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Decoding India's Lean–Green Financing Architecture for MSMEs: A Scheme-Wise Descriptive Analysis of Credit Flows, Sustainability Incentives, and Policy Alignment

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ABSTRACT: In India, Micro, Small, and Medium Enterprises (MSME) has played a major role in India's economic growth, generating employment, as well as in expanding India's industries. In recent times, promoting MSME in India regarding "lean" management as well as "green" sustainability through specialized funding initiatives has been a major focus of Indian authorities. This present study aims to explore emerging patterns in India's "lean green" MSME funding, particularly in major government programs promoting MSME's "lean" and "green" practices.

Through the application of another data-driven approach to analysis, the authors leverage secondary data by using official government documents, Reserve Bank of India documents, Ministry of MSME documents, as well as performance indicators. Scheme selection criteria form the foundation upon which the authors have identified specific schemes. These schemes include the Pradhan Mantri MUDRA Yojana Scheme, the CGTMSE Scheme, SIDBI's green initiative through MSE-GIFT and MSE-SPICE Scheme, as well as the ZED Certification Scheme.

The findings indicate a notable expansion in both the volume and scope of MSME lending; however, they also reveal significant gaps in the strategic integration of lean efficiency practices with the long-term sustainability objectives of green initiatives. Credit incentives, access to green funds, and effective risk-sharing mechanisms emerge as critical enablers for encouraging MSMEs to transition toward sustainable business models. At the same time, the study identifies persistent disparities in MSMEs' access to green initiatives, levels of awareness, cost burdens associated with green adoption, and managerial and executive capacity gaps. By addressing these dimensions collectively, the study contributes to the existing literature through the development of an integrated framework linking MSME finance, lean practices, green motivators, and performance outcomes. The study concludes with policy-oriented recommendations emphasizing the need for coordinated institutional support, dedicated green credit lines, and results-based financing mechanisms to enhance the resilience and sustainability of MSMEs.

KEYWORDS: MSMEs, Lean Management, Green Finance, Sustainable Development, MSME Financing, India, Policy Framework

1. INTRODUCTION

MSMEs hold a vital place in the economic landscape of India, with substantial contributions to national output, employment generation, and export performance. Recent reports suggest that MSMEs contribute almost 30% to the country's gross domestic product and employ more than 110 million people; therefore, MSMEs are very important for inclusive growth and sustainable development. Besides the economic contribution, MSMEs represent a very important segment of both the manufacturing and services sector with strong linkages with large industries and rural livelihoods.

Despite their significance in enhancing MSME activities and contributing to economic development at large, formal sources of finance remain a major challenge to MSMEs. A large proportion of MSMEs are not able to get adequate institutional credit. MSMEs face difficulties in accessing formal finances or face higher costs of borrowing finance owing to risks and lack of security instruments **(Kumar & Singh, 2023).** The inability of these firms to secure sustainable finances also affects their capacity to enhance and expand activities.

Concurrently, the global environment surrounding financial policies and strategies has also emphasized sustainability and climate change resilience. Thus, the emergence of the so-called "green finance"—the set of mechanisms used for achieving environmentally beneficial outcomes (United Nations Environment Programme **[UNEP], 2021)—**has been noted. Not only does the green finance allow for corporations to engage in energy-saving mechanisms and to adopt renewable energy resources in an organization-wide manner, but it also allows for the adoption of pollution reduction strategies. In the case of India, this sustainable finance mechanism has been noted as an important strategic area to be embraced within the overall set of environmental-based development strategies instituted within the framework of the overall set of National Determined Contributions (NDCs) to the global initiative for climate change and the broader set of Sustainable Development Agenda strategies **(NITI Aayog, 2022).**

Besides that, another significant paradigm that has evolved in recent years in addition to green finance is that of lean finance. It places significant emphasis on the optimisation of resources, waste elimination, and making processes more efficient in order to enhance productivity and cost-effectiveness (Womack & Jones, 2003). Having a strong lean mindset ensures that resources are used optimally, inefficiencies in the operations of the company are abolished, and a competitive advantage is secured—considering that these entities face resource challenges.

Recognizing not only the need to finance but also sustain MSME businesses in India, a number of initiatives in terms of finance schemes were launched by the Government of India. For example, there are initiatives like Pradhan Mantri MUDRA Yojana, through which small businesses are provided with credit on a collateral-free basis. Similar examples are schemes like the "Credit Guarantee Fund Trust for Micro and Small Enterprises" initiative that provides guarantees on credit to MSME businesses in India. Additionally, there are initiatives like the "Zero Defect Zero Effect" scheme through which businesses in India are incentivized to prefer sustainable and green practices. Furthermore, initiatives given by SIDBI in terms of schemes like MSE "Green Investment Finance for Transformation," "MSE SPICE" schemes are examples. They provide finance to MSME businesses in India with respect to investments in clean and green Technologies.

However, despite the attempts made through these schemes to fill various finance and sustainable gaps, literature shows there has not been any comprehensive study undertaken to analyse the integration of these lean and green finance schemes under various government schemes in the context of Indian MSMEs. Research conducted over past studies had focused mainly on exploring various finance issues faced by MSMEs, integration of green finance with the overall sustainability of enterprises **(Hima kumari & Martina Rani, 2025),** or evaluating the effectiveness of various government schemes **(Journal of Public Affairs, 2024).** However, a gap exists that needs to be fulfilled through a descriptive study regarding various schemes, or how these various schemes cumulatively make an impact.

In this regard, within the existing knowledge vacuum, this research aims to unlock and decode India’s lean green financing architecture for promoting MSMEs. This research aims to fill this critical knowledge vacuum through descriptive content on promotion that involves undertaking an integrated credit flow and thus applying descriptive analysis on promoting sustainable finance and policy. This involves synthesizing existing sources of information such as government sources, existing financial institutions, and policy documents that provide an integrated overview on how government financing schemes play an instrumental part in promoting lean and greening initiatives. This is critical to policy interventions and thus promoting sustainable finance.

2. LITERATURE REVIEW

The literature review attempts to synthesize the previous literature on MSME financing methods, lean and green practices, and the government schemes for sustainable development. There are gaps in the literature for the current study to be conducted.

MSME Financing Landscape in India

Usually, MSMEs have limited access to formal finance, which again hampers their ability to adopt modern technologies and expand their operations. It is estimated that only 16-20% of MSMEs have access to institutional finance while the remainder rely on informal sources, money lenders, or private borrowings. According to the Journal of Marketing & Social Research, 2025, major bottlenecks include:

- There is a lack of collateral or financial history.
- Interest rates that are very high
- Perception of Risk by Banks

Government interventions like MUDRA Yojana and CGTMSE attempt to address these gaps by providing collateral-free loans and credit guarantees to reduce lender risk **(SIDBI, 2025; Drishti IAS, 2025).**

Table 1: Key MSME Financing Schemes in India

Scheme	Objective	Key Features	Year Introduced
MUDRA Yojana	Facilitate credit to micro enterprises	Collateral-free loans, low interest	2015
CGTMSE	Reduce lending risk for banks	Credit guarantee for MSMEs	2000
SIDBI Green Finance	Promote energy efficiency and sustainability	Subsidized green loans, renewable energy support	2010
ZED Certification	Encourage quality and eco-friendly manufacturing	Incentives for lean & green practices	2016

Sources: *SIDBI (2025), Ministry of MSME (2023), Drishti IAS (2025)*

Lean Practices in MSMEs

Lean management mainly involves optimizing resources, eliminating waste, and optimizing costs. **Womack and Jones (2003)** characterize lean management as "a systematic approach to identifying and eliminating non-value-adding activities." In the context of MSMEs, the adoption of lean management enhances organizational efficiency without the need for capital expenses **(Rao & Sharma, 2024).** Based on the research, there are various benefits that accrue to MSMEs that adopt a lean approach, as shown by the following developments in:

- 10–15% cost reduction in production
- 15–20% faster delivery times
- Better inventory management

Lean practices are particularly effective when supported by financing schemes that reduce the burden of upfront costs for technology upgrades **(Himakumari & Martina Rani, 2025).**

Green Practices and Sustainable Finance

Green finance refers to investing in initiatives that have environmental benefits; some examples include energy conservation, adoption of renewable energy sources, decreased emissions, etc. (UNEP, 2021). Indian MSMEs have been utilizing the SIDBI Green Finance initiative along with the ZED Certification initiative to incorporate sustainability-related initiatives (SIDBI, 2025). According to studies:

Green MSMEs show 20–25% reduction in energy consumption over 3 years (Andriyani et al., 2025).

- Environmental compliance increases brand reputation and opens access to global supply chains (Trivedi & Jena, 2022).

Table 2: Benefits of Lean and Green Practices in MSMEs

Lean Practices	Green Practices
Cost Efficiency	Energy Efficiency
Resource Optimization	Sustainable Operations
Process Improvement	Environmental Compliance

Source: *Adapted from Womack & Jones (2003), SIDBI (2025)*

Government Schemes Promoting Lean- Green MSMEs

India has implemented several schemes integrating lean and green objectives, including:

- *MUDRA Yojana*: Provides collateral-free credit, enabling small firms to invest in efficiency improvements **(Drishti IAS, 2025)**.
- *CGTMSE*: Reduces risk for lenders, increasing access to capital for lean and green investments **(CGTMSE, 2025)**.
- *ZED Certification:* Encourages zero-defect production and environmentally friendly practices **(Ministry of MSME, 2023)**.
- *SIDBI Green Finance:* Supports energy efficiency, waste reduction, and adoption of clean technologies **(SIDBI, 2025)**.

The integration of these schemes ensures that MSMEs not only gain financial support but are incentivized to adopt operational efficiency and sustainability practices simultaneously.

Even though there exists various literature exploring each of these concepts, i.e., MSME finance, lean, or green adoption, none have specifically focused on an integrated approach toward problematizing the scheme-specific Indian finance framework with respect to lean and green adoption within the context of MSMEs in the country. The primary literature, as evident from past studies, highlights various studies conducted on independent financing schemes **(Kumar & Singh, 2023)**, sustainability adoption exclusive of finance **(Hima kumari & Martina Rani, 2025),** and approaches to undertaking lean adoption without finance **(Rao & Sharma, 2024).**

3. CONCEPTUAL FRAMEWORK

Figure 1 presents the conceptual framework of this study, mapping lean-green financing for MSMEs in India in a scheme wise manner. It captures, in a sequential manner, the flow from government schemes, through credit and sustainability incentives, to enterprise-level lean-green adoption, and ultimately alignment with national policy and developmental objectives. This framework guided the descriptive analysis undertaken in the study.

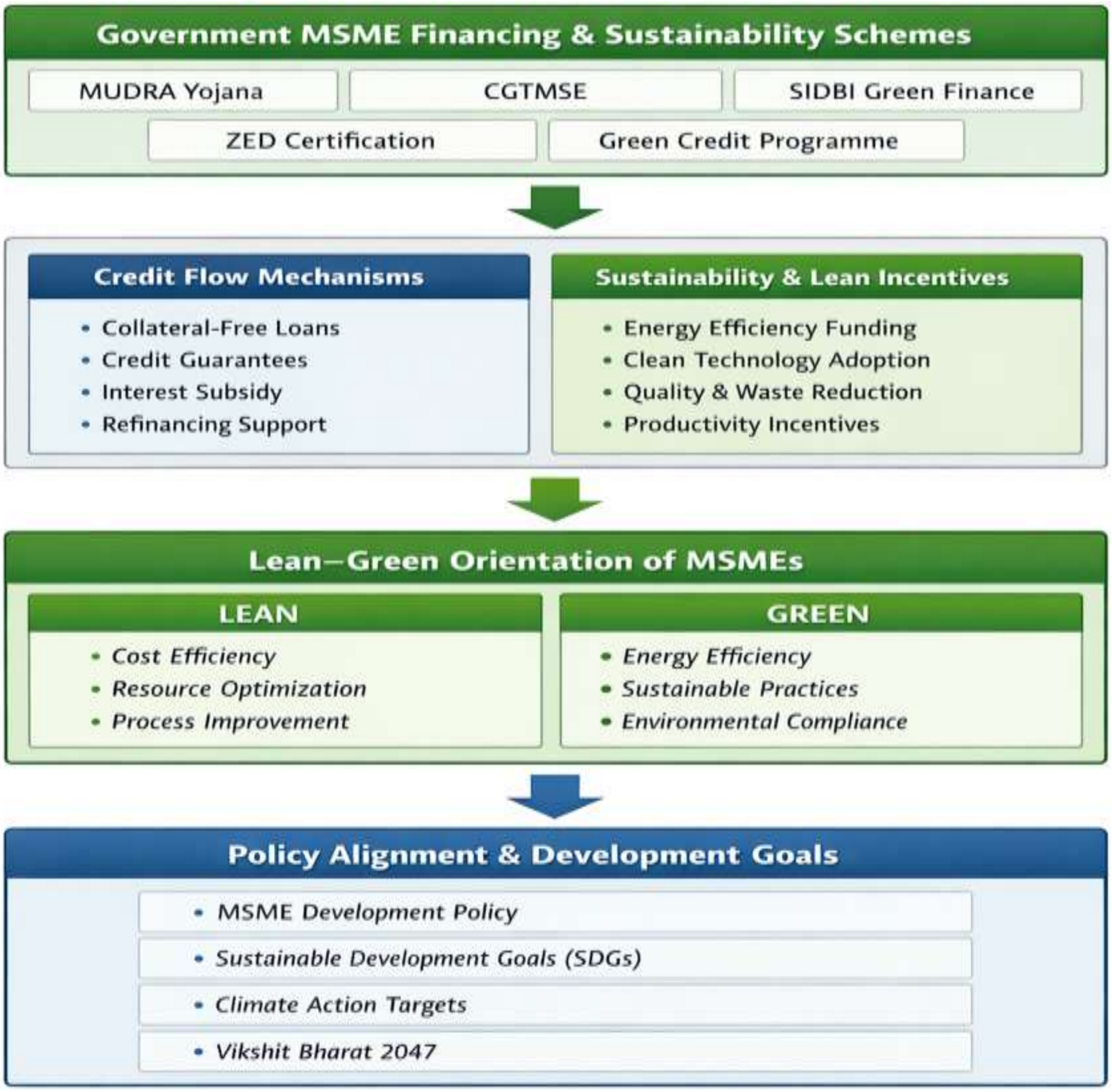
3.1 Government MSME Financing & Sustainability Schemes

The first layer consists of government-initiated schemes, acting as important catalysts in the lean-green transformation for MSMEs. These include the MUDRA Yojana, which provides collateral-free loans for the growth and upgradation of micro-enterprises **(Drishti IAS, 2025)**; CGTMSE, which provides credit guarantees to lenders for assessing risks and financing green technologies **(CGTMSE, 2025)**; ZED Certification, which enables zero-defect and eco-friendly manufacturing **(Ministry of MSME, 2023);** and SIDBI Green Finance, which supports clean technology, energy efficiency, and sustainability **(SIDBI, 2025).** All these collectively provide essential financial and non-financial incentives for Lean and Green practices.

3.2 Credit Flow Mechanisms & Sustainability Incentives

The second component of the suggested framework is comprised of critical mediating factors aimed at building on existing MSME growth. As such, there is the availability of credit flow assistance such as collateral-free credit, facilitators of guarantees, interest subsidies, as well as refinancing. This list of measures is supplemented by sustainability incentives such as aid for energy-efficient machinery, waste minimization initiatives, incentives related to sustainable energy resources, and productivity-related incentives. As such, there is a provision of critical financial liquidity for MSME firms even as sustainability is promoted. This ensures a healthy coexistence with the immediate environment. This is in line with the work of **Andriyani et al. (2025)** and **Trivedi & Jena; (2022).**

Figure 1. Scheme-Wise Lean–Green Financing Architecture for MSMEs in India



Note: The figure illustrates the sequential flow from government schemes (MUDRA, CGTMSE, ZED, SIDBI Green Finance), to credit flow mechanisms and sustainability incentives, influencing lean and green practices at MSME level, and aligning with policy and national development goals (SIDBI, 2025; Ministry of MSME, 2023).

3.3 Lean–Green Orientation of MSMEs

In the firm level, lean and green practices emerge with direct influence of incentives linked to government initiatives. Lean practices are directed toward cost reduction, process optimization, resource utilization efficiency, and enhanced productivity. Green practices address energy preservation, pollution reduction, sustenance of production process in a tangible way, and compliance with environmental legislation. The consolidation of lean and green initiatives generates a plethora of synergies, which enhance financial performance while achieving significant progress in environmental sustainability **(Hima kumari & Martina Rani, 2025).**

3.4 Policy Alignment & National Development Goals

The outermost layer places the implementation and adoption of lean green practices in MSMEs in its broader policy and development context. It emphasizes the high extent of alignment with the MSME Development Policy, significant added value to the attainment of Sustainable Development Goals, high supporting values to Global Climate Action goals, and high achievements in attaining the Vikshit Bharat 2047 vision. It is through these areas that the strategic

importance of lean green finance to national economic growth becomes apparent. As illustrated in Figure 1 above, the framework follows the sequential flow:
Government Schemes → Credit & Sustainability Incentives → Lean–Green MSME Practices → Policy & National Development Goals. This visualization offers a precise analytical perspective, enabling a clear descriptive study of the schemes in this research.

4. RESEARCH OBJECTIVES

1. To analyse the role of government financing schemes (MUDRA Yojana, CGTMSE, SIDBI Green Finance, ZED Certification) in facilitating access to credit for MSMEs in India.
2. To evaluate the impact of sustainability incentives embedded within government schemes on the adoption of green practices (energy efficiency, renewable energy, pollution reduction) by MSMEs.
3. To examine the integration of lean operational practices (process optimization, cost reduction, resource efficiency) with green initiatives among MSMEs receiving scheme support.
4. To assess the alignment of scheme-driven lean–green MSME practices with national policy and development goals, such as SDGs and *Vikshit Bharat 2047*.

5. METHODOLOGY

5.1 Research Design

Accordingly, the current study pursues a descriptive method of investigation to assess India's lean green financing mechanisms for MSMEs by undertaking a scheme-specific analysis of credit flows and environmental incentives therein. It may be rationalized that descriptive methods of investigation are more suitable while documentation of facts and processes and formulation of an outline of current laws, regulations, and policies in a nation-specific context are sought to be pursued **(Creswell, 2014).**
Given the nature of the research objectives, which emphasize mapping, comparison, and interpretation of government schemes, a secondary data–based approach was considered most suitable.

5.2 Sources of Data

The study is based entirely on secondary data, collected from credible and authoritative sources to ensure reliability and validity. The data sources include:

5.2.1 Government publications and official reports

- Ministry of MSME annual reports
- SIDBI annual and sustainability reports
- CGTMSE performance reports
- NITI Aayog policy documents

5.2.2 Institutional and regulatory sources

- Reserve Bank of India (RBI) MSME credit statistics
- World Bank and UNEP reports on green finance

5.2.3 Academic literature

- Peer-reviewed journal articles on MSME finance, lean practices, and green finance accessed through Google Scholar, JSTOR, and Scopus

5.2.4 Reputed policy and financial portals

- Drishti IAS
- Economic Times (ET BFSI)
- Government scheme dashboards

Secondary data usage is particularly appropriate for policy-oriented and macro-level studies where direct primary data collection may be resource intensive **(Johnston, 2017).**

5.3 Period of Study

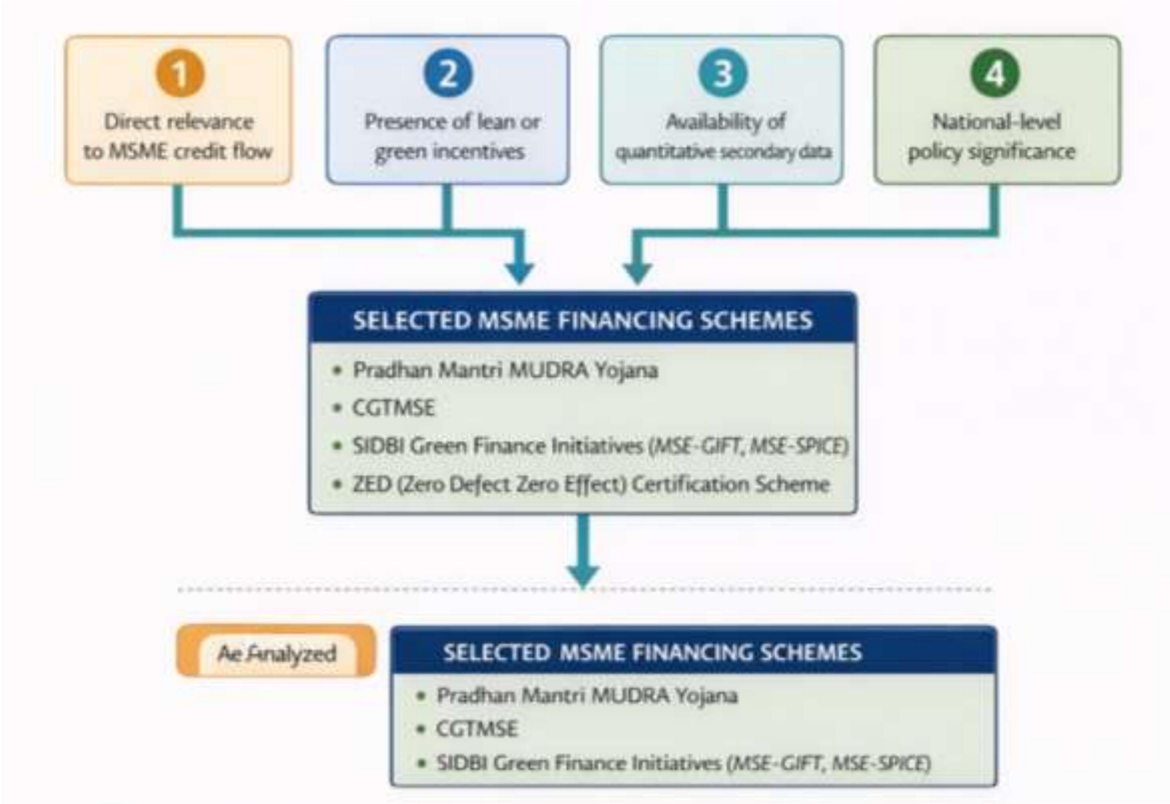
The analysis covers the period 2019–2025, which represents a phase of intensified government intervention in MSME financing and sustainability initiatives. This period captures:

- Expansion of MUDRA and CGTMSE coverage
- Introduction and scaling of green financing instruments by SIDBI
- Strengthening of sustainability-linked schemes such as ZED Certification
- Alignment with long-term policy visions like Vikshit Bharat 2047

5.4 Selection of Schemes

The schemes included in the study were selected based on the following criteria: Four criteria have been used to select the schemes analyzed in this study, namely- their direct relevance to MSME credit flow, the lean or green incentives, availability of quantitative secondary data, and their national-level policy significance.

Figure 2: Criteria-Based Selection of MSMEs Financing Schemes



Based on these parameters, the study focuses on major MSME financing and sustainability schemes, including the Pradhan Mantri MUDRA Yojana, CGTMSE, SIDBI's green finance initiatives (MSE-GIFT and MSE-SPICE), and the ZED (Zero Defect Zero Effect) Certification Scheme.

5.5 Variables and Analytical Dimensions

In alignment with the conceptual framework and research objectives, the study analyzes the following key dimensions:

Table 3: Key Variables and Analytical Focus

Dimension	Indicators
Credit Flow	Loan disbursement volume, number of MSMEs financed, guarantee coverage
Sustainability Incentives	Energy efficiency funding, green technology adoption, certification support
Lean Practices	Resource efficiency, cost optimization, productivity enhancement
Policy Alignment	Linkage with SDGs, MSME policy objectives, Vikshit Bharat 2047

Source: *Author's compilation based on SIDBI (2025) and Ministry of MSME (2023)*

5.6 Data Analysis Techniques

The collected secondary data were analyzed using descriptive statistical techniques, including:

- Tabular analysis to compare scheme-wise performance
- Trend analysis to observe changes in credit flow and sustainability financing over time
- Percentage and ratio analysis to assess relative contribution of schemes
- Graphical representations (bar charts and line graphs) to visually depict scheme-wise trends and outcomes

Graphs and tables were used only where necessary to enhance clarity and interpretability, in line with academic formatting norms.

5.8 Ethical Considerations

As the study relies exclusively on **publicly available secondary data**, no ethical issues related to confidentiality, consent, or personal data arise. All sources have been duly acknowledged following APA citation standards.

6. ANALYSIS OF FINDINGS

This section presents a scheme-wise descriptive analysis of India's lean–green financing ecosystem for Micro, Small and Medium Enterprises (MSMEs). The findings are analyzed in alignment with the research objectives, focusing on (i) credit flow patterns, (ii) sustainability-linked incentives, (iii) institutional design of schemes, and (iv) policy alignment with national sustainability and industrial development goals.

6.1 Scheme-wise Credit Flow Patterns toward MSMEs

The analysis indicates that Indian MSME financing structures are dominated with credit access schemes and incentives under sustainability are embedded as implicit or indirect safeguards as opposed to any real green conditional incentives.

Schemes such as Pradhan Mantri Mudra Yojana (PMMY), Credit Guarantee Fund Trust for Micro and Small Enterprises (CGTMSE), and Stand-Up India have greatly increased mainstream financial intermediation in MSME enterprises, particularly among first-time borrowers and those in the informal business sector (**RBI, 2023; Ministry of Finance, 2024**). While the focus of all these schemes has been financial inclusion and business start-up ecosystems, there has been no direct encouragement of environmental or lean production outcomes.

In contrast, schemes such as SIDBI's initiatives in Green Finance, Technology Upgradation Fund Scheme (TUFS), and ZED Certification Scheme by the government's Ministry of MSME show higher levels of conformity to sustainability goals through incentives on cleaner technologies, waste management, and efficient natural resource management practices **(SIDBI, 2022; Ministry of MSME, 2023)**.

Table 4: Scheme-wise Orientation of MSME Financing in India

Scheme	Primary Objective	Lean Orientation	Green Orientation
PMMY	Financial inclusion & micro-credit	Indirect	Low
CGTMSE	Collateral-free credit	Moderate	Low
Stand-Up India	Inclusive entrepreneurship	Indirect	Low
ZED Scheme	Quality & efficiency enhancement	High	High
SIDBI Green Finance	Sustainable industrial finance	High	High

Source: *Compiled from Ministry of MSME (2023), SIDBI (2022), RBI (2023).*

6.2 Integration of Lean and Green Incentives

The findings show that lean and green principles are only rarely related explicitly to financing schemes. Lean aspects, in terms of process efficiency, cost minimization, and productivity increase, are captured indirectly via programs of technology upgradation and quality certification. The green dimensions, covering energy efficiency, emission reduction, and waste minimization, are relatively more explicit in schemes targeted at renewable energy adoption, pollution control, and cleaner production financing.

The ZED Certification Scheme appears as an essential link between lean or green goals, providing defect-free manufacturing practices alongside environmentally friendly practices (Ministry of MSME, 2023). Another concrete case in this direction is SIDBI introducing green credit that pushes Micro, Small, and Medium Enterprises to use efficient machinery that is environmentally friendly **(SIDBI, 2022).**

Nevertheless, the absence of a mandatory sustainability-linked lending criteria framework in widely practiced MSME lending programs hinders the depth of the lean green transformation. Indeed, the majority of the incentives for sustainability are still voluntary.

6.3 Role of Financial Institutions and Policy Instruments

The analysis emphasizes the importance of development finance institutions like SIDBI in creating the green MSME financing landscape in the country. While banks focus only on scale and credit disbursement targets, sustainability screening, concessional interest rates, and technical support are part of the integrated financing methodologies used by the institutions **(RBI, 2023).**

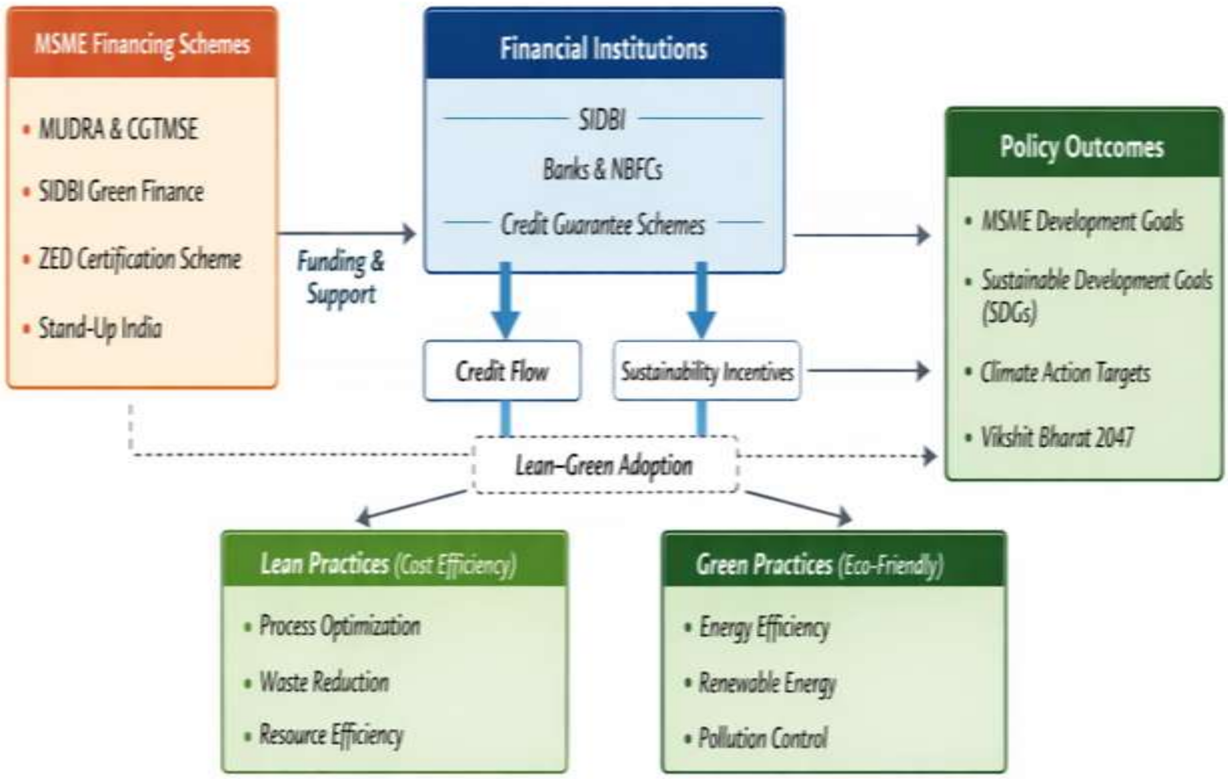
Credit risk mitigation through protective interventions of the government in credit guarantee mechanisms does not take into consideration ESG-based environmental risk indicators. Thus, it highlights the necessity of ESG-based lending mechanisms being integrated into MSME finance without increased compliance costs to small businesses **(OECD, 2021**)

6.4 Policy Alignment with National Development and Sustainability Goals

This indicates a moderate to high level of alignment in MSME schemes of financing with India's flagship programs such as Make in India, Atmanirbhar Bharat, National Action Plan on Climate Change (NAPCC), India's Net-Zero 2070 ambition, etc., although it is more conceptual in nature.

As a matter of fact, although policy papers emphasize and promote "sustainable industrialization," finance schemes are not developed with standardized metrics and reporting measures on sustainability and its impacts (**World Bank, 2022).** Furthermore, there are inadequate measurement and reporting of MSME finance impacts on the environment.

Figure 3: Lean- Green Financing Architecture for MSMEs in India



(Figure depicts interaction among MSME financing schemes, financial institutions, lean practices, green incentives, and policy outcomes)
Source: *Author's conceptualization based on Ministry of MSME (2023), RBI (2023).*

6.5 Key Insights from the Analysis

The analysis yields the following key findings:

- MSME financing in India is credit-centric, with sustainability acting as a secondary objective.
- Lean practices are promoted indirectly, while green incentives are limited to specific schemes.
- Institutional leadership in green finance emanates within a framework of development finance institutions and is actually somewhat out of the mainstream banking system.
- Alignment of policy exists at the strategic level, while it is not integrated operationally through measurable indicators.

These findings underscore the need for a unified lean–green financing framework that embeds sustainability incentives within core MSME credit schemes, rather than treating them as parallel or optional interventions.

7. DISCUSSION AND POLICY IMPLICATIONS

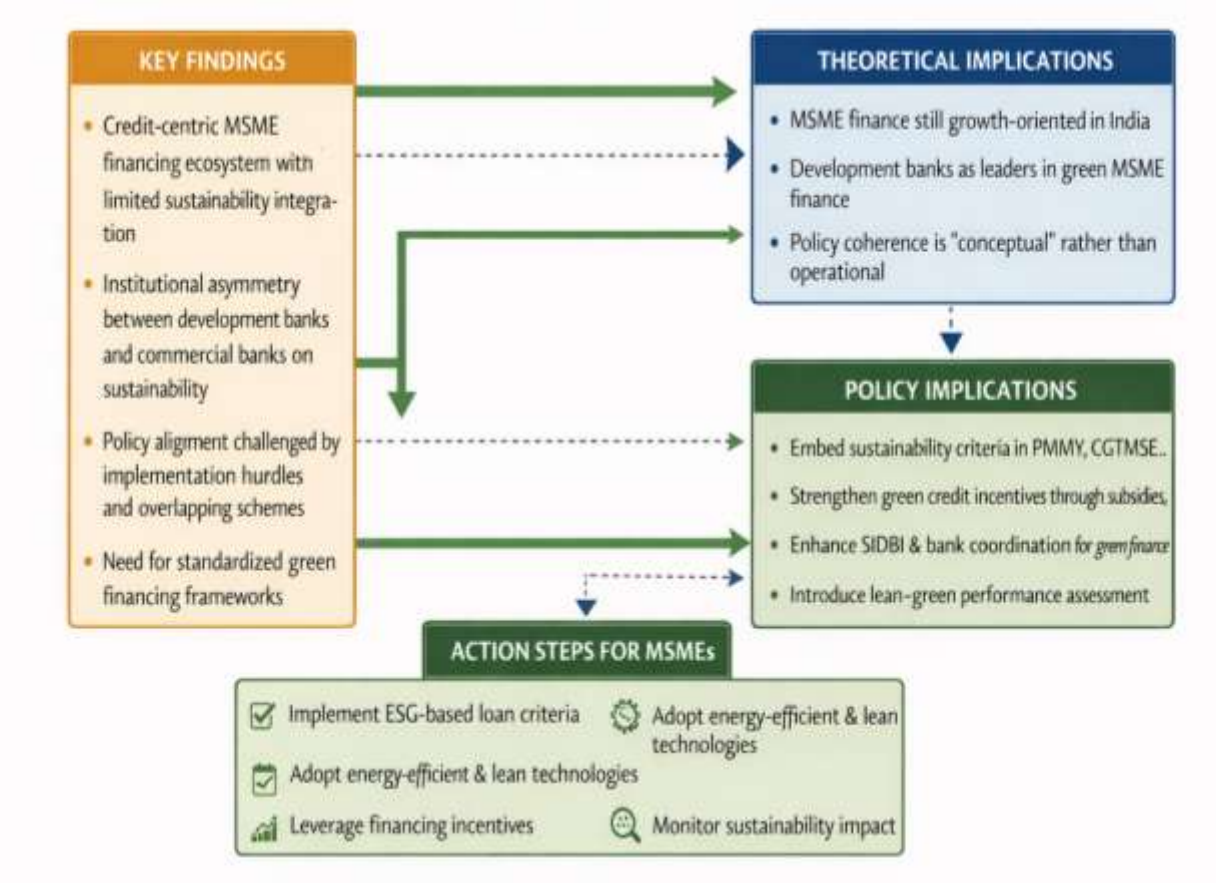
The discussion section contextualises the empirical and descriptive findings of the study within the broader context of MSME finance, sustainability transitions, and public policy in India. Further, drawing out implications that are relevant for policy, the discussion points to ways of strengthening the integration of lean and green principles within the MSME financing architecture.

7.1 Interpretation of Lean–Green Financing Architecture

What the study reveals is that the ecosystem for MSME financing that exists in India is mostly credit-based, where concerns for sustainability are secondary but integrated to the schemes. In the schemes of MUDRA, CGTMSE, Stand-Up India, etc., although access to credit has increased manifold for the MSMEs in the country, the emphasis overall has only been to create more enterprises instead of sustainability concerns.

This structural dynamic is visually summarized in *Figure 2*, which illustrates the interaction among MSME financing schemes, financial institutions, credit flows, sustainability incentives, and policy outcomes.

Figure 4: Lean–Green Financing Architecture for MSMEs in India



Source: *Author's conceptualization based on (OECD, 2021; UNEP, 2021; World Bank, 2022; Ministry of MSME, 2023; SIDBI, 2025).*

As presented in figure 2 above, MSME finance schemes currently channel their finance mostly through financial institutions such as banks, NBFCs, and SIDBI. However, the links between credit delivery and lean and green innovation uptake remain weak and indirect. This shows that there is little transformative power with these finance options.

7.2 Institutional Asymmetry and Sustainability Integration

One of the prominent issues from the discussion in Figure 2 is the asymmetry in promoting sustainable development finance. Development financial institutions, especially SIDBI, show a relatively stronger inclination to green financing in the offer of "concessional loans," "refinancing," and "sustainability-linked credit lines." On the other hand, other commercial banks are more focused on "scale," "risk," and "target disbursements," as opposed to environmental or "lean" metrics.

Thus, this not only maintains what has been postulated in the existing literature, it points us in the direction that development banks play a significant role in catalyzing the development of green finance, especially in the case of MSMEs facing higher perceived risk (OECD, 2021; UNEP, 2021). The absence of standard sustainability screening hampers mainstream institutions in any way and hence reflects on the development of green and lean practices in the MSME sector.

7.3 Lean–Green Adoption and MSME Behaviour

Figure 2 further highlights that lean practices (such as process optimization, waste reduction, and resource efficiency) are more readily adopted by MSMEs compared to green practices (such as renewable energy use and pollution control). This reflects the cost-driven nature of MSME decision-making, where immediate efficiency gains outweigh long-term environmental considerations.

The discussion suggests that lean practices often appear organically due to competitive pressures, while green practices necessitate direct financial incentives and technical support. Schemes such as the ZED Certification Scheme and SIDBI's green finance initiatives have only partially bridged this gap, showing quality, efficiency, and environmental compliance. However, their scale is so limited that broader impacts are restricted.

7.4 Policy Alignment and Development Outcomes

Thus, the policy outcomes indicated in Figure 2: MSME Development Goals, Sustainable Development Goals (SDGs), Climate Change Goals, and Vikshit Bharat 2047 convey a strong conceptual correlation between MSME finance and national development agendas. Nonetheless, the analysis suggests that such correlation is more aspirational in nature.

The lack of sustainability indicators with quantifiable metrics to measure sustainability and monitor progress of sustainability through its impact and end results also undermines the effectiveness of policymakers in understanding and analysing the contribution of MSME finance towards not only climate change mitigation but also sustainable growth and development of industries **(World Bank, 2022; RBI, 2023).** Sustainability remains peripheral at best.

7.5 Policy Implications

Drawing from the discussion and the conceptual relationships presented in Figure 2, the following policy implications emerge:

- ***Mainstreaming Lean–Green Criteria in MSME Credit***: Sustainability-linked indicators should be gradually embedded within core MSME financing schemes, rather than being confined to niche green programs.
- ***Strengthening the Role of Financial Institutions***: Commercial banks should be incentivized—through regulatory support and refinancing facilities—to adopt lean–green lending frameworks similar to those piloted by SIDBI.
- ***Enhancing Incentive Structures***: Interest subvention, credit guarantees, and priority sector benefits can be linked to verified adoption of energy-efficient and environmentally responsible practices.
- ***Improving Policy Monitoring and Evaluation:*** A standardized framework for tracking lean efficiency and environmental outcomes should be developed to ensure accountability and evidence-based policy refinement.

7.6 Contribution to Policy and Practice

This study, therefore, contributes to the policy discourse on sustainable MSME development by combining the scheme-wise financing mechanisms with the lean-green adoption pathways. The conceptual architecture in Figure 2 provides a pragmatic roadmap for aligning MSME finance with India's long-term economic and environmental objectives, especially with regard to Vikshit Bharat 2047 and its global climate commitments.

8. CONCLUSION

The present study attempted to decode India's evolving lean-green financing architecture for MSMEs through a scheme-wise descriptive analysis of credit flows, sustainability incentives, and policy alignment. The paper synthesizes evidence from major MSME financing schemes, regulatory frameworks, and institutional mechanisms to highlight strengths and structural gaps within the MSME finance ecosystem in India.

The analysis shows that India has done reasonably well in the access of credit to MSMEs through MUDRA, CGTMSE, Stand-Up India, and SIDBI-driven interventions. These have been invaluable interventions in the creation of enterprise, financial inclusion, and employment generation. However, sustainability considerations—especially environmental and green dimensions—remain weakly imbedded within mainstream MSME financing frameworks..

It has been concluded from the study that lean practices are more integrated into the operations of MSME as they have more cost efficiency benefits per se, while they totally depend on specific kinds of "financial incentives, concessional credit and institutional support" to ensure the implementation and foster green practices as seen in the study's result based on its specific "conceptual framework and findings" to ensure "sustainability-oriented financing" is still "fragmented and institutional" as opposed to "systemic and outcome-driven" **(RBI, 2023 and Ministry of MSME, 2023).**

Furthermore, this study also identifies how policy narratives can strongly connect MSME finance with national development priorities of Sustainable

Development Goals (SDGs), climate action pledges, and Vikshit Bharat 2047; yet again, the study argues that this just remains theoretical as there is a lack of standardized sustainability indicators or impact assessment systems to make this form of finance act as a device for sustainable industrial development **(World Bank, 2022; OECD, 2021).**

From a policy and pragmatic viewpoint, the study emphasizes the imperative to change paradigm from volume-of-credit-centric MSME finance to impact-centric and sustainable finance options for MSMEs. Financial intermediaries must now think beyond merely mitigating risks and transaction targets to achieve lean efficiency and sustainability as part of the MSME finance parameter.

Overall, this study adds to the emerging literature on green finance and MSME development through a holistic, scheme-wise understanding of India's lean-green financing architecture. It provides a conceptual and policy roadmap for strengthening the role of MSME finance in achieving inclusive, resilient, and sustainable economic growth in India.

9. LIMITATIONS & DIRECTIONS FOR FUTURE RESEARCH

Despite providing valuable insights into India's lean–green financing framework for MSMEs, the study has certain limitations. It is descriptive and based entirely on secondary data from government and institutional sources, which ensures policy relevance but limits understanding of firm-level behavior, adoption challenges, and real-time sustainability outcomes. The absence of econometric or causal analysis restricts the findings to interpretative insights rather than measurable cause–effect relationships on MSME performance. Additionally, the study treats MSMEs as a homogeneous group, overlooking sectoral, regional, and technological heterogeneity that may affect financing effectiveness and sustainability adoption. Finally, the lack of international comparison constrains assessment of India's MSME financing ecosystem against global best practices in green and ESG-linked finance.

Future research should employ primary and empirical approaches to examine MSMEs' adoption of lean–green finance, assess its causal impact on performance and sustainability outcomes, and explore sectoral, regional, and cross-country variations. Integrating digital finance, ESG metrics, and fintech-enabled green credit mechanisms can further strengthen alignment with global sustainability practices and India's Vikshit Bharat 2047 vision.

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