). <https://doi.org/10.1016/j.heliyon.2023.e19775>
- Jara Samaniego, J., et al. (2017). Composting as sustainable strategy for MSW in Chimborazo, Ecuador. *Journal of Cleaner Production*, 142, 663-674. <https://doi.org/10.1016/j.jclepro.2016.09.178>
- Kaza, S., Yao, L., Bhada-Tata, P., & Van Woerden, F. (2018). *What a waste 2.0: a global*

- snapshot of solid waste management to 2050. World Bank Publications.
- Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, conservation and recycling*, 127, 221-232. <https://doi.org/10.1016/j.resconrec.2017.09.005>
- Kuckertz, A., Berger, E. S., & Gaudig, A. (2019). Responding to the greatest challenges? Value creation in ecological startups. *Journal of Cleaner Production*, 230, 1138-1147. <https://doi.org/10.1016/j.jclepro.2019.05.149>
- Lieder, M., & Rashid, A. (2016). Towards circular economy implementation: a comprehensive review in context of manufacturing industry. *Journal of cleaner production*, 115, 36-51. <https://doi.org/10.1016/j.jclepro.2015.12.042>
- Merriam, S. B., & Tisdell, E. J. (2016). *Qualitative research: A guide to design and implementation* (4th ed.). Jossey-Bass.
- Ministerio del Ambiente, Agua y Transición Ecológica (2024). Boletín Estadístico 2024. Gestión de residuos sólidos y economía circular inclusiva (GRECI). Primera Edición 2024.
- Negash, Y. T., Sarmiento, L. S. C., Tseng, M. L., Lim, M. K., & Ali, M. H. (2021). Engagement factors for household waste sorting in Ecuador: Improving perceived convenience and environmental attitudes enhances waste sorting capacity. *Resources, Conservation and Recycling*, 175, 105893. <https://dx.doi.org/10.1016/j.resconrec.2021.105893>
- Nieto-Cañarte, C. A., Guamán-Sarango, V. M., Vélez-Ruiz, M. C., Alcocer-Quinteros, R. P., & Sinchi-Rivas, C. A. (2024). Optimizing solid waste management strategies in rural Ecuador. *Sapienza: International Journal of Interdisciplinary Studies*, 5(2), e24038-e24038. <https://doi.org/10.51798/sijis.v5i2.774>
- Organisation for Economic Co-operation and Development OECD (2024). Development Co-operation Report 2024. Tackling Poverty and Inequalities through the Green Transition. Recuperado de https://www.oecd.org/en/publications/development-co-operation-report-2024_357b63f7-en.html
- Peñafiel Arcos, R., et al. (2022). Management of domestic solid waste in rural communities – a case study of the Río Blanco community, Ecuador. *Green World Journal*. <https://doi.org/10.53313/gwj53050>
- Posso, F., Narváez C, R. A., Siguencia, J., & Sánchez, J. (2019). Use of municipal solid

waste (MSW)-derived hydrogen in Ecuador: Potential applications for urban transportation. Waste and Biomass Valorization, 10, 1529-1537.
<https://doi.org/10.1007/s12649-017-0161-1>

Tremblay, C., Gutberlet, J., & Peredo, A. M. (2010). United We Can: Resource recovery, place and social enterprise. Resources, Conservation and Recycling, 54(7), 422-428. <https://doi.org/10.1016/j.resconrec.2009.09.006>

United Nations Environment Programme UNEP. (2021). Planetary Action. Climate, Nature, Chemicals & Pollution. Recuperado de <https://www.unep.org/resources/annual-report-2021>

Xu, R., Yang, Z. H., Wang, Q. P., Bai, Y., Liu, J. B., Zheng, Y., ... & Fan, C. Z. (2018). Rapid startup of thermophilic anaerobic digester to remove tetracycline and sulfonamides resistance genes from sewage sludge. Science of the Total Environment, 612, 788-798. <https://doi.org/10.1016/j.scitotenv.2017.08.295>

World Economic Forum. WEF (2021). Annual Report 2020-2021. Recuperado de https://www3.weforum.org/docs/WEF_Annual_Report_2020_21.pdf

Conflicto de intereses:

Los autores declaran que no existe conflicto de interés