Vol. 19(12), pp. 444-456, December 2025
DOI: 10.5897/AJEST2025.3406
Article Number: 8A2186674078
ISSN: 1996-0786

http://www.academicjournals.org/AJEST

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African Journal of Environmental Science and Technology

Full Length Research Paper

Analysis of the challenges and opportunities related to the recycling of end-of-life vehicles in developing countries: Focus on the Republic of Guinea

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Received 28 August, 2025; Accepted 4 November, 2025

End-of-life vehicle (ELV) management in Guinea presents significant environmental challenges within the circular economy framework. This study examines the challenges and opportunities of automotive recycling in Guinea amid rapid vehicle fleet expansion from 15,000 units in 2010 to over 45,000 in 2023. A mixed-methods approach was employed, combining systematic literature review of 729 articles from major databases (PubMed, ScienceDirect, Elton B. Stephens Company [EBSCO], Scopus, Springer Link, and Google Scholar), direct field observations at seven informal dismantling centers in Conakry, and strengths, weaknesses, opportunities, and threats (SWOT) analysis. Results reveal an informal sector characterized by indigenous technical expertise and strong demand for recycled metals. However, critical weaknesses include the absence of specific regulatory frameworks, lack of specialized infrastructure, and inadequate hazardous waste management systems. Worker surveys (n=101) identified alarming occupational health deficiencies: only 15.84% utilize personal protective equipment, while 28.71% reported work-related illnesses. Key opportunities include energy recovery potential from automotive waste, integration with Economic Community of West African States (ECOWAS) regional initiatives, and strategic preparation for electric vehicle transition. Despite current regulatory and public health challenges, Guinea demonstrates substantial potential for developing sustainable circular economy practices in the automotive sector. This study provides baseline data for policy formulation and strategic planning in automotive waste management in Guinea and comparable developing nations.

Key words: End-of-life vehicles, circular economy, strengths, weaknesses, opportunities, and threats (SWOT) analysis, automotive recycling, developing countries, environmental management, hazardous waste.

INTRODUCTION

The circular economy represents a fundamental paradigm shift for rethinking production and consumption models, particularly in managing complex waste streams such as end-of-life vehicles (ELVs). This systemic approach, which

prioritizes material reuse, recycling, and recovery, has emerged as a viable alternative to traditional linear extraction-production-disposal models (Macarthur and Heading, 2019). In the African context, specifically in the republic of Guinea, ELV management constitutes a major environmental, economic, and public health challenge requiring an integrated approach adapted to local realities.

The African vehicle fleet is experiencing exponential growth, primarily fueled by used vehicle imports from developed countries (Ajayi et al., 2023). This dynamic generates increasing ELV volumes, whose management poses considerable challenges in contexts where formal recycling infrastructure is often insufficient or non-existent. The Republic of Guinea, like many West African countries, confronts this problem with limited resources and a developing regulatory framework AGroupe de la Banque Africaine de Développement (2024) United Nations Framework Convention on Climate Change [UNFCCC], 2021). ELVs constitute complex "urban mines" containing valuable materials (ferrous and non-ferrous metals, plastics) alongside hazardous substances requiring specialized management (Ghulam and Abushammala, 2023; Serpe et al., 2024).

Scientific literature reveals growing attention to ELV management in developing countries, notably through reverse supply chain analysis and valorization models adapted to local contexts (Mmereki et al., 2017). However, significant knowledge gaps persist in understanding circular economy implementation mechanisms within the West African automotive sector. Technological developments, particularly the emergence of electric vehicles, add a critical prospective dimension, with Harper et al. (2019) warning of specific challenges that batteries and electronic components will pose in the global south. This technological transition reinforces the urgency of developing appropriate regulatory frameworks and infrastructure.

The Republic of Guinea presents particular interest as a case study representative of challenges and opportunities faced by West African countries. With its transitional economy, significant natural resources, and strategic positioning within the Economic Community of West African States (ECOWAS), Guinea offers a relevant context to examine the articulation between public policies, informal practices, and circular economy development in the ELV sector. The potential for energy recovery from ELV recycling also represents a significant opportunity, as demonstrated by United Nations Environment Programme (UNEP, 2012) in Cameroon, aligning with circular economy principles through sustainable local value chain creation.

The main objective of this research is to comprehensively analyze challenges and opportunities related to ELV recycling in the Republic of Guinea, adopting a circular economy approach that integrates environmental, health, economic, and social dimensions. This analysis is based on a mixed-methods approach combining systematic literature review, field observations, and comparative assessment of regulatory frameworks, in accordance with sustainable development principles defined by Sala et al. (2015) and Côté (2005). The study contributes to understanding transition mechanisms toward a circular economy in the ELV sector within ECOWAS generally, and more specifically in Guinea, while proposing operational recommendations to improve the environmental and economic efficiency of automotive waste management.

METHODOLOGY

Study design and approach

This study examines the environmental and health impacts of ELV management systems in Guinea while assessing regulatory framework effectiveness through a circular economy and waste recovery approach. The study adopts a mixed-methods approach combining systematic literature review, field assessment, and stakeholder surveys to provide a comprehensive understanding of the ELV sector in Guinea. A SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) was conducted to evaluate the internal strengths and weaknesses as well as external opportunities and threats of ELV management in Guinea (Gürel and Merba, 2017). This strategic planning tool identifies critical environmental and organizational factors while determining available resource capabilities and external constraints. The analysis integrates economic, environmental, and social dimensions in accordance with sustainable development principles (Sala et al., 2015).

Searched terms

A comprehensive systematic literature search was conducted across multiple scientific databases: PubMed, ScienceDirect, EBSCO, Scopus, Springer Link, and Google Scholar. Search terms included: ELVs, "Republic of Guinea", "recycling of end-of-life vehicles in developing countries", "recycling of end-of-life vehicles in Africa", "regulations for ELV management and directives in Africa", "health impacts of ELV management in West Africa", and "circular economy in ELV management". The bibliographic search was conducted from January to May 2025 in French, English, and Spanish to maximize geographical and disciplinary coverage.

Inclusion criteria comprised:

(1) Peer-reviewed publications from 2010 to 2025,
(2) Studies focusing on Africa generally, West Africa specifically, or Guinea particularly
(3) Research addressing environmental and health aspects of automotive recycling in developing countries.

Articles that did not meet these criteria or lacked empirical data were excluded. The reviewed literature is summarized in Table 1.

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Table 1. Summary of literature on end-of-life vehicle (EOL) management in developing countries' development: Circular economy perspective summary of studies reviewed.

Author(s) and Year	Title	Objective of the study	Methodology	Main results	Relevance to the circular economy
Karagoz et al. (2019)	End-of-life vehicle management: a comprehensive review	Review the overall management of ELV and identify challenges	Systematic literature review, comparative analysis of regulations	Managing ELV requires an integrated approach involving all stakeholders in the value chain. Challenges include technical, economic, and regulatory aspects.	Direct integration of circular economy principles into material recovery and waste reduction
Numfor et al. (2021)	A Review of Challenges and Opportunities for End-of-Life Vehicle Recycling in Developing Countries and Emerging Economies: A SWOT Analysis	Analyzing the challenges and opportunities of ELV recycling in developing countries through a SWOT analysis	SWOT analysis, comparative study of 8 developing countries	Identification of the main challenges: inadequate policies, lack of infrastructure, absence of a regulatory framework. Opportunities: material recovery, job creation.	Promoting the circular economy through waste recovery and the creation of sustainable value chains
Molla et al. (2023)	Evaluation of end-of-life vehicle recycling system in India in responding to the sustainability paradigm: an explorative study	Assessing the sustainability of the ELV recycling system in India	Exploratory study, stakeholder analysis, environmental impact assessment	The Indian system has gaps in formalizing the sector and managing hazardous substances. Regulatory and technological improvements are needed.	Application of sustainable development and circular economy principles in the evaluation of recycling systems
Numfor et al. (2022)	Energy recovery from end-of-life vehicle recycling in Cameroon: A system dynamics approach	Analyzing the potential for energy recovery from ELV recycling in Cameroon	System dynamics approach, energy modeling	Recycling ELV could significantly contribute to Cameroon's energy supply and reduce dependence on traditional energy sources.	Energy recovery is a key component of the circular economy, reducing dependence on primary resources
Bagwasi et al. (2022)	Effectiveness of Waste Management Practices for End-of-Life Vehicle Components in the City of Nairobi, Kenya	Evaluate the effectiveness of ELV waste management practices in Nairobi	Field survey, analysis of current practices, impact assessment	Informal practices dominate the sector, with significant environmental impacts. Improved training and regulations are needed.	Integrating informal practices into a formalized circular economic approach
Trang and Li (2023)	Reverse supply chain for end-of-life vehicles treatment: An in-depth content review	Analyzing reverse supply chains for ELV processing	In-depth content review, analysis of supply chain models	Reverse supply chains are essential for effective ELV management, particularly in developing countries where volumes are increasing rapidly.	Optimization of material flows and creation of closed loops characteristic of the circular economy

Table 1. Cont'd

Prates et al. (2023)	Sustainability for all? The challenges of predicting and managing potential risks of end-of-life electric vehicles in the Global South	Examining the specific challenges of end-of-life electric vehicles in the Global South	Prospective analysis, risk assessment, comparison with traditional ELV	Electric vehicles present specific challenges related to batteries and electronic components, requiring approaches tailored to developing countries.	Anticipation of technological transitions in circular economy models

Study area and site selection

The field study was conducted in Conakry, Republic of Guinea, located in the Atlantic intertropical zone between 7°30' to 12°51' North latitude and 7°30' to 15° West longitude. Seven informal ELV dismantling sites were purposively selected across different municipalities: Bonfi and Madina (Matam commune), Dabomdi and Gbessia (Gbessia commune), Behanzin and Enta (Matoto commune), and Sonfonia (Figure 1). Site selection was based on the following criteria:

(1) Presence of active ELV dismantling activities
(2) Accessibility for field surveys
(3) Safety considerations for research team
(4) Representative geographical coverage of exposure areas across Conakry.

Study population and sampling

The study population consisted of 101 informal sector workers aged at least 18 years with a minimum of one year of experience in ELV-related activities. Workers were classified into four operational categories: collectors, repairers, dealers, and recyclers. A purposive, non-probability sampling technique was employed due to the informal nature of the sector and challenges in establishing a sampling frame. Exclusion criteria included pregnant women and individuals with pre-existing chronic respiratory diseases to avoid confounding health outcomes.

Data collection

Data collection was conducted through structured questionnaire administration by trained interviewers in participants' preferred language (French, Susu, or Malinke) at their workplaces between. The questionnaires comprised five sections:

(1) Demographic and socioeconomic characteristics
(2) Occupational history and work practices
(3) Behavioral and lifestyle factors
(4) Hazardous substance exposure assessment
(5) Technical information on treatment equipment and methods used for dismantling ELV.

The research protocol received approval from the institutional ethics committee of IRDPMAG, and all participants provided written informed consent after receiving detailed information regarding study objectives, procedures, potential risks, and benefits. For participants with limited literacy, the consent process was conducted orally with a witness present. This approach documented current practices for handling hazardous fluids (used oils, coolants, fuels) and assessed workers' exposure to toxic substances (Figure 2).

Regulatory framework analysis

The legal framework analysis was based on systematic review of Guinean legislative and regulatory texts, particularly decrees and directives from the Ministry of Environment and Sustainable Development (MEDD). A comparative assessment with European directives (Directive 2000/53/EC on ELVs) and African best practices from South Africa and Ghana identified regulatory gaps and opportunities for improvement. Internal reports and policy documents from national solid waste management agencies were analyzed to understand existing institutional mechanisms and their operational effectiveness.

Data analysis

Quantitative data were analyzed using descriptive statistics including frequencies, percentages, means, and standard deviations using SPSS statistical package 12.0 (SPSS Inc Chicago, USA). Qualitative data from field observations and open-ended questionnaire responses were thematically analyzed to identify recurring patterns and key themes. The SWOT analysis was conducted through systematic categorization of identified factors into the four quadrants, with validation through triangulation of literature review findings, field observations, and stakeholder input.

RESULTS

Article collection and selection process

This research examined the challenges and opportunities associated with end-of-life vehicle (ELV) recycling in developing countries, with particular emphasis on the Republic of Guinea. The inclusion criteria were designed to capture diverse methodological approaches and geographical contexts while maintaining scientific rigor and relevance. The study period spanning 2010 to 2025 reflects the escalating environmental concerns driven by the exponential increase in vehicle numbers in Guinea, rising from approximately 15,000 vehicles in 2010 to over 45,000 in 2023, according to data from the General Directorate of Customs. This dramatic upward trend raises critical questions regarding the management of end-of-life vehicles in contexts characterized by limited recycling infrastructure and nascent waste management systems (Institut National de la Statistique [INS], 2023).

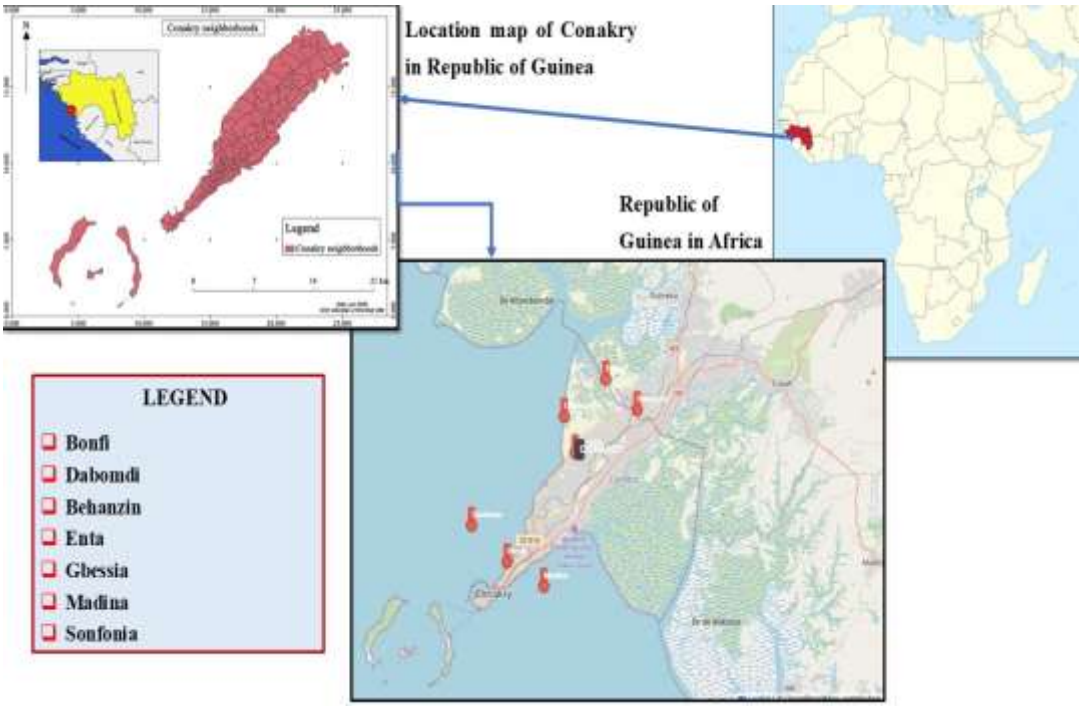


Figure 1. Geographical location of Conakry and the sites selected for the study, Republic of Guinea.

Figure 2. Impressions on end-of-life vehicles abandoned at the various sites studied, Conakry (Republic of Guinea).

Publications meetings the following inclusion criteria were selected:

(1) Peer-reviewed articles published between 2010 and 2025,
(2) Manuscripts written in French, English, or Spanish,
(3) Studies focusing on Africa, West Africa, or developing countries more broadly,
(4) Research addressing environmental, health, and economic dimensions of automotive recycling,
(5) Works integrating circular economy concepts, sustainable development principles, or examining

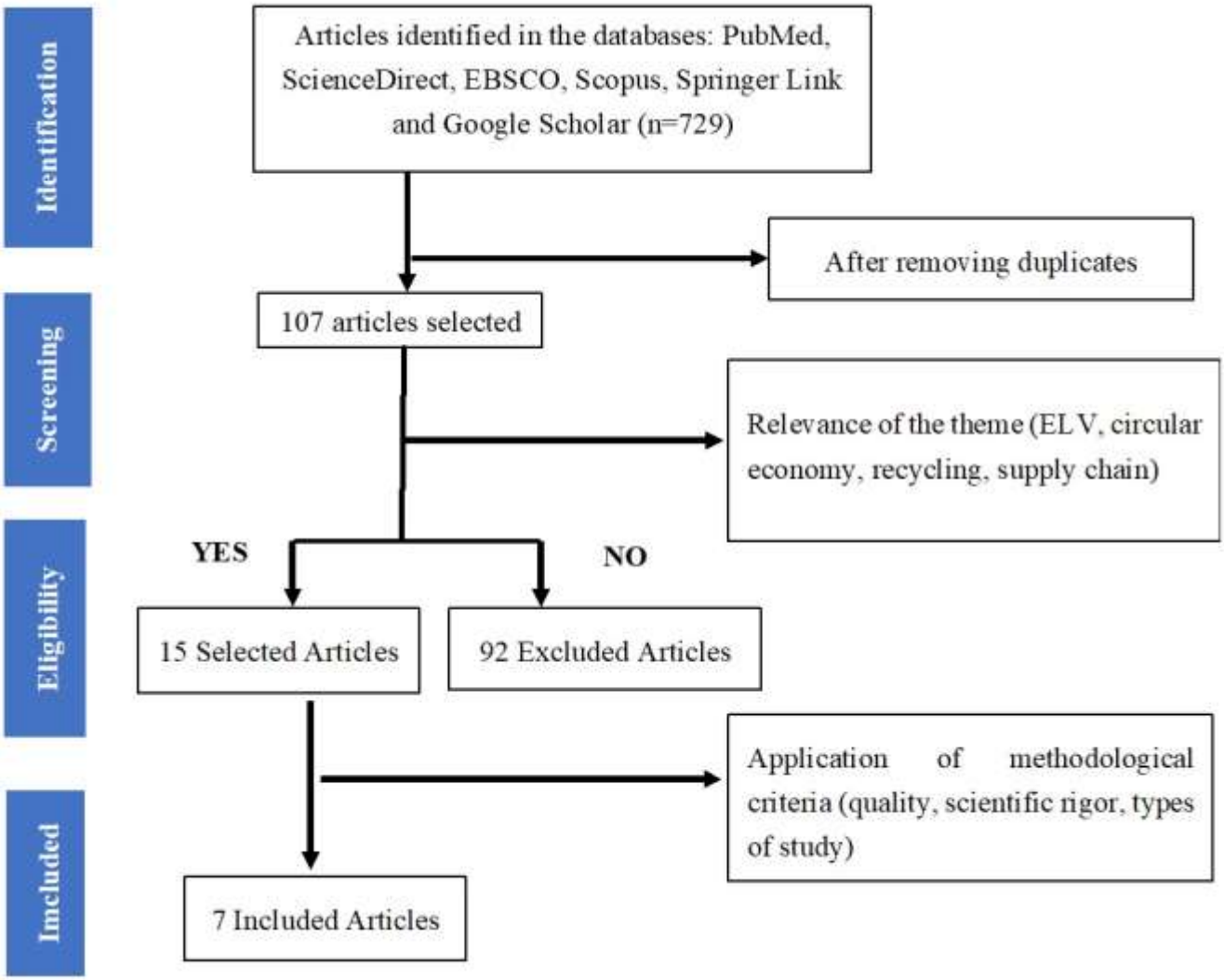


Figure 3. Flowchart of the selection criteria for articles of interest.

regulatory frameworks and public policies related to ELV management.

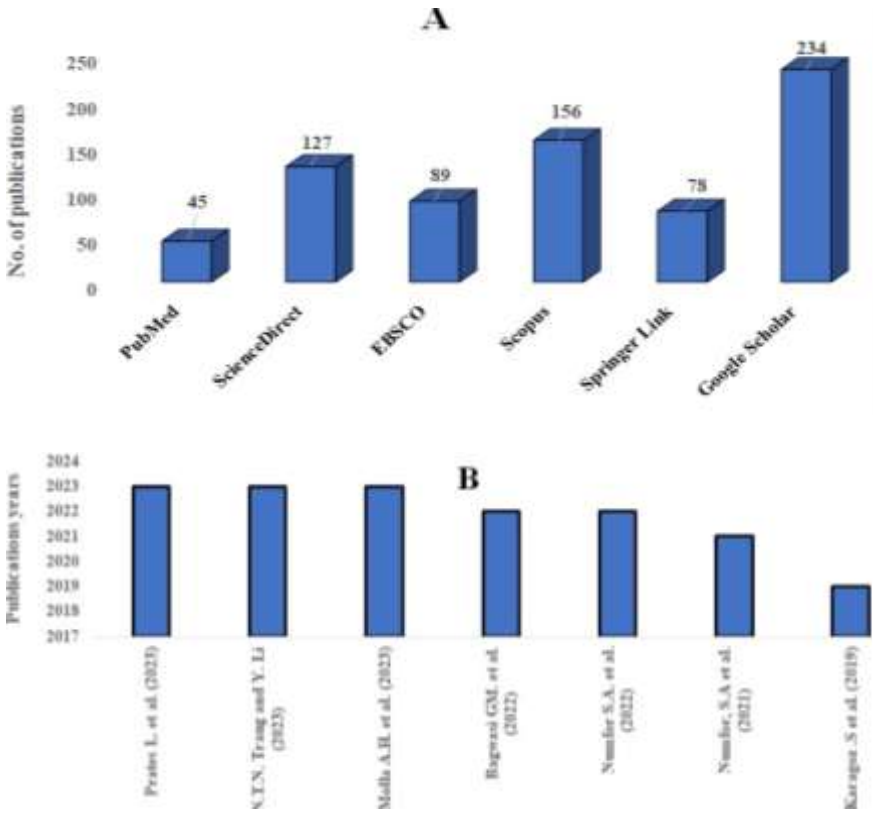
Conversely, exclusion criteria eliminated:

(1) Non-peer-reviewed publications and grey literature,
(2) Publications dated prior to 2010,
(3) Purely technical studies lacking environmental or social components,
(4) Articles exclusively addressing developed countries without comparative analysis of Global South contexts,
(4) Publications without full-text accessibility,
(5) Duplicate or redundant articles identified across multiple databases.

Figure 3 shows the distribution of publications identified through keyword searches across different databases. A total of 729 articles were initially identified through systematic database searches: PubMed yielded 45 articles (8 retained after screening), ScienceDirect 127 articles (23 retained), EBSCO 89 articles (15 retained), Scopus 156 articles (31 retained), Springer Link 78 articles (12 retained), and Google Scholar 234 articles (18 retained following duplicate elimination). Following the rigorous application of inclusion and exclusion criteria, 107 articles were ultimately retained for comprehensive analysis, with 7 publications specifically identified and examined as key contributions to scientific literature on ELV management in developing countries.

Figure 4 shows the number of publications over the past 15 years related to keywords associated with end-of-life vehicles (ELVs) across different databases. Figure 4A presents the number of articles identified in each database. Figure 4B shows the articles identified and analyzed by the authors for this literature review.

The retained studies predominantly focus on ELV management and the integration of circular economic



principles. Key findings emphasize the importance of integrated approaches involving multiple stakeholders across the automotive value chain (Karagoz et al., 2019), the unique challenges facing developing countries in implementing effective ELV recycling systems (Numfor et al., 2021; Bagwasi et al., 2022), and the pressing need for improved regulatory frameworks and physical infrastructure to support sustainable recycling practices (Molla et al., 2023). Additional studies highlight the significant potential for energy recovery from ELV materials (Numfor et al., 2021), strategies for optimizing reverse supply chains in resource-constrained settings (Trang and Li, 2023), and emerging challenges associated with electric vehicle end-of-life management (Prates et al., 2023) (Table 1).

Cross-sectional survey

Sociodemographic characteristics of study participants

Analysis of sociodemographic data revealed that all 101 survey participants were male. The functional distribution of participants was dominated by vehicle repairers, representing 43.56% (n = 44) of the sample, followed by auto parts resellers at 32.67% (n = 33), recyclers at 12.87% (n = 13), and collectors at 10.89% (n = 11). The age distribution indicated a predominantly young workforce, with 53.46% (n = 54) classified as young adults and 34.65% (n = 35) as young-adult category, while only 11.88% (n = 12) represented the adult-senior age group.

Literacy levels within the study population were particularly concerning, with 60% (n = 61) of participants classified as illiterate and an additional 20.79% (n = 21) experiencing significant difficulties with reading and writing. Regarding marital status, 65.34% (n = 66) of participants were married, compared to 26.73% (n = 27) who were single. Religious affiliation was predominantly Muslim, accounting for 85.14% (n = 86) of the study population (Table 6).

Occupational risk assessment and health indicators

The assessment of occupational risks and health indicators revealed substantial gaps in workplace safety and health prevention measures. Only 25.74% (n = 26) of workers reported having received formal information regarding occupational risks, while 41.58% (n = 42) explicitly stated they had received no such training or information. The utilization of personal protective equipment (PPE) was markedly deficient, with only 15.84% (n = 16) reporting regular use of appropriate protective gear during work activities.

Table 2. Summary of references for SWOT analysis in developing countries: Comparison with the Republic of Guinea (Strengths).

SWOT criteria	Developing countries - References	Context Republic of Guinea	Circular economy integration
Labor availability	Informal recycling practices generate significant employment in urban centers (Bagwasi et al., 2022). In India, the informal sector employs thousands of people in the dismantling of ELV (Molla et al., 2023).	Guinea has a large and experienced workforce in the informal metal recycling sector, particularly in Conakry and regional urban centers.	Converting current human resources into formalized circular economic principles.
Local technical expertise	Development of technical know-how adapted to local conditions in African countries (Numfor et al., 2021). Local craftsmen have mastered efficient manual dismantling techniques.	Guinean scrap metal dealers and mechanics have developed remarkable skills in repairing and recycling auto parts, creating a robust informal technical ecosystem.	Capitalizing on local expertise to develop circular recycling processes
Growing demand for raw materials	Strong regional demand for recycled ferrous and non-ferrous metals (Numfor et al., 2022). Local markets efficiently absorb recycled materials.	Guinea benefits from sustained demand for recycled metals, particularly for the construction and mining sectors.	Creation of local value loops reducing dependence on imports

Health problems were prevalent among the study population. Notably, 28.71% (n = 29) of participants reported experiencing illness within the three months preceding the survey, and 24.75% (n = 25) reported moderate symptoms potentially related to occupational exposures. Lifestyle risk factors were also common, with 33.66% (n = 34) of participants reporting active smoking habits and 21.78% (n = 22) reporting regular alcohol consumption (Table 7).

DISCUSSION

This study reveals complex challenges and significant opportunities in ELV management in Guinea within the broader developing country context. The comparative SWOT analysis and systematic literature review highlight substantial obstacles to circular economy implementation in the African automotive sector while demonstrating Guinea's considerable potential for establishing successful ELV recycling operations.

The presence of a skilled workforce in the informal sector represents a crucial comparative advantage, corroborating findings from Bagwasi et al. (2022) in Kenya and Molla et al. (2023) in India. Local expertise, acquired through practical experience by Guinean scrap dealers and mechanics, constitutes significant human capital for establishing structured automotive recycling industries. This technical knowledge, developed through years of informal practice, provides a foundation for transitioning toward formalized circular economic approaches.

Sustained demand for recycled metals, particularly in the construction and mining sectors, creates continuous economic opportunities for ELV materials (Table 2). According to Macarthur and Heading (2019), this market trend stimulates local value chain development, an essential circular economy component. Unlike countries with saturated recycled material markets, Guinea benefits from favorable conditions for integrating automotive recycling products into existing economic structures.

Energy recovery potential from non-metallic ELV components represents a strategic opportunity for reducing energy dependence (Table 4). Numfor et al. (2022) demonstrated in Cameroon that this approach aligns with circular economy principles by transforming waste into energy sources. Additionally, Trang and Li (2023) highlight opportunities for optimizing material flows through reverse supply chain development, creating closed loops characteristic of circular systems.

Regional integration through ECOWAS waste management initiatives offers opportunities to consolidate resources and expertise, as recommended by Numfor et al. (2021). This approach facilitates technology transfer and standardizes ELV management practices across West Africa. Furthermore, anticipating electric vehicle challenges presents strategic advantages, as Guinea can develop early expertise in battery and electronic component recycling before mass deployment (Prates et al., 2023).

The analysis reveals significant shortcomings hindering effective circular economic implementation in ELV management (Table 3).

The absence of specific legal frameworks

Table 3. Summary of references for SWOT analysis in developing countries: Comparison with the Republic of Guinea (Weaknesses).

SWOT criteria	Developing countries-References	Context Republic of Guinea	Challenges for the circular economy
Insufficient regulatory framework	Lack of specific regulations for ELV in most countries studied (Numfor et al., 2021). Existing policies are inadequate and poorly enforced (Karagoz et al., 2019).	Guinea does not have specific regulations for ELV, relying on general waste management texts which are often not applied.	Major obstacle to the establishment of formalized circular systems
Limited technical infrastructure	Lack of specialized treatment facilities for hazardous substances (Mwanza et al., 2018). Dismantling centers do not meet environmental standards.	Very limited recycling infrastructure, lack of treatment centers for automotive fluids and electronic components.	Limitation of material flow looping capacities
Management of hazardous substances	Improper handling of hydraulic fluids used oils and electronic components (Molla et al., 2023). High health and environmental risks.	Poor management of toxic substances, frequent spills of used oils into the environment, exposure of workers to chemical risks.	Compromising the principles of environmental sustainability

Constitutes a major obstacle shared by most countries studied by Numfor et al. (2021). This regulatory gap prevents the establishment of environmental and health standards essential for sustainable ELV management.

Inadequate technical infrastructure poses particularly serious challenges. The lack of dedicated hazardous material management facilities for used oils, coolants, and electronic components compromises environmental sustainability objectives (Karagoz et al., 2019). This situation exposes informal sector workers to significant health risks while creating considerable environmental impacts on urban and peri-urban ecosystems.

Field observations at seven study sites (Bonfi, Dabomdi, Behanzin, Enta, Gbessia, Madina, and Sonfonia) revealed worker exposure to hazardous substances without appropriate protective measures. This context illustrates problems identified by Molla et al. (2023) across various developing countries, where prolonged pollutant exposure constitutes a major public health hazard. Environmental degradation in Conakry's peri-urban areas confirms concerns expressed by Bagwasi et al. (2022) in Nairobi, underscoring the urgent need for sector organization and control.

Cross-sectional survey results from 101 informal workers highlight concerning socioeconomic vulnerabilities. With over 60% illiterate and 30% lacking formal education, this population demonstrates characteristic features of informal recycling sectors in developing countries, increasing vulnerability to health hazards (Ohajinwa et al., 2017; Tue et al., 2016). The exclusively male workforce (100%) with predominantly young demographics (53.46%) raises concerns about long-term health impacts (Song and Li, 2015) (Table 5).

High frequencies of respiratory and dermatologi symptoms correlate with exposure to vapors and metal particles during dismantling and combustion procedures (Julander et al., 2014; Grant et al., 2013). Despite awareness of dangers evidenced by makeshift protective measures, personal protective equipment usage remains critically low (15.84%). This phenomenon reflects limited access to adequate materials and safety resources (Caravanos et al., 2011; Heacock et al., 2016). Unfair competition from imported low-quality automotive parts undermines the local recycling economy. Karagoz et al. (2019) observed similar trends that compromise the economic sustainability of circular systems and discourage investments in recycling technique improvements. Rapid technological advancement and modern vehicle complexity with sophisticated electronics risk eclipsing traditional local techniques, threatening the viability of existing informal expertise (Table 6).

Environmental degradation risks, particularly water resource contamination in peri-urban Conakry areas where dismantling activities concentrate, pose serious sustainability challenges. These threats, combined with chronic population exposure to airborne pollutants and soil contaminants, contradict the social sustainability objectives fundamental to circular economy principles.

Transitioning toward a circular economy for ELVs in Guinea requires systematic approaches integrating regulation, infrastructure development, and training while preserving local expertise

Table 4. Summary of references for SWOT analysis in developing countries: Comparison with the Republic of Guinea (Opportunities).

SWOT criteria	Developing countries - References	Context Republic of Guinea	Circular economy potential
Energy recovery	Significant potential for energy recovery from ELV (Numfor et al., 2022). Energy dynamics systems show a possible contribution to national supply.	Opportunity for energy recovery of non-metallic components of ELV to reduce the country's energy dependence.	Development of circular energy sectors
Development of reverse supply chains	Reverse supply chain models offer opportunities for optimization (Trang and Li, 2023). Possible integration of informal actors into formalized systems.	Possibility of structuring existing informal networks into efficient reverse value chains, connecting collectors, dismantlers and recyclers.	Creation of closed loops of materials
Regional cooperation	Development of South-South partnerships for the transfer of technologies and good practices (Numfor et al., 2021).	Potential incorporation into regional into ECOWAS programs pertaining to the circular economy and trash management.	Pooling of resources and expertise
Transition to electric vehicles	Necessary anticipation of challenges specific to electric vehicles (Prates et al., 2023). Opportunity to develop suitable sectors before mass production.	Opportunity to develop early expertise in the recycling of batteries and electronic components before the mass arrival of electric vehicles.	Preparing for circular technological transitions

Table 5. Summary of references for SWOT analysis in developing countries: Comparison with the Republic of Guinea (Threats).

SWOT criteria	Developing countries - References	Context Republic of Guinea	Risks for the circular economy
Environmental degradation	Significant negative impacts on soil and water (Bagwasi et al., 2022). Contamination of groundwater by automotive fluids.	Risk of pollution of water resources, particularly critical in the peri-urban areas of Conakry where dismantling activities are concentrated.	Compromise of environmental sustainability
Health risks	Exposure of workers to toxic substances without adequate protection (Molla et al., 2023). Public health problems in adjacent communities.	Chronic exposure of populations to air pollutants and soil contaminants, particularly in the districts.	Contradiction with social sustainability objectives
Competition from imports	Competition with low-cost imported new parts (Karagoz et al. 2019). Consumer preference for new products.	Unfair competition from poor quality imported auto parts, affecting the economic viability of local recycling.	Weakening of circular economic circuits
Technological evolution	Increasing complexity of modern vehicles makes recycling more difficult (Prates et al., 2023). Obsolescence of traditional dismantling techniques.	Risk of mismatch between local techniques and modern automotive technologies, particularly electronic and hybrid.	Need for continuous technological adaptation

Table 6. Sociodemographic profile of informal ELVs waste workers surveyed at dismantling sites.

Characteristics		n = 101	%
Collectors		11	10.89
Repairers		44	43.56
Recyclers		13	12.87
Resellers		33	32.67
Gender (Male)		101	100
Age	Young people	54	53.46
	Young Adults	35	34.65
	Adults-Seniors	12	11.88
Literacy	Illiterate	61	60
	Can read and write with difficulty	21	20.79
	Can read and write	19	18.81
Marital status	Bachelor	27	26.73
	Married	66	65.34
	Divorced/Separated	7	6.93
	Widower	-	-
	Others	8	7.92
Religion	Muslim	86	85.14
	Christian	11	10.89
	Others	4	3.96

to ensure efficiency and societal acceptance. Creating synergies between formal and informal sectors can enhance skills while improving health and environmental standards. Several studies advocate this hybrid approach for promoting gradual shifts toward sustainable circular practices (Numfor et al., 2021; Molla et al., 2023).

Regional integration represents an essential tool for addressing local constraints through South-South collaborations, facilitating access to appropriate technologies, and standardizing West African practices. Investment in infrastructure for hazardous substance management through regional partnerships can reduce costs while optimizing technical efficiency. Formalizing the informal sector through training and certification programs promotes local employment while improving environmental and health practices. Technical skill enhancement programs adapted to low literacy levels, emphasizing practical and visual approaches, would facilitate the adoption of sound environmental practices.

This analysis acknowledges several methodological limitations requiring future investigation. Health impact studies using biomarkers and field measurements are needed, along with the development of circularity indicators specifically adapted to developing country contexts (Table 7). Detailed examination of ELV circular economy financing mechanisms, including public-private partnerships and green finance options, is crucial for mobilizing necessary resources.

The geographical restriction to Conakry limits the generalizability of findings to rural areas and other Guinean urban centers. Extended research incorporating gender-inclusive approaches and seasonal variation analysis would enhance understanding of ELV management dynamics across Guinea. Results indicate the importance of designing regulatory frameworks adapted to Guinean contexts while leveraging African best practices. Such frameworks should include environmental standards, training requirements, and economic incentives encouraging ELV circular economy development. The study demonstrates that despite current challenges, Guinea possesses substantial potential for developing sustainable circular economy practices in the automotive sector through strategic integration of local expertise with formal regulatory and infrastructure development.

Conclusion

This study reveals significant circular economy potential for ELVs in Guinea despite identified regulatory and public health challenges. Remark-able local technical expertise and growing demand for recycled materials offer sustainable recovery opportunities. However,

Table 7. Perception of occupational risks and health indicators among informal ELVs workers interviewed at dismantling sites.

Indicators		n =101	%
Received information on the risks of waste work	Received information	26	25.74
	Did not receive information	42	41.58
	Don't know	33	32.67
Personal Protective Equipment (PPE)	Users	16	15.84
	Non-users	27	26.73
	Use of own clothing (scarves, caps)	37	36.63
	Don't know	21	20.79
Illness in the last 3 months	Illness experienced	29	28.71
	No disease	37	36.63
	Can't remember	21	20.79
	Not reported	14	13.86
Symptoms in the past 3 months	None	13	12.87
	Benign	19	18.81
	Moderate	25	24.75
	Moderately severe	9	8.91
	Severe	0	0
	Not reported	35	35.65
Smoking status	Smoking	34	33.66
	Non-smoker	55	54.45
	Not reported	12	11.88
Drink alcohol	Yes	22	21.78
	No	71	70.29
	Not reported	8	7.92

critical gaps in occupational health protection, with only 15.84% of workers using personal protective equipment, necessitate an integrated intervention approach. The development of an appropriate regulatory framework, combined with investment in hazardous waste management infrastructure and worker training programs, remains a priority for effective ecological transition. Regional collaboration through ECOWAS initiatives and strategic preparation for electric vehicle transition present additional opportunities for Guinea to establish sustainable automotive waste management systems. Future research should focus on developing context-specific circularity indicators, conducting biomarker-based health assessments, and exploring innovative financing mechanisms to support the transition toward formalized circular economy practices in the ELV sector.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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