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Sustainable Industrialization in India: Public Perceptions, MSME Challenges, and Cluster-Based Green Transition

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Abstract – **For India to balance social justice, environmental protection, and economic growth, sustainable industrialization has become a national imperative. Greenhouse gas emissions reached an estimated 3.22 billion tonnes of CO2 in 2025, even as renewable energy capacity crossed 50.07% of total installed power (484.82 GW), enabling India to meet its COP26 targets ahead of schedule. However, industrial activities continue to generate pollution, deplete resources, and deepen regional and social inequalities.**

This study uses a mixed-methods design combining a primary survey of 70 respondents across India, secondary data from government and international reports, case studies of industrial clusters, and an extensive literature review. The analysis identifies four interlinked pillars for a sustainable industrial future: unified policy frameworks, technological innovation and circular economy practices, green finance and MSME empowerment, and cluster-based strategies for collective compliance.

Survey findings reveal that 91.4% of respondents are aware of sustainability concepts, 97.1% believe industries contribute significantly to pollution, and 68.6% prefer buying from companies that follow eco-friendly and fair practices. A total of 50.0% are willing to support renewable energy use even at higher prices, while 50.7% see high cost/finance as the key barrier for MSMEs to adopt green practices.

The results highlight strong public support for inclusive green industrialization, with 78.3% favouring fair jobs and inclusion of women and weaker sections and 68.6% endorsing cluster-based industrial development with shared green infrastructure. The paper recommends phased policy, financial, and managerial interventions to promote MSME greening, strengthen cluster governance, and advance a just transition aligned with India's net-zero 2070 commitment.

Keywords – **Sustainable industrialization, MSMEs, Industrial clusters, Green finance, Public perception, Green**

transition, Circular economy, Net-zero 2070, CETPs, Green manufacturing, Environmental sustainability

I. INTRODUCTION

Industrialization has long been the backbone of modern economic development in India, acting both as a driver of growth and a source of environmental and social stress. Post-independence policy regimes moved from state-led planning to economic liberalization in the 1990s and, more recently, toward globalization and competitiveness. The traditional growth path, based on resource-intensive production and uneven regional development, is increasingly incompatible with the realities of climate change, resource scarcity, and persistent inequality. Sustainable industrialization has therefore emerged as a strategic national priority, seeking to integrate economic performance with environmental stewardship and social inclusion. This paper examines how India can transition from a high-emissions, resource-heavy industrial model to a more resilient, inclusive, and low-carbon industrial system, with a particular focus on the role of MSMEs and industrial clusters.

A. Rationale for Sustainable Industrialization – India is currently one of the world's largest emitters of carbon, with industry – especially steel, cement, and chemicals – contributing a significant share of overall emissions. Without decisive mitigation measures, industrial emissions risk undermining India's Paris Agreement commitments and long-term ecological security. Industrialization has also been spatially and socially uneven, with industrial hubs concentrated in select states while large regions remain underdeveloped. High levels of labour informality, gender disparities, and the marginalization of weaker sections further accentuate exclusion. Survey evidence from this study shows that 78.3% of respondents believe industries should focus on fair jobs and inclusion of women and weaker sections.

MSMEs form the backbone of India's industrial base, contributing close to 30% of GDP and employing over 100 million people, yet face financial, technological, and infrastructural constraints in adopting green practices. In the survey, 50.7% of respondents identified high cost/finance as the biggest barrier for MSMEs, followed by lack of awareness (21.7%) and lack of technology (11.6%).

B. Current Policy Landscape and Green Industrialization – From the 2010s onward, sustainability has gained prominence in industrial and energy policy through renewable energy targets, energy-efficiency programmes

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such as Perform, Achieve and Trade (PAT), and sector-specific interventions. The National Green Hydrogen Mission (2023) aims to promote green hydrogen for decarbonizing hard-to-abate sectors, while the Green Steel Mission (2024) targets emission reductions in one of the most carbon-intensive industries. Recent initiatives emphasise "green MSME" policies, cluster-level greening, and incentives for advanced technologies including carbon capture, utilization and storage (CCUS). The National Manufacturing Mission positions clean-tech manufacturing—such as solar PV modules, EV batteries, and wind turbines—as central to India's strategy for aligning industrialization with its net-zero 2070 trajectory.

C. Research Gap and Significance – Existing literature on sustainable industrialization in India often treats environmental and economic dimensions separately and pays limited attention to social inclusion and public perceptions. Case studies frequently focus on specific sectors or regions, offering limited insight into nationwide patterns or cross-cluster lessons. There is also a shortage of integrated frameworks linking industrial policy, MSME dynamics, cluster-based approaches, and citizen attitudes to sustainability. This research contributes by combining literature review, policy analysis, case evidence, and updated primary survey data from 70 respondents to develop a holistic framework that balances economic, environmental, and social priorities.

II. LITERATURE REVIEW

A. Academic and Policy Perspectives

Singh and Kumar (2020) trace India's industrial policy evolution and find that while sustainability rhetoric has strengthened, implementation and monitoring mechanisms remain weak, underscoring the need for coherent targets and incentives. UNIDO (2021) highlights the potential of green industrial clusters, showing that shared infrastructure such as common effluent treatment plants (CETPs) and energy services can reduce compliance costs and accelerate technology diffusion, provided governance and financing are robust. NITI Aayog (2020) stresses public–private partnerships, technology adoption, and data-driven monitoring to align industrial growth with sustainable development. The World Bank (2022) suggests that early gains can be achieved through energy efficiency and targeted electrification, while process-intensive sectors require long-term technology shifts. Das and Rao (2021) analyse MSMEs and conclude that although some firms innovate locally, many lack access to capital, skills, and market incentives, reinforcing the importance of tailored finance and technical assistance.

B. Case Studies of Sustainable Practices in India

Several industrial clusters illustrate practical pathways towards sustainable industrialization. The Tirupur textile cluster in Tamil Nadu has implemented CETPs and water-recycling systems that significantly reduce effluent pollution. The Surat diamond and textile cluster demonstrates cost savings and competitiveness gains through large-scale solar adoption and efficient machinery. The Morbi ceramic cluster in Gujarat has shifted to gas-based kilns and waste-heat recovery, reducing air pollution and improving product quality. In Kanpur's leather cluster, CETPs have helped mitigate severe water pollution, while Pithampur in Madhya Pradesh has piloted circular economy initiatives involving material recovery, recycling, and waste-to-energy solutions. These cases show that cluster-based interventions can combine environmental compliance with economic gains when supported by appropriate institutional and financial arrangements.

III. RESEARCH OBJECTIVES

This study aims to:

- Analyse the evolution of India's industrial policies towards sustainable and inclusive growth.
- Examine the role of MSMEs in driving green and climate-resilient industrial development.
- Evaluate the impact of industrial clusters on resource efficiency and emission reduction.
- Identify key challenges in implementing sustainable industrialization, including financial, technological, and regulatory barriers.
- Assess the effectiveness of green manufacturing technologies in reducing industrial carbon footprints.
- Explore social inclusion dimensions such as gender participation, employment for marginalized groups, and regional equity.
- Examine the integration of circular economy practices in industrial sectors.
- Evaluate how sustainable industrialization affects economic competitiveness and productivity.
- Analyse public perceptions, awareness, and attitudes through primary survey research.

Propose actionable strategies and frameworks to balance growth, environmental sustainability, and social inclusion in India's industrial sector.

IV. RESEARCH METHODOLOGY

A. Research Design – The study follows a descriptive-exploratory design, integrating policy analysis, literature review, case study evaluation, secondary data synthesis, and primary survey data. This mixed-methods approach is intended to provide both breadth and depth on sustainable industrialization and MSME dynamics.

B. Primary Data Collection – A structured questionnaire items was administered through Google Forms between September 2025 and February 2026. The instrument covered demographics, awareness of sustainability, perceptions of industrial pollution, views on MSMEs and green practices, consumer preferences, policy support, and perceived barriers. Convenience sampling was used, targeting Indian residents with at least basic awareness of

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industrial and environmental issues. A total of 70 respondents completed the survey, and ongoing survey.

C. Secondary Data, Case Studies, and Global Benchmarking – Secondary data were drawn from government reports (e.g., Ministry of Commerce and Industry, NITI Aayog, Central Pollution Control Board, MoEFCC), industry and ESG reports, academic publications, and international organizations such as the World Bank, IEA, UNIDO, and WRI. Few case studies were selected purposively from Indian industrial clusters and MSMEs that have adopted green practices, circular economy models, or inclusive employment strategies. Global benchmarking compared India's approaches with those of leading countries in sustainable industrialization to assess the transferability of international best practices to the Indian context.

D. Sampling Strategy For the primary survey, respondents were required to be Indian residents with at least basic awareness of industrial and environmental issues. The gender distribution was 51.4% male (36) and 48.6% female (34). Among 69 valid occupation responses, 53.6% were "other", 27.5% salaried, 15.9% self-employed, and 2.9% business owners. For the case studies, purposive sampling was used based on adoption of green technologies, participation in industrial clusters, evidence of social inclusion, and ESG compliance.

Gender Distribution	
Male	51.4% (36)
Female	48.6% (34)

Occupation	
Salaried	27.50%
Self Employed	15.90%
Business Owner	2.90%
Other	53.60%

V. DATA ANALYSIS AND FINDINGS

a. Awareness and Perceptions of Industrial Pollution – A total of 91.4% of respondents had heard of "sustainability" or "green industry". Overall, 97.1% believed that industries contribute significantly to pollution, with 55.7% answering "Yes, a lot" and 41.4% "Yes, but some industries". When asked about the most critical type of pollution caused by industries, 61.4% cited air pollution, followed by waste (18.6%) and water pollution (17.1%). An overwhelming 65.7% considered it "very important" and 24.3% "important" that industries reduce pollution, indicating strong public concern.

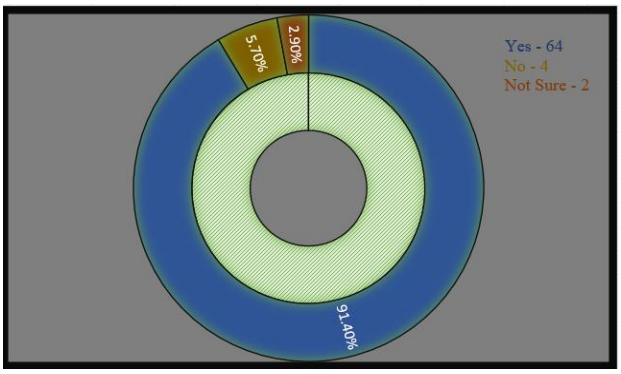

Fig. 1 - Awareness of Sustainability and Green Industry.

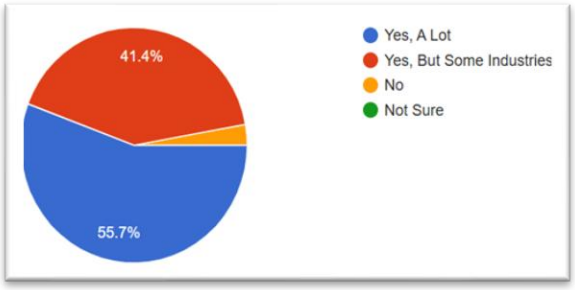

Fig. 2: Perception of Industrial Contribution to Pollution in India.

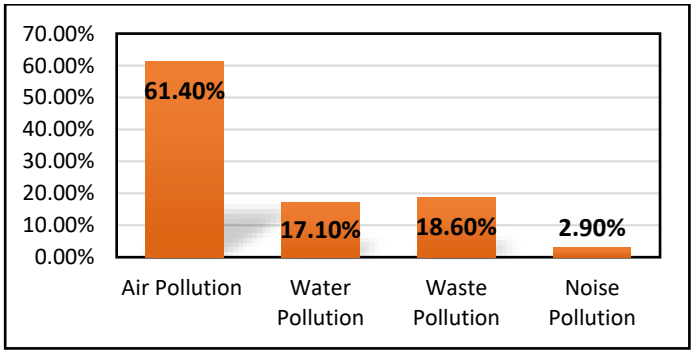

Fig. 3: Major Types of Pollution Caused by Industries.

b. Views on MSMEs and Green Practices – Two-thirds of respondents (67.1%) believed MSMEs can play a role in protecting the environment, though 22.9% were not sure and 8.6% disagreed. A majority (60.0%) reported seeing or hearing of industries near them adopting eco-friendly practices such as solar power, recycling, or energy-saving machines. High cost/finance emerged as the dominant perceived barrier for MSMEs to adopt green practices, selected by 50.7% of respondents, followed by lack of awareness (21.7%) and lack of technology (11.6%). Only 8.7% choose "lack of government support," and 7.2% "no demand for eco-friendly products," suggesting that financial and informational constraints overshadow pure demand-side issues.

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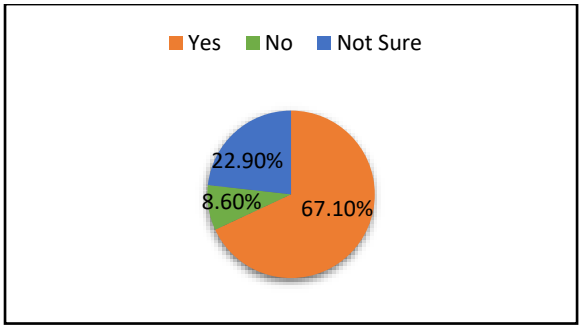

Fig. 4: Perception of MSMEs' Role in Environmental Protection

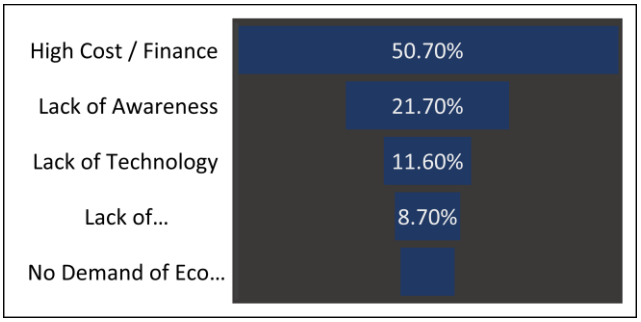

Fig. 5: Perceived Barriers for MSMEs in Adopting Green Practices

c. **Consumer Preferences and Behaviour** – A total of 68.6% of respondents said they would prefer buying from companies that follow eco-friendly and fair practices, and another 24.3% said it would depend on price. Similarly, 50.0% would support industries using renewable energy even if products cost more, while 35.7% said "maybe" and only 8.6% said "no". Environmental concerns already influence behaviour: 54.3% reported having avoided a product because they thought it was harmful to the environment, and 34.3% had done so sometimes. When asked how they would support green industries, 37.7% chose "paying slightly more for eco-friendly products", 34.8% "spreading awareness", and 24.6% "choosing eco-friendly brands over others".

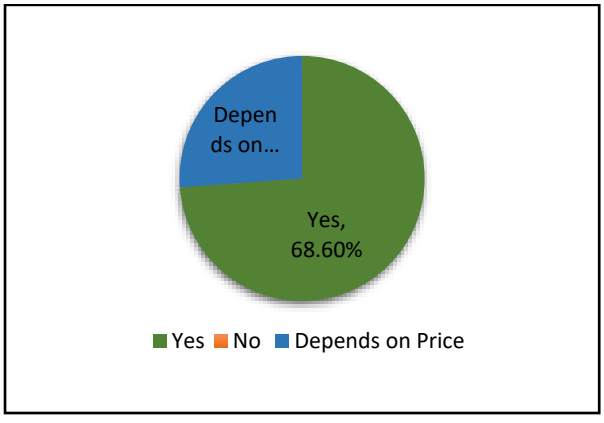

Fig. 6: Consumer Preference for Eco-Friendly and Fair Practice Companies.

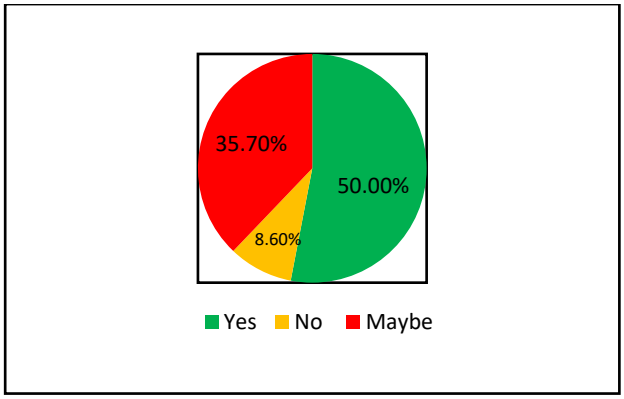

Fig. 7: Consumer Willingness to Support Renewable Energy-Based Industries at Higher Cost.

d. **Social Inclusion and Employment** – A combined 78.3% either strongly agreed (50.7%) or agreed (27.5%) that industries should focus on fair jobs and inclusion of women and weaker sections. Only 2.9% disagreed and 18.8% were neutral. Regarding jobs, 71.4% believed sustainable industries can create more employment in India, 20.0% were not sure, and 7.1% disagreed. These results indicate that respondents do not see green transitions as inherently job-destroying and instead expect net employment gains.

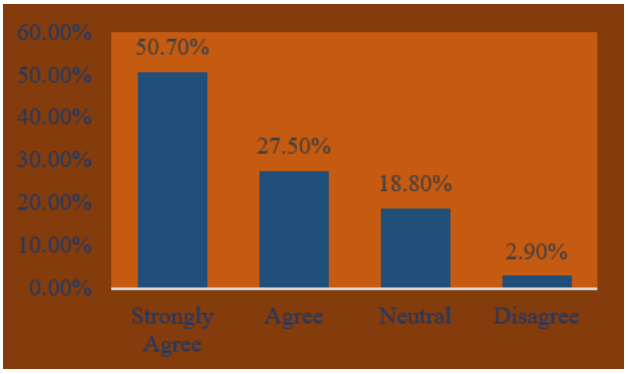

Fig. 8: Attitude Toward Social Inclusion in Industries.

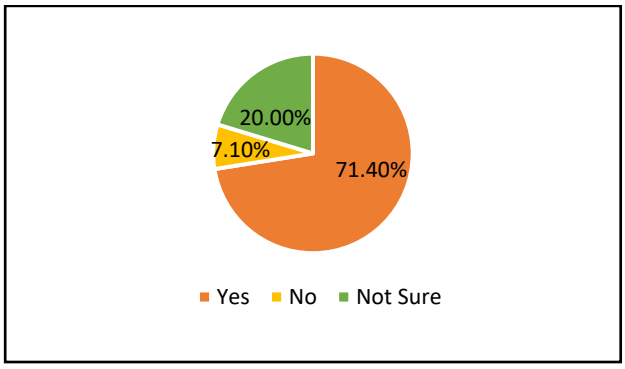

Fig. 9: Perception of Job Creation Potential.

e. **Policy, Governance, and Cluster-Based Approaches** – Views on government performance were mixed: 35.7% felt the government is not doing enough to promote sustainable industries, 32.9% believed it is, and 28.6% were not sure. At the same time, 62.9% believed industries can

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adopt green practices with the support of government incentives such as tax breaks, subsidies, and training. Regarding leadership, 51.5% stated that government, businesses, and consumers should act together, 29.4% selected government alone, 11.8% business owners, and 7.4% consumers. Cluster-based industrial development with shared green infrastructure (e.g., CETPs, waste treatment plants) was supported by 68.6% of respondents, with 17.1% not sure and 11.4% opposed. Finally, 54.3% believed India can become a global leader in green and sustainable industries, 27.1% said "maybe", and the remaining respondents were either unsure or disagreed.

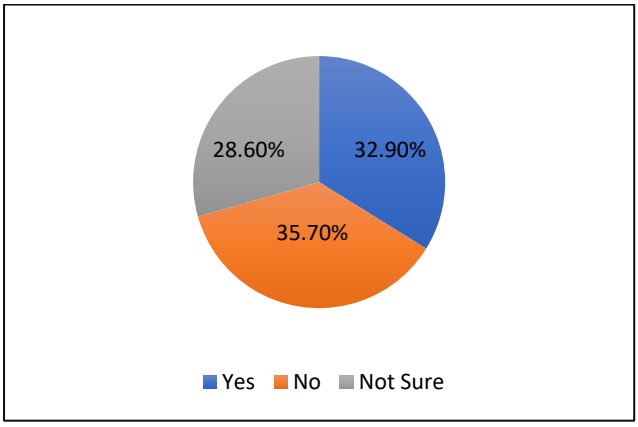

Fig. 10: Public Opinion on Government Efforts to Promote Sustainable Industries in India.

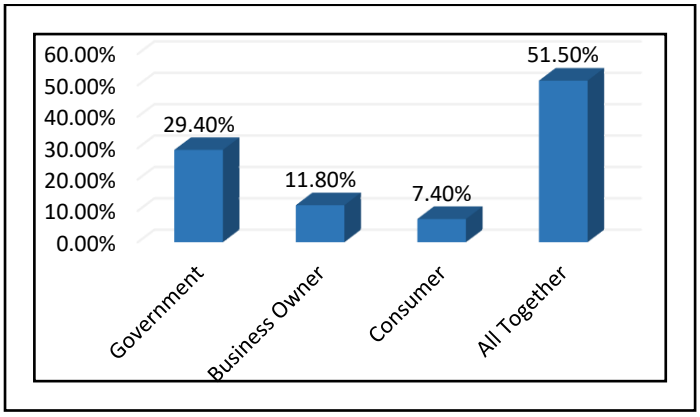

Fig. 11: Perceived Responsibility for Promoting Sustainable Industries.

Discussion – The findings confirm a strong public mandate for sustainable industrialization, combining high awareness of sustainability with concern about industrial pollution and support for green products. This aligns with international evidence that consumer preferences increasingly favour environmentally responsible firms and suggests growing domestic market space for green offerings. The emphasis on finance as the main barrier for MSMEs indicates that green transitions will require targeted credit, concessional finance, and risk-sharing mechanisms rather than purely regulatory pressure. Cluster-based strategies, backed by the case evidence from Tirupur, Surat, Morbi, Kanpur, and Pithampur, offer an effective way to spread costs, share infrastructure, and facilitate technology diffusion, especially for smaller firms. Strong support for social inclusion and green job creation underscores the importance of designing just transition policies that combine worker protection, skill development, and opportunities for women and marginalized groups. Mixed views on government performance but high confidence in incentives point to a need for visible, well-communicated programmes that bridge policy intent and on-ground implementation.

VI. CONCLUSION AND MANAGERIAL IMPLICATIONS

India faces a critical imperative to shift from resource-intensive, pollution-heavy industrialization toward a sustainable model that balances growth, employment, and environmental protection. The survey results show high awareness of sustainability (91.4%), widespread recognition of industrial pollution (97.1%), and strong preferences for eco-friendly and fair-practice companies (68.6%). Financial constraints, particularly for MSMEs, remain the central obstacle to green adoption, while cluster-based approaches and shared infrastructure enjoy broad public support (68.6%). Social inclusion expectations are high, with 78.3% of respondents in favour of fair jobs and inclusion of women and weaker sections, and more than 71% seeing sustainable industries as a source of job creation. To translate this mandate into practice, coordinated action is required among policymakers, large enterprises, MSMEs, industry associations, and consumers, with a focus on green finance, cluster governance, technology diffusion, and just transition support.

a. Implications for Large Enterprises

- Integrate ESG proactively into core strategy to gain advantages in market access, investor relations, and operational efficiency.
- Green supply chains by supporting MSME suppliers with technical assistance, co-investment, and longer-term contracts.
- Invest in clean technologies and proprietary sustainability innovations to differentiate products and services.
- Enhance transparent sustainability reporting to build trust and signal long-term resilience.

b. Implications for MSMEs

- Prioritise low-cost, quick-payback energy efficiency measures such as efficient motors and lighting to free resources for deeper upgrades.
- Leverage cluster organizations for shared infrastructure, collective procurement, and knowledge sharing.
- Actively access government schemes, subsidies, and credit lines designed for green adoption.
- Communicate sustainability achievements to customers and buyers, especially in B2B markets where ESG performance is a selection criterion.

c. Implications for Industry Associations and Policymakers

- Develop centralized knowledge platforms on technologies, financing options, regulations, and best practices.

- Promote collective procurement of green technologies to reduce costs for member firms.
- Facilitate peer learning networks and cluster-level pilot projects to demonstrate benefits and build confidence.
- Design targeted green finance and incentive instruments that address MSME risk perceptions and collateral constraints.
- Embed social inclusion objectives into industrial and climate policies, including skills programmes, support for women-led enterprises, and safeguards for vulnerable workers.

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VIII. APPENDIX

Appendix – A

The primary data were collected from the respondents with the following questions in this research study. The survey was completed online and recorded on Google Forms.

i. Have you heard about the term "sustainability" or "green industry"?
ii. Do you think industries in India contribute significantly to pollution?

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iii. Which type of pollution do you think industries cause the most?
iv. Do you believe small businesses (MSMEs) can play a role in protecting the environment?
v. Have you seen or heard of industries near you adopting eco-friendly practices (solar, recycling, energy-saving machines)?
vi. Would you prefer buying from companies that follow eco-friendly and fair practices?
vii. Would you support industries using renewable energy (solar, wind) even if products cost a bit more?
viii. Do you think industries should also focus on fair jobs and inclusion of women and weaker sections?
ix. Do you think sustainable industries can create more jobs in India?
x. How important is it for you personally that industries reduce pollution?
xi. Have you ever avoided a product because you thought it was harmful for the environment?
xii. What do you think is the biggest barrier for small businesses (MSMEs) to adopt green practices?
xiii. Do you think customers in India care about eco-friendly products?
xiv. Do you think industries can balance growth, jobs, and environmental protection together?
xv. Do you think the Indian government is doing enough to promote sustainable industries?
xvi. Who should take the lead in promoting sustainable industries?
xvii. Do you believe that industries can adopt green practices with the support of government incentives such as tax breaks, subsidies, and training?
xviii. Would you support cluster-based industrial development (industries working together with shared green infrastructure like waste treatment plants)?
xix. Would you be willing to support green industries by:
xx. Do you think India can become a global leader in green and sustainable industries?

Appendix – B

The survey was initially designed and distributed with the Google Forms. The online version of the questionnaire, with original format and response layout, can be accessed via the link provided below.

https://docs.google.com/forms/d/e/1FAIpQLScnC3YItDRaAu_qmLOA2in8wYCMYMzkHTnIwXcXPORDtUIffQ/viewform?usp=sharing&ouid=102901556703091113310