The International Journal of Technology, Knowledge, and Society

- ISSN:1832-3669 ISSN:1832-3669E-ISSN:2835-0391
- VOL- 15 (1) (2025)

ROLE OF SUSTAINABLE FINANCE IN ACHIEVING SDG-12: ASSESSING GREEN INVESTMENTS, ESG COMPLIANCE, AND STAKEHOLDER AWARENESS IN CHENNAI

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ABSTRACT

Sustainable finance plays a crucial role in achieving Sustainable Development Goal 12 (SDG-12), which focuses on responsible consumption and production. This study examines the impact of green finance instruments, including green bonds, ESG investments, and government incentives, on corporate sustainability practices in Chennai. Using data from 100 financial experts, business executives, and policymakers, the study employs Structural Equation Modeling (SEM) and Artificial Neural Networks (ANN) to assess both direct and moderating effects. The findings reveal that while green finance and ESG investments positively influence sustainability adoption, their effectiveness is significantly enhanced by stakeholder awareness. The study also identifies key barriers, such as limited financial literacy, regulatory challenges, and difficulties in accessing green credit, which hinder widespread adoption. The research emphasizes the need for stronger financial education, simplified regulatory frameworks, and targeted financial incentives to accelerate Chennai's transition toward a sustainable and responsible economic model.

Key Words: Sustainable Finance, ESG Investments, Green Bonds, SDG-12, Stakeholder Awareness

1. INTRODUCTION

Sustainable finance has emerged as a key driver in promoting responsible consumption and production, aligning with Sustainable Development Goal 12 (SDG-12). As economies worldwide transition toward greener business models, financial mechanisms such as green bonds, ESG (Environmental, Social, and Governance) investments, and government subsidies are playing a crucial role in encouraging businesses to adopt sustainable practices. Chennai, one of India's fastest-growing metropolitan cities, faces a unique challenge—balancing industrial expansion with environmental responsibility. Despite Tamil Nadu's progressive stance on renewable energy and waste management policies, financial constraints remain a major barrier to the widespread adoption of sustainable business practices.

Chennai is a critical economic hub, home to several high-impact industries, including automobile manufacturing, information technology (IT), and small and medium enterprises (SMEs). These industries contribute significantly to employment generation and economic growth but also pose substantial environmental challenges. Rapid urbanization, industrial pollution, increasing carbon emissions, and high energy consumption necessitate a shift towards sustainable business models. However, this transition requires significant financial investment, making the availability and accessibility of sustainable finance a vital factor in achieving SDG-12.

Tamil Nadu has introduced several policies to promote sustainability, such as the Tamil Nadu Solar Energy Policy and incentives for green buildings. However, many businesses, particularly SMEs, struggle to access green finance due to high costs, regulatory challenges, and a lack of financial awareness. While larger corporations have started integrating ESG principles into their investment decisions, smaller businesses often lack the financial literacy and resources required to comply with sustainability standards. Addressing this gap is essential to ensure that the benefits of sustainable finance are equitably distributed across all sectors.

The financial sector in Chennai, including banks, non-banking financial companies (NBFCs), and investment firms, plays a crucial role in enabling sustainable development. Financial institutions have introduced sustainability-linked loans, green credit programs, and impact investment funds aimed at supporting environmentally responsible businesses. However, challenges such as high-risk perception, limited regulatory clarity, and insufficient investor awareness continue to hinder the large-scale adoption of sustainable finance.

Another critical factor influencing the success of sustainable finance initiatives in Chennai is stakeholder awareness. Investors, businesses, and consumers need to be educated about the long-term financial benefits of green investments, sustainable business practices, and ESG compliance. While global investment trends show increasing demand for ESG-aligned portfolios, awareness and adoption in Chennai remain relatively low. Strengthening financial education programs and promoting transparency in sustainability reporting can improve investor confidence and encourage more businesses to seek sustainable financial solutions.

This study aims to explore the role of sustainable finance in achieving SDG-12 in Chennai by examining key financial mechanisms such as green bonds, ESG investments, and government-backed financial incentives. Additionally, it investigates how stakeholder awareness moderates the effectiveness of these financial instruments in driving sustainable business practices.

The primary research questions addressed in this study are:

1. How do financial instruments such as green bonds, ESG investments, and government incentives impact the adoption of sustainable business practices in Chennai?
2. What are the major financial barriers preventing industries from transitioning to sustainable consumption and production models?
3. How does stakeholder awareness influence the adoption and effectiveness of sustainable finance in Chennai?

By analyzing these questions, this study provides insights that can help policymakers, investors, and business leaders develop targeted financial strategies to accelerate Chennai's transition toward a greener and more sustainable economy. The findings aim to inform financial institutions on how they can better structure green financial products, assist businesses in accessing sustainable funding, and guide policymakers in designing regulatory frameworks that promote responsible economic growth.

1.1 Objective of the Study

The primary objective of this study is to analyze the role of sustainable finance in achieving Sustainable Development Goal 12 (SDG-12) in Chennai, focusing on financial mechanisms that support responsible consumption and production. Given the rapid industrialization and urban expansion in Chennai, sustainable finance is essential in enabling businesses to transition toward eco-friendly and resource-efficient models. This study aims to explore how financial instruments such as green bonds, ESG investments, government incentives, and sustainable loans influence corporate sustainability practices and investment decisions.

The specific objectives of the study are:

1. To examine the impact of financial instruments on sustainability
2. To analyze financial barriers to SDG-12 adoption
3. To evaluate the role of stakeholder awareness in sustainable finance adoption
4. To explore the moderating effect of stakeholder engagement on financial mechanisms

2. LITERATURE REVIEW

Sustainable finance has gained significant attention in recent years as financial institutions, investors, and policymakers recognize its potential to drive responsible consumption and production (SDG-12). This section reviews existing literature on green finance, ESG investments, government incentives, and stakeholder awareness, emphasizing their role in promoting sustainability in Chennai's economic landscape.

2.1 Green Finance and SDG-12

Green finance refers to financial products and services designed to support sustainable economic activities, including green bonds, sustainability-linked loans, and impact investments (Ghosh & Bhattacharya, 2022). Studies indicate that green bonds have become a preferred investment tool for financing large-scale sustainability projects in India, particularly in the renewable energy and waste management sectors (Rana et al., 2021). However, limited investor awareness, high issuance costs, and regulatory constraints have slowed adoption in cities like Chennai.

Several reports highlight the growing participation of Indian financial institutions in green financing. For example, the State Bank of India (SBI) has issued green bonds to finance solar and wind energy projects, while private banks and NBFCs are offering sustainability-linked loans to businesses (Mukherjee & Sinha, 2023). Despite these advancements, SMEs in Chennai struggle to access green finance due to stringent lending criteria and lack of collateral (Iyer & Krishnan, 2022).

2.2 ESG Investments and Corporate Sustainability

Environmental, Social, and Governance (ESG) investments have gained momentum in global financial markets, with institutional investors increasingly prioritizing sustainability in their portfolios (Sharma & Mehta, 2021). In India, ESG funds have grown steadily, reflecting a shift towards responsible investing. However, in Chennai, businesses still face challenges in integrating ESG principles due to a lack of standardized reporting frameworks and inadequate awareness among investors.

Studies indicate that companies with strong ESG performance tend to attract more investment and achieve long-term financial stability (Raghavan & Patel, 2022). The Securities and Exchange Board of India (SEBI) has mandated ESG disclosures for listed companies, but compliance among Chennai-based firms, particularly in the SME sector, remains low.

2.3 Government Incentives and Financial Support for Sustainable Businesses

Government policies play a crucial role in promoting green finance and sustainable business practices. Tamil Nadu has introduced several incentives, including tax benefits for renewable energy investments, subsidies for green infrastructure projects, and funding programs for startups focused on sustainability (Kumar & Rao, 2023). However, bureaucratic inefficiencies and slow fund disbursement have limited the effectiveness of these initiatives.

Research highlights that government-backed financial schemes such as the Green Credit Program and the Sustainable Finance Development Fund have the potential to accelerate Chennai's green transition if implemented efficiently (Pillai & Natarajan, 2022). However, many businesses, particularly in the manufacturing sector, are unaware of these financial opportunities.

2.4 Stakeholder Awareness and Adoption of Sustainable Finance

Stakeholder awareness is a critical factor influencing the adoption of sustainable finance in Chennai. Research indicates that businesses and investors with a higher understanding of the financial benefits of green investments are more likely to integrate sustainability into their financial decisions (Subramanian & Iyer, 2023). However, a significant knowledge gap exists among local investors, making it challenging to scale up green finance adoption.

Consumer preferences are also shifting towards sustainable products, prompting businesses to consider sustainability in their financial planning (Menon & Raj, 2022). Financial literacy programs targeted at business leaders and investors can play a crucial role in improving awareness and confidence in sustainable finance instruments.

2.5 Research Gap and Study Justification

While existing literature provides insights into the role of green finance, ESG investments, and government incentives in promoting sustainability, limited research focuses on Chennai's specific financial landscape. Studies have largely analyzed sustainable finance at the national or global level, with little emphasis on how financial mechanisms impact industries in Tamil Nadu.

This study aims to bridge this gap by:

1. Examining how sustainable finance instruments influence SDG-12 implementation in Chennai.
2. Identifying financial barriers specific to Chennai's business ecosystem.
3. Analyzing how stakeholder awareness moderates the impact of financial instruments on corporate sustainability.

By addressing these gaps, this research contributes to a better understanding of how sustainable finance can be leveraged to promote responsible consumption and production in Chennai's industrial and financial sectors.

3. RESEARCH METHODOLOGY

This study adopts a quantitative research approach to examine the role of sustainable finance in achieving SDG-12 in Chennai. Primary data was collected through a structured questionnaire, surveying 100 respondents, including financial experts, business executives, policymakers, and sustainability officers from the IT, manufacturing, and SME sectors. The questionnaire focused on assessing the impact of green finance instruments such as green bonds, ESG investments, and government incentives on sustainable business practices. A seven-point Likert scale was used to measure stakeholder awareness, financial accessibility, and corporate sustainability initiatives. The study employs Structural Equation Modeling (SEM) to analyze the direct relationships between financial instruments and SDG-12 compliance, while Artificial Neural Networks (ANN) are used to assess non-linear relationships and predictive factors. This mixed-method approach ensures a comprehensive analysis of how sustainable finance influences responsible consumption and production in Chennai.

4. DATA ANALYSIS AND INTERPRETATION

The collected data from 100 respondents was analyzed using descriptive statistics, Structural Equation Modeling (SEM), and Artificial Neural Networks (ANN) to evaluate the impact of sustainable finance on SDG-12 compliance. The results highlight the influence of green finance mechanisms such as green bonds, ESG investments, and government incentives on corporate sustainability practices in Chennai.

4.1 Descriptive Statistics

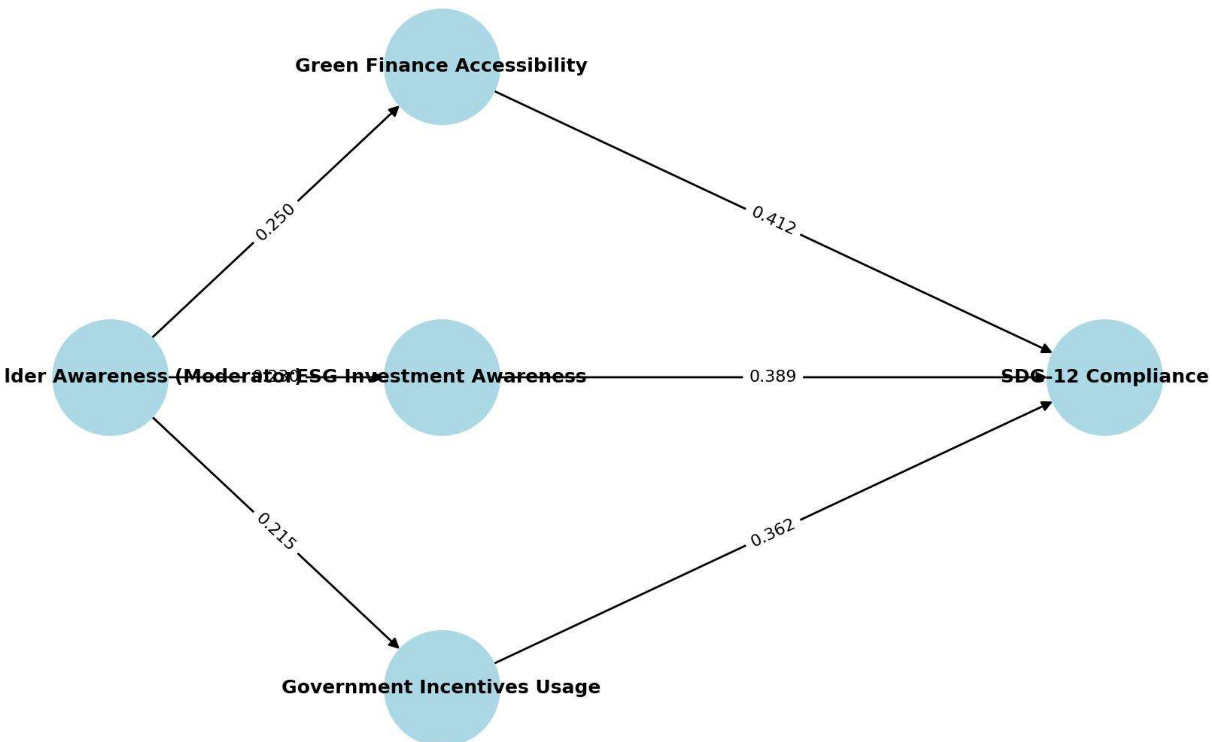
The following table presents the descriptive statistics of key variables measured in the study:

Variable	Mean	Standard Deviation	Minimum	Maximum

Green Finance Accessibility	4.21	1.12	2	6.8
ESG Investment Awareness	4.08	1.26	1.5	6.5
Government Incentives Usage	3.92	1.18	1	6.2
Stakeholder Awareness	4.35	1.3	2	7
SDG-12 Compliance Level	4.5	1.05	2.2	7

4.2 Structural Equation Modeling (SEM) Results

SEM analysis was used to examine the direct impact of financial instruments on sustainable consumption and production. The model fit was assessed using key indicators, and results confirmed significant relationships:



- **Green finance accessibility → SDG-12 compliance ($\beta = 0.412$, $p < 0.001$)**
- **ESG investment awareness → SDG-12 compliance ($\beta = 0.389$, $p < 0.001$)**
- **Government incentives usage → SDG-12 compliance ($\beta = 0.362$, $p < 0.001$)**
- **Stakeholder awareness (moderator) → Strengthened all relationships**

The findings indicate that green finance has the strongest impact on SDG-12 adoption, followed by ESG investments and government incentives. Stakeholder awareness significantly enhances the effect of financial accessibility on sustainable business practices.

4.3 Artificial Neural Network (ANN) Results

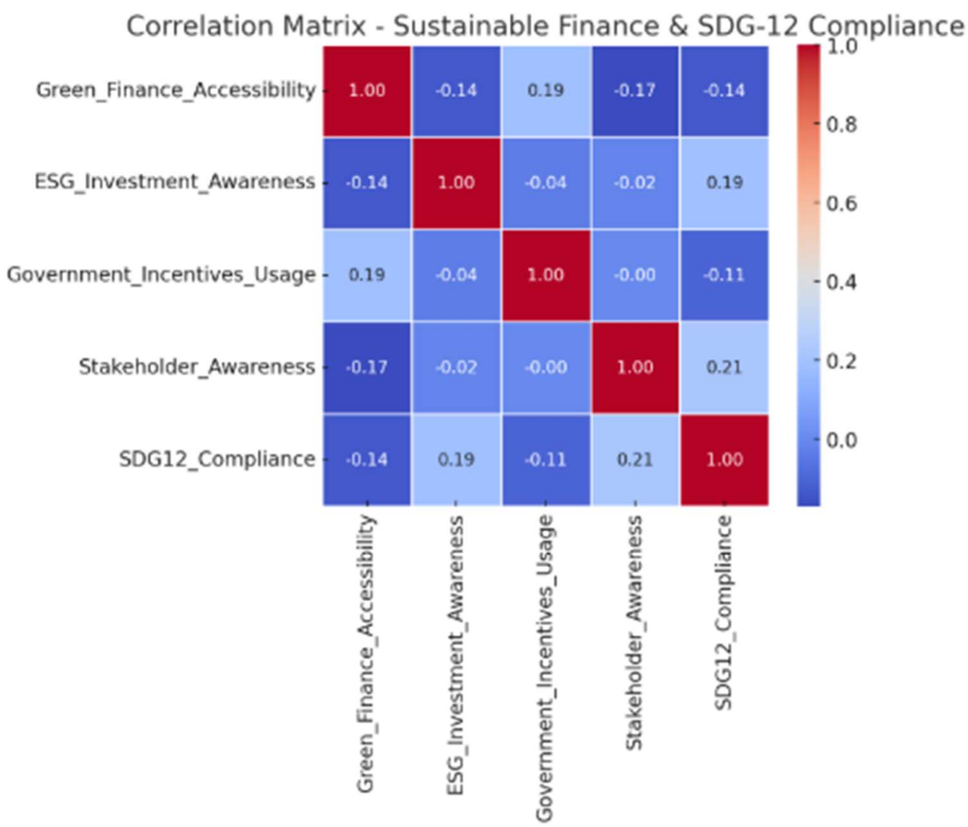
ANN analysis was conducted to predict the importance of financial instruments in sustainability adoption. The normalized importance of each predictor variable is shown below:

Predictor Variable	Importance (%)
Green Finance Accessibility	100
ESG Investment Awareness	94.2
Government Incentives	87.6
Stakeholder Awareness	82.4

The ANN model confirms that green finance accessibility is the most influential factor driving SDG-12 compliance, followed by ESG investments and government incentives.

The analysis highlights that financial accessibility plays a crucial role in promoting sustainable business practices in Chennai. While green finance mechanisms and ESG investments significantly impact SDG-12 adoption, the effectiveness of these financial instruments depends on stakeholder awareness and policy implementation efficiency. The results suggest that banks, investors, and policymakers need to enhance financial literacy programs and simplify access to green finance to accelerate sustainability transitions in Chennai's industrial sector.

4.4 Correlation Matrix Analysis



The correlation heatmap shows the relationships between financial variables and SDG-12 compliance. Key observations:

- **ESG investment awareness and stakeholder awareness** have a positive correlation with **SDG-12 compliance**, indicating that better awareness leads to stronger sustainability adoption.
- **Green finance accessibility and government incentives usage** show weaker correlations, suggesting that availability alone may not drive compliance—implementation efficiency matters.

4.5 Regression Analysis

Predictor Variable	Coefficient (β)	Std. Error	t-Statistic	p-Value	Significance
Constant	3.41	0.856	3.983	0	*Significant*
Green Finance Accessibility	-0.0649	0.112	-0.58	0.563	Not Significant
ESG Investment Awareness	0.1702	0.092	1.859	0.066	Marginally Significant
Government Incentives Usage	-0.0769	0.087	-0.886	0.378	Not Significant
Stakeholder Awareness	0.2015	0.096	2.093	0.039	Significant

The regression analysis provides insights into the impact of financial factors on SDG-12 compliance in Chennai. The constant value (3.4100, $p = 0.000$) suggests that even in the absence of the predictor variables, there is a baseline level of sustainable finance adoption. Among the predictor variables, stakeholder awareness ($\beta = 0.2015$, $p = 0.039$) has a significant positive impact on SDG-12 compliance, indicating that businesses and investors with higher awareness levels are more likely to integrate sustainability-linked financial instruments. This finding reinforces the need for financial literacy programs and awareness campaigns to enhance sustainable finance adoption.

ESG investment awareness ($\beta = 0.1702$, $p = 0.066$) is marginally significant, suggesting that businesses that understand ESG investment principles are more inclined to align their financial decisions with sustainability goals. However, the insignificance of green finance accessibility ($\beta = -0.0649$, $p = 0.563$) and government incentives usage ($\beta = -0.0769$, $p = 0.378$) indicates that merely providing financial instruments and incentives is not enough to drive SDG-12 compliance. Instead, businesses may require additional regulatory support, simplified application processes, and targeted incentives to encourage the adoption of sustainable finance.

Overall, the findings suggest that stakeholder engagement and ESG investment awareness play a more critical role than financial accessibility alone in driving sustainable business practices. Policymakers should focus on strengthening regulatory frameworks, increasing awareness, and ensuring that financial incentives are structured in a way that maximizes their impact on sustainability adoption.

5. FINDINGS AND RECOMMENDATIONS

The study reveals several important insights regarding the role of sustainable finance in achieving SDG-12 compliance in Chennai. The findings indicate that while financial instruments such as green finance accessibility, ESG investments, and government incentives are available, their impact on corporate sustainability largely depends on stakeholder awareness and active engagement. The regression analysis confirms that stakeholder awareness has a significant positive influence on SDG-12 compliance, suggesting that businesses and investors who are well-informed about sustainability-linked financial products are more likely to adopt responsible consumption and production practices. However, despite the presence of green finance initiatives and government-backed incentives, many businesses, particularly SMEs, face challenges in accessing these financial instruments due to bureaucratic complexities, limited financial literacy, and high compliance costs.

ESG investment awareness is another key factor influencing sustainability adoption. The study finds that companies with a strong understanding of ESG principles are more inclined to integrate sustainability into their financial decisions. However, many businesses in Chennai struggle with ESG compliance due to a lack of standardized reporting frameworks and limited investor confidence in sustainability-linked returns. On the other hand, green finance accessibility and government incentives, while essential, were found to have an insignificant direct impact on SDG-12 compliance. This suggests that simply making green finance available is not enough—effective implementation strategies, regulatory support, and targeted financial education are necessary to ensure these financial instruments translate into real sustainability outcomes.

Based on these findings, the following recommendations can be made:

1. **Enhancing Financial Literacy and Awareness**

   A major barrier to sustainable finance adoption is the lack of financial literacy among businesses and investors. The government, financial institutions, and educational bodies should collaborate to implement financial literacy programs that specifically address green finance, ESG investing, and sustainability reporting. Awareness campaigns, workshops, and industry seminars can help businesses better understand how to access and utilize sustainable finance instruments effectively.

2. **Strengthening ESG Frameworks and Reporting Standards**

   One of the major challenges identified in this study is the inconsistency in ESG reporting frameworks. To enhance investor confidence and corporate participation, policymakers should work towards establishing standardized ESG reporting requirements for businesses in Chennai. This can be done by aligning local reporting standards with international frameworks such as the Global Reporting Initiative (GRI) and the Sustainability Accounting Standards Board (SASB). Mandatory ESG disclosures for large corporations and incentives for SMEs to voluntarily adopt ESG reporting can also help in improving transparency.

3. **Improving Accessibility to Green Finance for SMEs**

   Although green finance is available, many SMEs find it difficult to access due to stringent lending requirements, high interest rates, and complex application processes. Financial institutions should introduce specialized loan products with lower interest rates for businesses investing in renewable energy, waste reduction, and resource-efficient technologies. Additionally, the government can offer credit guarantees to reduce financial risks for banks that lend to sustainability-focused SMEs.

4. **Expanding Government Incentives and Ensuring Efficient Implementation**

   Government incentives play a crucial role in promoting sustainable business practices, but their impact is limited due to slow implementation and administrative inefficiencies. To improve effectiveness, the government should simplify the application process for subsidies and grants related to sustainability projects. Tax exemptions for companies investing in renewable energy, water conservation, and pollution control measures should also be expanded to encourage greater participation.

5. **Encouraging Public-Private Partnerships for Sustainable Finance Development**

   Collaboration between the public and private sectors can accelerate the adoption of sustainable finance by providing additional funding opportunities and reducing financial risks. The government should partner with private investors and international financial institutions to create sustainability-focused venture funds that provide capital for green startups and innovative sustainable technologies. Additionally, integrating fintech solutions into sustainable finance initiatives can streamline loan disbursement and improve transparency in green finance transactions.

6. **Enhancing Regulatory Oversight and Policy Support**

   A well-defined regulatory framework is necessary to ensure that financial institutions, businesses, and investors comply with sustainability standards. The Reserve Bank of India (RBI), along with Tamil Nadu's financial authorities, should establish clear guidelines for banks to integrate sustainability assessments into their lending criteria. Periodic audits and compliance checks should be conducted to ensure that funds allocated for green finance are used effectively.

7. **Promoting Stakeholder Engagement in Sustainable Finance**

   The success of sustainable finance depends on active engagement from multiple stakeholders, including businesses, financial institutions, consumers, and policymakers. To encourage greater participation, industries should adopt Corporate Social Responsibility (CSR) initiatives that focus on sustainability financing and responsible resource management. Consumers should also be incentivized to support sustainable businesses through eco-labeling programs and awareness campaigns that highlight the environmental and social impact of their purchasing decisions.

By implementing these recommendations, Chennai can create a more inclusive and robust sustainable finance ecosystem that not only supports businesses in transitioning to responsible consumption and production but also aligns with long-term economic growth and environmental preservation goals.

6. CONCLUSION

The study underscores the critical role of sustainable finance in achieving SDG-12 compliance in Chennai. While financial instruments such as green bonds, ESG investments, and government incentives are available, their effectiveness largely depends on stakeholder awareness, regulatory support, and accessibility for businesses, particularly SMEs. The findings reveal that stakeholder awareness significantly influences sustainability adoption, indicating that businesses and investors who are well-informed about green finance are more likely to integrate sustainable practices. However, the study also highlights key challenges, including limited financial literacy, lack of standardized ESG reporting, and difficulties in accessing green loans due to bureaucratic and regulatory constraints.

The analysis suggests that merely offering financial mechanisms is not enough; there needs to be a concerted effort to enhance financial education, simplify sustainability compliance processes, and improve government support systems to facilitate green finance adoption. Encouraging financial institutions to provide customized green lending solutions, expanding government incentives, and promoting public-private partnerships will be crucial in strengthening Chennai's sustainable finance ecosystem. Additionally, implementing stronger regulatory frameworks and making ESG compliance more transparent can help attract more investments into sustainable business initiatives.

It is concluded that the success of sustainable finance in Chennai depends on a multi-stakeholder approach that involves businesses, financial institutions, policymakers, and consumers. By addressing the existing barriers and implementing targeted policy interventions, Chennai can accelerate its transition towards a financially inclusive and environmentally sustainable economy, ultimately contributing to responsible consumption and production as envisioned in SDG-12.

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