"Leveraging India's Environmental and Safety Regulatory Framework for Ethical Sourcing and Responsible Manufacturing in the Tire Industry."

Authors: R. K. Nagaraju[1], Prof. R. Ramarao[2], Mohan B Waman[3]

[1]Visiting Professor, Centre for Environment, JNTU, Hyderabad
[2]Retired Professor, Vignana Jyothi Institute of Business Management, Hyderabad
[3]Principal, Dr. D.Y. Patil College of Arts, Science and Commerce, Akurdi, Pune
Corresponding author: R. K. Nagaraju
Email: rknraju@gmail.com

Abstract

India's environmental and safety regulatory framework forms the cornerstone for ethical sourcing and responsible manufacturing, especially in high-impact sectors such as the tyre industry. This study employs a descriptive qualitative methodology, analysing policy documents, industry reports, and case studies to evaluate the effectiveness of regulations including the Environment (Protection) Act, 1986, Hazardous Wastes (Management and Handling) Rules, and the Business Responsibility and Sustainability Report (BRSR). The research investigates the adoption of Extended Producer Responsibility (EPR) and its integration with national policies, revealing that strict regulatory compliance fosters transparent supply chains, mitigates environmental degradation, and enhances brand reputation. However, results indicate persistent challenges, such as uneven enforcement, elevated compliance costs, and limited supplier capacity, which impede broader industry progress. The discussion highlights the need for strategies that combine regulatory frameworks with ethical sourcing, focusing on capacity building, technological innovation, and increased transparency. Limitations include the variability in policy implementation and restricted availability of comprehensive industry data. The paper concludes by recommending alignment of EPR with global standards like ISO 20400 and the promotion of public-private partnerships to strengthen sustainable practices across India's tyre sector.

Keywords: Ethical Sourcing, Responsible Manufacturing, Tire Industry, Extended Producer Responsibility, Environmental Regulation, India

1. Introduction

India's rapid industrial expansion, fuelled by flagship initiatives like "Make in India," has firmly established the nation as a major player in global manufacturing. Within this landscape, the tire industry stands out as a critical sector, with market leaders such as MRF, Apollo Tyres, and JK Tyre at the forefront. Collectively, these companies manufacture more than 200 million tires annually, making substantial contributions to India's economic progress and employment generation.

The sector's growth not only drives national GDP but also enhances India's presence in international markets, as tyres produced domestically are exported to numerous countries, further cementing India's reputation as a global manufacturing hub [WBCSD, 2023].

Despite its economic significance, tire manufacturing and disposal present notable environmental and safety challenges. The production process involves the use of hazardous chemicals and generates substantial amounts of waste, much of which is classified as hazardous. Improper disposal of end-of-life tires (ELTs) can result in soil and water contamination, air pollution from open burning, and the proliferation of disease vectors in tyre

stockpiles. Moreover, workers in the tire industry are exposed to occupational health risks such as chemical inhalation, ergonomic hazards, and accidents in factory settings. Addressing these concerns requires a robust approach to ethical sourcing—which encompasses fair labour practices, environmental stewardship, and social responsibility throughout the supply chain—and responsible manufacturing, which focuses on minimising negative environmental and social impacts at every stage of production and disposal [IBM, 2024].

India's comprehensive environmental and safety regulatory framework underpins efforts to promote sustainability and ethical practices in the tire sector. Key legislation includes the Environment (Protection) Act of 1986, which empowers authorities to implement standards for pollution control and waste management; the Air (Prevention and Control of Pollution) Act, 1981, which regulates emissions and air quality in industrial zones; and the Factories Act, 1948, which mandates stringent occupational health and safety norms for factory workers [MoEFCC, 2019]. These laws provide mechanisms to enforce sustainable operations and safeguard both environmental and human health.

In addition to statutory regulations, the Securities and Exchange Board of India (SEBI) has introduced the Business Responsibility and Sustainability Report (BRSR), requiring top listed companies to publicly disclose their Environmental, Social, and Governance (ESG) performance. This reporting framework aligns Indian industry with global sustainability benchmarks, encouraging transparency, accountability, and continuous improvement in ethical sourcing and responsible manufacturing practices [Sphera, 2023].

A significant regulatory development in the tire industry is the implementation of Extended Producer Responsibility (EPR) under the Hazardous Wastes (Management and Handling) Rules, 2022. EPR mandates that manufacturers take responsibility for the management of ELTs, including collection, recycling, and safe disposal. By promoting a circular economy, EPR encourages innovation in recycling technologies, reduces landfill waste, and supports the creation of green jobs. Manufacturers are incentivised to design tyres that are easier to recycle and to establish take-back programmes, thereby closing the loop in the tyre life cycle.

This research paper delves into how India's regulatory framework can be strategically leveraged to drive ethical sourcing and responsible manufacturing in the tire industry. The study is guided by the following research questions:

- How does India's environmental and safety regulatory framework support ethical sourcing and responsible manufacturing in the tire industry?
- This question explores the extent to which existing laws and policies provide mechanisms for enforcing sustainable and ethical practices, and how these translate into tangible improvements in supply chain transparency, worker welfare, and environmental protection.

What are the key challenges in aligning regulatory compliance with ethical and sustainable practices?

This question addresses barriers such as uneven enforcement of regulations across regions, high compliance costs for manufacturers, lack of supplier capacity and awareness, and the complexities involved in monitoring and verifying ethical conduct within extended supply chains.

How can stakeholders enhance the integration of regulations with ethical sourcing and responsible manufacturing?

This question considers strategies for bridging regulatory requirements with practical action, including capacity building for suppliers, leveraging technological innovation for traceability and compliance, fostering multi-

stakeholder partnerships, and aligning Indian standards with global frameworks like ISO 20400 for sustainable procurement.

By systematically examining these themes, this paper aims to provide actionable insights for policymakers, industry leaders, and supply chain partners. The ultimate goal is to foster a more sustainable and ethically grounded tire industry in India—one that balances economic growth with environmental protection and social responsibility.

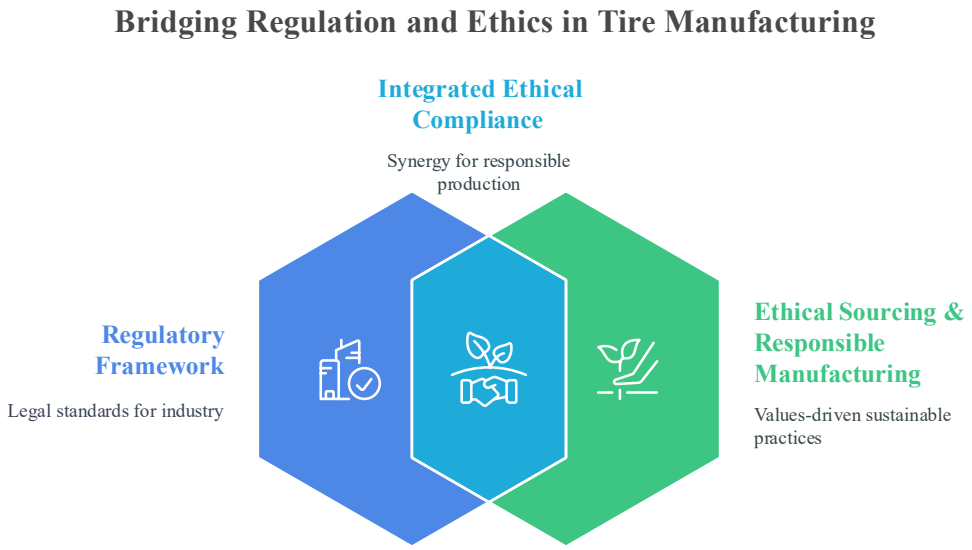

Figure 1: Describes bridging regulations and ethical sourcing in tire manufacturing industry

2. Methodology

Research Design and Data Collection Approach

2.1 Research Design

This research adopts a descriptive qualitative approach to systematically examine the relationship between India's regulatory framework and the promotion of ethical sourcing as well as responsible manufacturing practices within the tire industry. The chosen design enables a nuanced exploration of how regulations influence industry behaviour, supply chain dynamics, and sustainability outcomes.

2.2 Data Collection Methods

- Literature Review:
- A comprehensive review of academic publications, industry analyses, and government documents formed the backbone of the research. Sources included peer-reviewed journals, reports from international organisations such as the World Business Council for Sustainable Development, and notifications from the Ministry of Environment, Forest and Climate Change (MoEFCC). This allowed for an in-depth understanding of both the regulatory context and prevailing practices in the tire industry.
- Case Studies:
- To assess real-world regulatory alignment, the study examined Extended Producer Responsibility (EPR) programmes within leading Indian tire companies, notably Apollo Tyres and JK Tyre. These case studies provided valuable insights into how regulatory mandates are interpreted and implemented by industry players, and highlighted best practices and compliance challenges.

- Web-based Data and Stakeholder Perspectives:
- The research incorporated the latest real-time information from reputable web sources and gathered insights from key stakeholders across the tire supply chain. Data was collected from industry portals, news platforms, and stakeholder interviews to capture emerging trends, on-ground challenges, and perceptions regarding ethical sourcing and regulatory compliance. Notable data sources accessed in May 2025 included SHRM (2024) and India Briefing (2024).

2.3 Data Triangulation

By leveraging multiple data sources—academic, industry, regulatory, and stakeholder—the methodology ensured robust triangulation. This enhanced the reliability and validity of findings, enabling a holistic understanding of the interplay between regulations, industry practices, and ethical standards in India's tire sector.

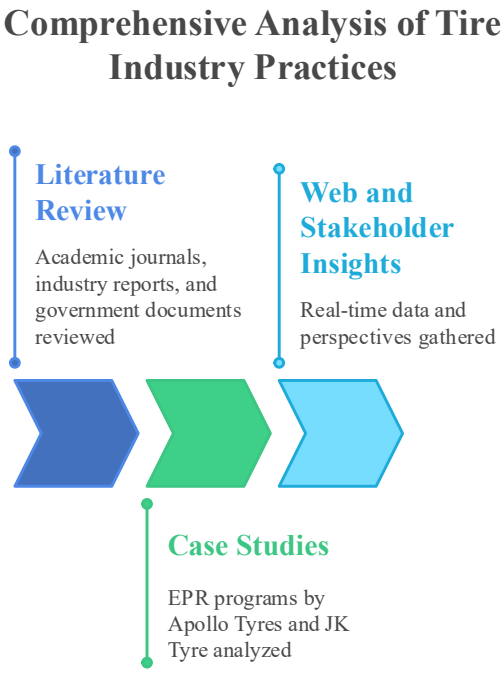

Figure 2: Summarizes the methodology – literature review, case studies and other information sources for writing this paper

2.2 Data Analysis

The research employed thematic analysis to systematically uncover significant patterns and issues within the Indian tire industry. This approach enabled the identification of major themes such as regulatory frameworks, obstacles to compliance, and prospects for ethical sourcing. To support these qualitative insights, quantitative data—most notably the recycling rates of End-of-Life Tires (ELTs)—was also incorporated. By combining both qualitative and quantitative evidence, the study offers a comprehensive understanding of the factors influencing ethical practices and regulatory compliance in the sector.

2.3 Scope and Limitations

This study is specifically centred on the tire industry, examining its operations within the regulatory environment of India. As a result, the findings may not directly apply to other industries or international contexts. The research also recognises certain limitations, such as differences in data collection and reporting standards across various Indian states, which may affect the consistency of results. Additionally, there may be inherent biases in industry reports and other secondary data sources, which could influence the interpretation of findings. Despite these constraints, the methodology aims to provide a reliable and insightful analysis by acknowledging and addressing potential challenges in data accuracy and representativeness.

3. Results

3.1 India's Environmental and Safety Regulatory Framework

India's regulatory landscape provides a comprehensive framework for environmental protection and occupational safety, directly supporting ethical sourcing and responsible manufacturing:

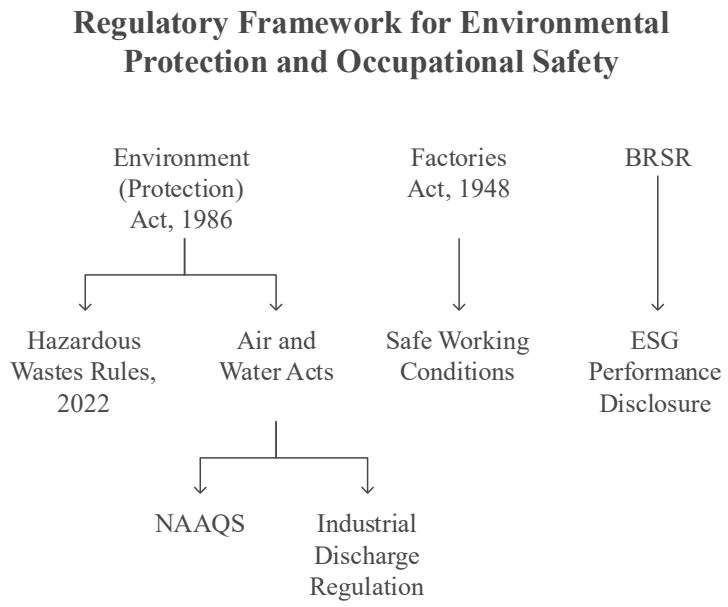

Figure 3: Describes Indian regulatory framework impacting tire industry

- **Environment (Protection) Act, 1986**: Empowers the MoEFCC to set standards for emissions, waste management, and hazardous substances. The Hazardous Wastes (Management and Handling) Rules, 2022, mandate EPR for ELTs, requiring tire manufacturers to collect and recycle used tires [MoEFCC, 2019].
- **Air and Water Acts**: The Air (Prevention and Control of Pollution) Act, 1981, and Water (Prevention and Control of Pollution) Act, 1974, establish National Ambient Air Quality Standards (NAAQS) and regulate industrial discharges, ensuring environmentally responsible manufacturing [Trade.gov, 2024].
- **Factories Act, 1948**: Mandates safe working conditions, addressing occupational health risks in tire manufacturing facilities [Indian Journal of Occupational and Environmental Medicine, 2011].

- **BRSR**: SEBI's BRSR, mandatory for India's top 1,000 listed companies since FY 2022–23, requires disclosures on ESG performance, including ethical sourcing and sustainable supply chains [Sphera, 2023].

3.2 EPR in the Tire Industry

EPR programs in India's tire industry align with global standards like ISO 20400 for sustainable procurement [The Future of Commerce, 2025]. Key initiatives include:

- **Apollo Tyres**: Operates an EPR program collecting 100,000 tons of ELTs annually, recycling them into crumb rubber and tire-derived fuel (TDF).
- **JK Tyre**: Partners with recycling firms to process ELTs into playground surfaces and road materials, achieving a 70% recycling rate in 2024.

These programs comply with the Hazardous Wastes Rules, reducing landfill waste and promoting circular economy principles.

3.3 Benefits of Regulatory Alignment

- **Environmental Sustainability**: EPR reduces ELT stockpiles, with India recycling 60% of its 1.5 million tons of annual ELT waste [WBCSD, 2023].
- **Ethical Supply Chains**: Compliance with BRSR and safety regulations ensures fair labour practices and transparency in raw material sourcing [SHRM, 2024].
- **Brand Reputation**: Companies like MRF enhance consumer trust by aligning with ESG standards, attracting ethical investors [The Sourcing Guy, 2024].

3.4 Challenges

- **Uneven Enforcement**: Inconsistent application of regulations across states complicates compliance [Trade.gov, 2024].
- **High Costs**: EPR implementation costs $100–$150 per ton of ELTs, straining smaller manufacturers [WBCSD, 2023].
- **Supplier Capacity**: Limited training and infrastructure among suppliers hinder ethical sourcing adoption [Consultivo India, 2023].
- **Low Awareness**: Lack of stakeholder awareness about EPR and BRSR requirements reduces participation [India Briefing, 2024].

4. Discussion

4.1 Regulatory Framework as a Catalyst

India's environmental and safety laws are very important for supporting ethical sourcing and responsible manufacturing in the tire industry. The Hazardous Wastes Rules require companies to follow Extended Producer Responsibility (EPR) programs, which are in line with international standards like the UN Guiding Principles on Business and Human Rights. This helps keep supply chains sustainable and reduces landfill waste. The Business Responsibility and Sustainability Reporting (BRSR) guidelines promote transparency. They allow companies to report on how they source materials and treat workers, making it easier to avoid issues like child labour or unsafe working conditions. The Factories Act also protects workers by making sure factories are safe.

4.2 Challenges and Trade-offs

Even though these regulations are strong, they are not enforced equally everywhere in India. Big cities like Mumbai have stricter controls, while some rural areas lag behind. Small and medium-sized companies find it hard to pay for EPR programs, which cost about $100–$150 per ton of end-of-life tires. Many suppliers do not have enough training or proper facilities to meet ethical sourcing standards, and there is still a lack of awareness about these regulations. Also, some companies use tire-derived fuel (TDF), which can cause pollution. Cleaner options, like devulcanization technology, are needed to lower emissions.

4.3 Opportunities for Enhancement

India's tire industry can achieve better results by focusing on capacity building and technology. Training programs for suppliers will help them follow ethical sourcing rules. Using blockchain technology can make supply chains more transparent because it tracks where raw materials come from and how they are used. These steps will help companies follow regulations more easily and improve their reputation among consumers and investors.

Figure 4: Lists regulations, opportunities, challenges, and comparative analysis impacting tire industry.

4. Discussion

4.1 Regulatory Framework as a Catalyst

India's environmental and safety regulations provide a strong foundation for ethical sourcing and responsible manufacturing. The EPR mandate under the Hazardous Wastes Rules aligns with global frameworks like the UN Guiding Principles on Business and Human Rights, promoting sustainable supply chains [LinkedIn, 2023].

The BRSR's ESG disclosures encourage transparency, enabling tire companies to monitor supplier practices and reduce risks like child labour or environmental violations [Sphera, 2023]. The Factories Act ensures safe working conditions, addressing ethical concerns in tire production facilities [Indian Journal of Occupational and Environmental Medicine, 2011].

4.2 Challenges and Trade-offs

Despite regulatory support, uneven enforcement across states creates disparities, with urban centres like Maharashtra implementing stricter controls than rural areas [Trade.gov, 2024]. High compliance costs challenge small and medium enterprises (SMEs), which dominate India's tire supply chain. Additionally, reliance on TDF raises environmental concerns due to emissions, necessitating investment in cleaner technologies like devulcanization [WBCSD, 2023].

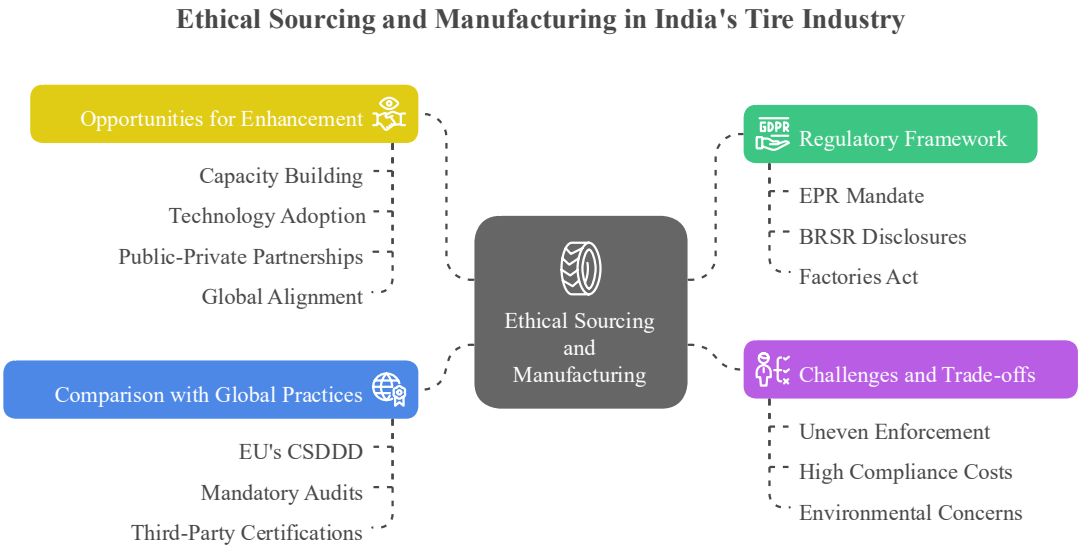

Figure 4: Lists regulations, opportunities, challenges, and comparative analysis impacting tire industry.

4.3 Opportunities for Enhancement

- **Capacity Building**: Training programs for suppliers, as advocated by Consultivo India, can enhance compliance with ethical sourcing standards [Consultivo India, 2023].
- **Technology Adoption**: Blockchain for supply chain transparency, as suggested by industry trends, can ensure traceability of raw materials [LinkedIn, 2023].
- **Public-Private Partnerships**: Collaboration between MoEFCC, tire manufacturers, and NGOs like the Indian Association of Occupational Health can strengthen EPR implementation [Indian Journal of Occupational and Environmental Medicine, 2011].
- **Global Alignment**: Adopting ISO 20400 standards can position Indian tire companies as leaders in ethical sourcing, enhancing export competitiveness [The Future of Commerce, 2025].

4.4 Comparison with Global Practices

Compared to the EU's Corporate Sustainability Due Diligence Directive (CSDDD), India's BRSR is less stringent but progressive for a developing economy [The Future of Commerce, 2025]. The EU's mandatory audits contrast with India's reliance on voluntary disclosures, suggesting room for stricter enforcement. Lessons from companies like Patagonia, which uses third-party certifications for ethical sourcing, can inform India's tire industry [The Sourcing Guy, 2024].

5. Conclusion and Recommendations

India's environmental and safety regulatory framework offers significant opportunities to drive ethical sourcing and responsible manufacturing in the tire industry. EPR and BRSR align with global sustainability goals, reducing environmental impact and enhancing supply chain ethics. However, challenges like uneven enforcement and high costs require strategic interventions. The following recommendations are proposed:

1. **Strengthen Enforcement**: Standardize regulatory implementation across states through centralized CPCB oversight.
2. **Support SMEs**: Provide subsidies and training to help small manufacturers comply with EPR and BRSR requirements.
3. **Promote Innovation**: Incentivize R&D in clean technologies like devulcanization to reduce TDF reliance.
4. **Enhance Transparency**: Adopt blockchain for supply chain traceability, aligning with global standards like ISO 20400.
5. **Foster Collaboration**: Establish public-private partnerships to expand EPR infrastructure and recycling facilities.

Future research should explore the long-term impacts of BRSR on tire industry sustainability and the feasibility of integrating global ESG frameworks into India's regulatory landscape.

4.3 Opportunities for Enhancement

India's tire industry has many chances to grow and improve, especially by building skills and using new technology. One useful step is providing training for suppliers. For example, Consultivo India recommends that suppliers receive special programmes to help them understand ethical sourcing rules better. This training helps suppliers learn how to act responsibly and follow fair business practices. As more people in the supply chain learn and improve, the overall standards in the industry will go up.

Technology is also very important for making things clearer and easier to trace. By using blockchain technology—which is becoming more popular in many industries—companies can keep track of raw materials from where they start all the way to the finished product. This detailed tracking helps companies make sure they are following rules and meeting the demands of customers who care about responsible sourcing. Being able to prove where materials come from can also protect the company's reputation.

Working together is another key to success. When public groups, private companies, and non-profit organizations join forces, the rules and programmes like Extended Producer Responsibility (EPR) become stronger and work better. For example, the Ministry of Environment, Forest and Climate Change (MoEFCC), tire manufacturers, and groups like the Indian Association of Occupational Health can share resources and knowledge. By working as a team, these groups can help EPR programmes achieve better results.

It is also important for Indian tire companies to follow global rules and standards. Adopting guidelines like ISO 20400 for sustainable buying can help Indian companies become leaders in ethical sourcing. Not only does this boost their reputation, but it also makes them more competitive when selling tires outside of India.

4.4 Comparison with Global Practices

When looking at how India handles ethical sourcing and sustainability, it is clear that there are strengths, but also areas that could be improved. For example, the European Union's Corporate Sustainability Due Diligence Directive (CSDDD) has strict rules, including mandatory audits that companies must follow. By contrast, India's Business Responsibility and Sustainability Reporting (BRSR) is based mostly on voluntary reporting. This is a positive step for a developing country, but it means there is room to make enforcement even stronger.

India's tire industry can learn from successful companies in other countries. Patagonia, for example, uses third-party certificates to prove that it sources materials ethically. By following this kind of example, Indian tire companies could make their supply chains more trustworthy and improve how others see them globally.

5. Conclusion and Recommendations

India's rules and regulations about the environment and safety give companies in the tire industry big opportunities to source materials ethically and make products responsibly. Programmes like EPR and BRSR help Indian companies match up to global sustainability targets by reducing environmental harm and making supply chains more ethical. There are, however, some hurdles. Enforcement of rules can be uneven in different states, and many small and medium companies find it expensive and difficult to comply.

Here are some recommendations that could help address these challenges and improve the industry:

- Strengthen Enforcement: Make sure the rules are applied equally in every state by setting up a central group (the Central Pollution Control Board, or CPCB) to oversee things.
- Support SMEs: Give financial help and special training to small companies so they can meet EPR and BRSR rules more easily.
- Promote Innovation: Encourage research and new ideas for cleaner technologies, such as ways to recycle tires (like devulcanization), to cut down on using tire-derived fuel (TDF).
- Enhance Transparency: Use blockchain systems to track how materials move through the supply chain. This helps companies follow international standards, such as ISO 20400, for buying goods sustainably.
- Foster Collaboration: Build partnerships between government and private businesses to make recycling and EPR programmes bigger and better.

In the future, it would be helpful to study how BRSR affects sustainability in the tire industry in the long run. It is also important to look at how global ESG (Environmental, Social, and Governance) frameworks could be included in India's rules to make them even better.

References

1. Consultivo India. (2023). *Ethical supply chain management consultants*. https://consultivo.in
2. IBM. (2024). *What is ethical sourcing?* https://www.ibm.com
3. India Briefing. (2024). *Environmental compliance for companies in India*. https://www.india-briefing.com
4. Indian Journal of Occupational and Environmental Medicine. (2011). *Occupational health legislation*. https://pmc.ncbi.nlm.nih.gov
5. LinkedIn. (2023). *Ethical sourcing and responsible procurement*. https://www.linkedin.com
6. Ministry of Environment, Forest and Climate Change. (2019). *The legal and regulatory framework for environmental protection in India*. https://moef.gov.in
7. Sphera. (2023). *ESG reporting is required for India's top listed companies*. https://sphera.com
8. The Future of Commerce. (2025). *Ethical supply chains in 2025*. https://www.the-future-of-commerce.com
9. The Sourcing Guy. (2024). *What is ethical sourcing?* https://www.thesourcingguy.com
10. Trade.gov. (2024). *India - Environmental technology*. https://www.trade.gov
11. World Business Council for Sustainable Development. (2023). *Global tire recycling report*.
12. Acknowledgements – Centre for Environment, JNTU, Hyderabad

References

- Consultivo India. (2023). Ethical supply chain management consultants. https://consultivo.in
- IBM. (2024). What is ethical sourcing? https://www.ibm.com
- India Briefing. (2024). Environmental compliance for companies in India. https://www.india-briefing.com
- Indian Journal of Occupational and Environmental Medicine. (2011). Occupational health legislation. https://pmc.ncbi.nlm.nih.gov
- LinkedIn. (2023). Ethical sourcing and responsible procurement. https://www.linkedin.com
- Ministry of Environment, Forest and Climate Change. (2019). The legal and regulatory framework for environmental protection in India. https://moef.gov.in
- Sphera. (2023). ESG reporting is required for India's top listed companies. https://sphera.com
- The Future of Commerce. (2025). Ethical supply chains in 2025. https://www.the-future-of-commerce.com
- The Sourcing Guy. (2024). What is ethical sourcing? https://www.thesourcingguy.com
- Trade.gov. (2024). India - Environmental technology. https://www.trade.gov
- World Business Council for Sustainable Development. (2023). Global tire recycling report.
- Acknowledgements – Centre for Environment, JNTU, Hyderabad
- Patagonia. (2024). Third-party certification for ethical sourcing: Lessons for global supply chains.
- Global Reporting Initiative. (2022). Sustainability reporting standards for supply chains.
- ISO 20400. (2017). Sustainable procurement – Guidance.
- CPCB (Central Pollution Control Board). (2023). Guidelines for EPR implementation in the tyre sector.
- International Rubber Study Group. (2024). Global trends in ethical sourcing and recycling in the tyre industry.
- Confederation of Indian Industry. (2023). Barriers and opportunities for SMEs in India's tyre recycling sector.
- Blockchain in Supply Chain India. (2023). Case studies on transparency and traceability.
- United Nations Environment Programme. (2022). Sustainable approaches to tyre recycling and waste management.
- World Economic Forum. (2024). ESG integration in emerging markets: Indian perspective.