
Waste Management Implications of Ageing Vehicles in India

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Abstract

India's rapid expansion in vehicle ownership has transformed mobility, economic activity, and urban connectivity. However, this growth has also generated an under-recognised waste management challenge: ageing vehicles that have exceeded their functional and regulatory lifespans. Privately and commercially owned vehicles of over 15 and 10 years old, respectively, contribute disproportionately to air pollution, fuel inefficiency, road safety risks, and environmental degradation. Recognising these concerns, the Government of India has introduced age-based vehicle fitness and scrappage regulations to phase out unfit vehicles and promote a circular economy. While these policies are environmentally motivated, their successful implementation depends heavily on managerial effectiveness, institutional coordination, and stakeholder engagement.

The findings suggest that vehicle scrappage policies can yield substantial environmental and economic benefits, including reduced emissions, improved fuel efficiency, resource recovery, and employment generation in recycling-related activities. However, these outcomes depend on the development of a robust waste management ecosystem supported by incentives, transparent monitoring mechanisms, and public-private collaboration. The paper concludes that managing waste from ageing vehicles should be viewed not merely as a regulatory obligation but as a strategic management function aligned with India's sustainable mobility goals. Strengthening institutional capacity, promoting consumer participation, and embedding circular-economy principles into vehicle lifecycle management are essential to transforming end-of-life vehicles from environmental liabilities into opportunities for sustainable growth.

Keywords: Waste Management, End-of-Life Vehicles, Vehicle Scrappage Policy, Sustainable Mobility, Scrap Vehicles, Dry Waste Management, Curbing Pollution.

Introduction

India's rapid growth in motor vehicle ownership has been closely linked to enhanced mobility, economic integration, and urban expansion. Less visible, but increasingly consequential, is the accumulation of ageing vehicles that have outlived their functional, environmental, or regulatory relevance. Vehicles exceeding prescribed age thresholds, i.e., 15 years for private vehicles and 10 years for commercial vehicles³, tend to exhibit higher emission intensities, lower fuel efficiency, and elevated safety risks. Collectively, these ageing vehicles represent a growing source of solid and hazardous waste that remains inadequately addressed within India's broader waste management and mobility frameworks.

This paper examines waste management issues associated with end-of-life vehicles (ELVs) in the Indian market from a general management perspective. The study is based entirely on secondary data, drawing on government policy documents, sustainability reports, automotive industry publications, and existing academic literature. It seeks to analyse how vehicle age regulations influence waste generation, recycling practices, and organisational decision-making within the broader framework of sustainable development. It highlights that ageing vehicles generate complex waste streams, including metals, plastics, rubber, oils, batteries, and electronic components, many of which pose environmental and health risks if improperly handled. In India, a significant portion of ELV dismantling takes place in the informal sector, characterised by inadequate safety standards and limited environmental oversight. Although formal scrapping facilities are being promoted, infrastructure gaps, uneven regional implementation, and low public awareness continue to limit their effectiveness. From a management standpoint, the study identifies key challenges, including fragmented governance, a lack of coordination among regulatory agencies, limited private-sector participation, and resistance from vehicle owners driven by both economic and emotional factors. Commercial fleet operators face additional operational and financial pressures when mandated to replace ageing vehicles without sufficient transition support. Automobile manufacturers, on the other hand, are increasingly expected to integrate end-of-life considerations into product design and supply chain strategies.

The Union Government of India has introduced age-based vehicle fitness norms and a national vehicle scrappage policy⁴ to phase out unfit vehicles, reduce pollution, and promote resource recovery. While the policy signals a shift toward sustainable mobility and circular economy principles, its implementation reveals deeper managerial and governance challenges. End-of-life vehicles (ELVs) generate complex waste streams comprising metals, plastics, rubber, oils, batteries, and electronic components, many of which require specialised handling to avoid environmental and public health harm. However, in India, ELV dismantling and recycling continue to be dominated by informal actors operating outside formal regulatory oversight, often under unsafe and environmentally unsound conditions.

Statement of Problem

The central problem addressed in this paper is not the absence of regulation, but the fragmentation of governance and management mechanisms surrounding ELVs. Policy intent remains unevenly translated into operational outcomes due to weak inter-agency coordination, limited formal recycling infrastructure, inconsistent enforcement across regions, and resistance from vehicle owners driven by economic constraints and behavioural factors⁵. From a management perspective, ELVs are still treated primarily as a compliance issue rather than as part of an integrated lifecycle system involving regulators, manufacturers, fleet operators, recyclers, and consumers.

This paper argues that without a coherent waste management ecosystem supported by institutional coordination, stakeholder alignment, and strategic incentives, vehicle scrappage policies risk failing to meet their environmental and economic objectives. Accordingly, the study seeks to reframe ELV management in India as a strategic governance and managerial challenge central to achieving sustainable mobility and circular economy goals.

Conceptual Framework and Methodology

This study adopts a conceptual and policy-analytical approach to examine end-of-life vehicle management in India, drawing upon insights from management theory, sustainability studies, and public policy analysis. Two complementary theoretical lenses guide the analysis. First, institutional theory⁶ is used to interpret how regulatory structures, enforcement mechanisms, and institutional capacity shape organisational behaviour and policy outcomes. In contexts characterised by institutional voids or fragmented governance, well-intentioned policies often yield uneven results, a pattern particularly evident in India's ELV ecosystem. Second, circular economy⁷ principles provide a lifecycle-oriented perspective, emphasising resource efficiency, extended producer responsibility, and the reintegration of recovered materials into production systems. Together, these frameworks enable an examination of ELVs not merely as waste, but as managed outcomes of interconnected institutional and managerial decisions across the vehicle lifecycle.

Methodologically, the paper is based on a qualitative systematic review of secondary data sources. The review encompasses government policy documents, regulatory guidelines, and reports issued by the Ministry of Road Transport and Highways (MoRTH), the Central Pollution Control Board (CPCB), NITI Aayog, and industry bodies like the Society of Indian Automobile Manufacturers (SIAM). In addition, peer-reviewed academic literature on vehicle scrappage, ELV recycling, circular economy practices, and sustainable mobility was examined to situate Indian developments within a broader scholarly context⁸. Sources were selected based on their relevance to ELV governance, implications for waste management, and managerial or policy-oriented insights.

The analytical process involved thematic synthesis, whereby data were coded and interpreted in relation to recurring themes, including waste composition, institutional coordination, informal sector dynamics, stakeholder incentives, and policy implementation gaps⁹. Rather than aggregating quantitative indicators, the study focuses on conceptual integration and policy mapping to identify structural patterns and governance challenges. This approach is appropriate given the study's objective of informing policy design and managerial practice rather than evaluating programmatic outcomes. Where appropriate, conceptual diagrams and schematic representations are used to illustrate the ELV ecosystem, waste streams, and regulatory interventions, thereby enhancing analytical clarity while maintaining a concise narrative suitable for a policy-oriented conceptual paper.

Table: State-Wise Registered Vehicles and Estimated ELV (Vehicles ≥ 15 Years) – India

State / UT	Registered Vehicles (approx.)	Vehicles ≥ 15 Years (ELV Proxy)	Notes / Source
Andhra Pradesh	~13.1 million (2019–20)	Included in AP split but not separate	MoRTH road transport yearbook data
Assam	~4.36 million (2019–20)	~0.6% of total ELV (NE states very low)	MoRTH + ELV share national analysis

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State / UT	Registered Vehicles (approx.)	Vehicles \geq 15 Years (ELV Proxy)	Notes / Source
Bihar	~9.90 million (2019–20)	~0.4% of national ELV	MoRTH + ELV share national analysis
Chhattisgarh	~6.99 million (2019–20)	Not separately published	MoRTH
Goa	~1.46 million (2019–20)	Not separately published	MoRTH
Gujarat	~26.8 million (2019–20)	~4.3 lakh (4% national share)	MoRTH + ELV share estimate
Haryana	~8.60 million (2019–20)	~3.9 lakh (3% national share)	MoRTH + ELV share estimate
Karnataka	~26.1 million (2019–20)	~17.3 lakh (14% national share)	MoRTH + ELV share estimate
Kerala	~14.1 million (2019–20)	~6.5 lakh (5% national share)	MoRTH + ELV share estimate
Madhya Pradesh	~17.9 million (2019–20)	~>5% national share	MoRTH + ELV share estimate
Maharashtra	~37.2 million (2019–20)	~5.8 lakh (5% national share)	MoRTH + ELV share estimate
Punjab	(Not fully listed)	~4.1 lakh (3% national share)	ELV share estimate
Tamil Nadu	(Not fully listed)	~10.8 lakh (9% national share)	ELV share estimate
Uttar Pradesh	(Not fully listed)	~10.4 lakh (9% national share)	ELV share estimate
West Bengal	(Not fully listed)	~10.3 lakh (9% national share)	ELV share estimate
Delhi	(Not fully listed)	~17.5 lakh (15% national share)	ELV share estimate
India Total	~326.30 million (as of 31 Mar 2020)	>61 million vehicles \geq 15 years	MoRTH + national ELV estimate

Explanation & Notes

- Registered Vehicles: The figures in the “Registered Vehicles” column are from the official Road Transport Yearbook 2019–20, provided by the Ministry of Road Transport and Highways (MoRTH), which is the most recent, fully consolidated, state-wise dataset publicly available.
- Vehicles \geq 15 Years (ELV Proxy): Because formal ELV counts are sparse at the state level, a commonly accepted proxy is the count/share of vehicles that are 15 years or older, as these are the ones subject to scrappage norms. Nationally, there are over 61 million vehicles aged 15+ years (\approx 17.9% of the total fleet) as of March 2023.

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- State ELV Distribution: A 2023 analysis based on VAHAN transport data indicates that the top states account for about 76–78% of the national ELV burden, with Delhi, Karnataka, Tamil Nadu, Uttar Pradesh, and West Bengal together contributing over half.
 - Telangana Data Specificity: Telangana’s official VAHAN data historically has been partially separate (not fully on VAHAN 4.0 as of 2024), making complete comparative counts tricky; recent media reports suggest Telangana had around 17.3 million registered vehicles by March 2025 (1.73 crore) from rapid annual additions, but official ELV breakouts for Telangana specifically are not yet published in the public ELV dataset.

Analysis and Discussion

The management of end-of-life vehicles in India presents a complex interplay between material flows, institutional arrangements, and stakeholder behaviour. Ageing vehicles generate heterogeneous waste streams that include high-value, recoverable materials such as steel and aluminium, alongside low-value or hazardous components, including plastics, rubber, lubricants, batteries, and electronic parts. While metals are relatively easier to recover and recycle, non-metallic and hazardous fractions pose significant environmental and health risks when processed without adequate safeguards. In the absence of systematic dismantling protocols, these materials often enter informal recycling chains, contributing to soil contamination, air pollution, and occupational hazards¹⁰.

A defining characteristic of the Indian ELV ecosystem is the predominance of the informal sector¹¹. Informal dismantlers operate with minimal capital investment, rely on manual labour, and function outside formal environmental and safety regulations. Their persistence is not merely a consequence of regulatory non-compliance but an outcome of economic incentives and institutional gaps¹². Informal operators offer higher immediate returns to vehicle owners by avoiding compliance costs, while formal scrappage facilities face higher operational expenses, licensing requirements, and uneven policy support across states. From an institutional perspective, this reflects a governance imbalance in which enforcement capacity and incentive alignment remain insufficient to shift ELV flows into formal channels.

Managerial challenges also arise from fragmented regulatory oversight. Responsibilities related to vehicle registration, fitness certification, pollution control, and waste management are distributed across multiple agencies, often with limited coordination. This fragmentation creates ambiguity for stakeholders and weakens accountability mechanisms. Commercial fleet operators, particularly in logistics and public transport, face operational disruptions and financial pressure when mandated to retire ageing vehicles without adequate transition support or financing mechanisms. For private vehicle owners, emotional attachment, resale expectations, and information asymmetries further influence resistance to scrappage, undermining policy effectiveness.

Automobile manufacturers occupy a critical yet underdeveloped role in the ELV governance framework. Although extended producer responsibility is increasingly discussed in policy discourse, its practical integration into vehicle design and supply chain strategies remains limited. Design choices that complicate disassembly or material separation reduce recycling efficiency and increase

downstream environmental costs. From a circular economy perspective, this represents a missed opportunity to embed end-of-life considerations into product development, procurement, and reverse logistics systems.

Conceptually, these dynamics can be represented through a lifecycle-based ELV ecosystem map illustrating interactions among regulators, manufacturers, vehicle owners, dismantlers, and recyclers, along with points of policy intervention and leakage into informal channels. Such a representation highlights that ELV-related waste outcomes are shaped less by individual actor behaviour and more by the structural coherence of the governance and management system as a whole. Without integrated oversight and aligned incentives, age-based scrappage regulations alone are unlikely to deliver their intended environmental and economic benefits.

The Government of Telangana has recently introduced a Vehicle Fleet Modernisation Policy that encourages voluntary scrapping of ageing end-of-life vehicles through targeted incentives, including motor vehicle tax concessions, green tax waivers, and infrastructure investments in registered scrapping facilities and automated testing stations. This state-level initiative exemplifies how subnational governance can complement national policy frameworks by creating localised incentive structures and expanding formal scraping infrastructure.¹³

Key Findings and Policy Suggestions

The analysis yields several interrelated findings that highlight both the potential and the limitations¹⁴ of India's current approach to managing end-of-life vehicles. First, age-based vehicle scrappage policies have the potential to reduce emissions, improve fuel efficiency, and facilitate material recovery, but only when supported by a strong institutional capacity and coordinated implementation. Regulatory intent alone is insufficient; without effective enforcement, monitoring, and incentive alignment, a significant share of ELVs continues to bypass formal recycling systems.

Second, the continued dominance of the informal dismantling sector reflects structural governance failures rather than a lack of awareness among stakeholders. Informal operators remain economically competitive because formal scrappage facilities face higher compliance costs, uneven access to finance, and inconsistent policy support across regions. This suggests that transitioning ELV processing into the formal sector requires not only stricter regulation but also managerial strategies that integrate informal actors through training, certification, and phased formalisation rather than outright exclusion.

Third, stakeholder incentives¹⁵ across the entire lifecycle of the ELV remain poorly aligned. Vehicle owners, particularly commercial fleet operators, often experience scrappage mandates as a financial burden rather than a value-generating transition. Manufacturers, while increasingly aware of sustainability expectations, lack strong regulatory or market incentives to design vehicles with dismantling and recyclability in mind. As a result, responsibility for ELV waste management is effectively shifted downstream to recyclers and local authorities, weakening lifecycle accountability.

State-level incentives, such as those under Telangana's voluntary scrappage framework, including tax rebates on new vehicle purchases after scrapping and waivers of outstanding taxes, illustrate how financial mechanisms can shift owner behaviour and support formal ELV flows.

Based on these findings, several policy and managerial suggestions emerge. Strengthening inter-agency coordination through a unified ELV governance framework could reduce regulatory fragmentation and improve accountability. Financial incentives, such as scrappage-linked subsidies, tax credits, or access to green financing, may encourage vehicle owners and fleet operators to participate in formal scrapping systems. Clearer mandates and incentives for manufacturers to adopt design-for-disassembly principles could enhance material recovery and reduce downstream waste management costs.

Public-private partnerships (PPP) can play a critical role in expanding formal scrap infrastructure and improving regional equity in implementation. Additionally, transparent digital tracking mechanisms for ELVs, from deregistration to dismantling, could improve monitoring¹⁶ and reduce leakage into informal channels. Collectively, these measures shift ELV management from a reactive compliance exercise toward a strategic function embedded within sustainable mobility and circular economy objectives.

Conclusion

The management of end-of-life vehicles in India represents a critical yet underexamined dimension of the country's transition toward sustainable mobility. While age-based vehicle fitness and scrappage policies signal an important regulatory shift, their effectiveness ultimately depends on the coherence of the surrounding management and governance ecosystem. This study has shown that ELVs should not be viewed merely as regulatory liabilities or waste disposal problems, but as strategic resources whose environmental and economic value can be realised through coordinated institutional action, aligned stakeholder incentives, and lifecycle-oriented management practices.

By adopting an interdisciplinary conceptual perspective, the paper highlights that persistent challenges in ELV management stem less from policy gaps than from fragmented implementation, informal-sector dominance, and limited integration of circular-economy¹⁷ principles into vehicle design and disposal systems. Addressing these issues requires strengthening institutional capacity, fostering public-private collaboration, and encouraging active participation from vehicle owners, manufacturers, and recyclers alike. When effectively managed, ELVs can contribute to emission reduction, resource recovery, employment generation, and broader sustainability objectives.

Scope for Future Research

The study also identifies several avenues for future research. Empirical investigations comparing the implementation of ELV policies across Indian states could yield insights into context-specific governance dynamics. Comparative studies examining India's ELV framework alongside those of the European Union or other emerging economies may further inform policy learning. In addition, research exploring behavioural and economic factors that influence vehicle owner responses to scrappage mandates, as well as supply-chain redesign for circular mobility, would deepen the understanding of how ELV management can be operationalised more effectively. Conclusively,

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reframing end-of-life vehicle management as a strategic issue is essential for transforming ageing vehicles from environmental burdens into opportunities for sustainable growth within India's evolving mobility landscape.

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