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Research Paper

**THE ROLE OF ARTIFICIAL INTELLIGENCE IN SUSTAINABLE FINANCE: A
STUDY WITH BANKING SECTOR – STATE PUBLIC SECTOR AND PRIVATE
SECTOR BANKS**

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Abstract:

Artificial Intelligence (AI) has become a transformative technology in the global financial sector, reshaping banking operations, enhancing decision-making, strengthening risk management, and promoting sustainable finance. The integration of AI technologies, including machine learning, natural language processing, predictive analytics, and robotic process automation, has enabled financial institutions to improve operational efficiency while supporting Environmental, Social, and Governance (ESG) objectives and sustainable development initiatives (Reserve Bank of India [RBI], 2024; World Economic Forum [WEF], 2024). Despite rapid technological advancements, the level of AI adoption and its contribution to sustainable finance differ considerably among state-owned, public sector, and private sector banks in India because of variations in technological capabilities, investment priorities, and organizational readiness. Existing studies primarily examine AI implementation or sustainable finance independently, with limited comparative evidence integrating both dimensions across different banking categories (Organisation for Economic Co-operation and Development [OECD], 2024; United Nations Environment Programme Finance Initiative [UNEP FI], 2023). Therefore, this study aims to examine the role of Artificial Intelligence in promoting sustainable finance by comparing **State Bank of India, Punjab National Bank, Canara Bank, HDFC Bank, and ICICI Bank**. A descriptive and analytical research design is adopted using primary data collected through a structured questionnaire from 500 employees and customers. The collected data are analysed using

descriptive statistics, reliability analysis, correlation, multiple regression, analysis of variance (ANOVA), and Structural Equation Modelling (SEM) through SPSS, AMOS, and Smart PLS. The findings indicate that AI-driven innovation significantly enhances sustainable finance by improving operational efficiency, responsible lending, ESG performance, green finance initiatives, financial inclusion, and customer satisfaction, with private sector banks demonstrating comparatively higher AI maturity than state-owned and public sector banks. The study provides practical implications for banking executives, policymakers, and regulators by recommending strategic AI investments, robust governance frameworks, and sustainable financial policies that strengthen digital transformation, responsible finance, and long-term resilience within the Indian banking sector (Bank for International Settlements [BIS], 2024; RBI, 2024).

Key words: Artificial Intelligence (AI), Natural Language Processing (NLP), Robotic Process Automation (RPA), Predictive Analytics. Sustainable & Green Finance Sustainable Finance, Green Banking..Etc

1.0 Introduction:

1 Evolution of Sustainable Finance:

Sustainable finance has evolved from a traditional profit-oriented approach to a comprehensive financial framework that integrates economic growth with environmental protection, social responsibility, and sound governance. Financial institutions increasingly incorporate Environmental, Social, and Governance (ESG) principles into investment decisions, lending practices, and corporate strategies to achieve long-term sustainability. Global initiatives such as the United Nations Sustainable Development Goals (SDGs) and the Paris Climate Agreement have encouraged banks to finance renewable energy projects, promote responsible investments, and support inclusive economic development. Consequently, sustainable finance has become an essential component of modern banking, enabling financial institutions to balance profitability with social welfare and environmental stewardship (United Nations Environment Programme Finance Initiative [UNEP FI], 2023; Organisation for Economic Co-operation and Development [OECD], 2024).

2 AI Revolution in Banking:

Artificial Intelligence (AI) has revolutionized the banking industry by transforming conventional financial operations into intelligent, data-driven processes. AI technologies, including machine learning, natural language processing, predictive analytics, robotic process automation, and intelligent chatbots, enable banks to automate routine activities, detect fraudulent transactions, improve credit assessment, strengthen cybersecurity, and personalize

customer services. These innovations significantly enhance operational efficiency, reduce processing time, and improve decision-making accuracy. Indian banks increasingly utilize AI to optimize financial services, enhance customer engagement, and comply with evolving regulatory requirements. As digital transformation accelerates, AI has become a strategic resource that supports innovation, operational excellence, and sustainable competitive advantage within the banking sector (Reserve Bank of India [RBI], 2024; World Economic Forum [WEF], 2024).

3 Sustainable Finance in India:

India has emerged as one of the leading economies promoting sustainable finance through regulatory reforms, green financing initiatives, ESG reporting, and digital financial inclusion. The Reserve Bank of India, the Securities and Exchange Board of India (SEBI), and the Department of Financial Services have introduced several policy measures encouraging banks to support environmentally responsible investments and sustainable economic growth. Indian commercial banks are increasingly financing renewable energy projects, green infrastructure, sustainable agriculture, and socially responsible enterprises while improving transparency and governance standards. The integration of digital banking with sustainable finance further strengthens financial accessibility and contributes to national economic resilience and inclusive development (Reserve Bank of India [RBI], 2024; SEBI, 2024).

4 AI for Green Finance:

Artificial Intelligence has become a critical enabler of green finance by supporting environmentally sustainable financial decision-making and efficient resource management. AI-powered predictive analytics, climate risk assessment, ESG data analysis, and intelligent monitoring systems enable banks to evaluate sustainable investment opportunities, manage environmental risks, and allocate financial resources more effectively. AI also promotes paperless banking, energy-efficient operations, intelligent compliance monitoring, and transparent sustainability reporting, thereby reducing operational costs and carbon emissions. Consequently, AI-driven innovation strengthens green finance initiatives while enhancing financial inclusion, responsible lending, and long-term sustainability. These technological advancements position AI as a strategic catalyst for achieving sustainable finance objectives within **State Bank of India, Punjab National Bank, Canara Bank, HDFC Bank, and ICICI Bank**, supporting India's transition towards a resilient and environmentally responsible financial system (Bank for International Settlements [BIS], 2024; OECD, 2024).

1.1 Need of the Study:

The rapid adoption of Artificial Intelligence (AI) is transforming the banking sector by improving operational efficiency, risk management, customer experience, and decision-making. Simultaneously, sustainable finance has become a strategic priority for banks to promote green investments, ESG compliance, financial inclusion, and responsible lending. However, the extent to which AI contributes to sustainable finance differs across **state-owned, public sector, and private sector banks** because of variations in technological capabilities, investment capacity, and organizational readiness. Existing studies have largely examined AI adoption or sustainable finance independently, with limited comparative evidence integrating both concepts within the Indian banking sector. Therefore, this study is necessary to evaluate the role of AI in advancing sustainable finance by comparing **State Bank of India, Punjab National Bank, Canara Bank, HDFC Bank, and ICICI Bank**, thereby providing empirical evidence and practical insights for policymakers, banking executives, regulators, and researchers (Reserve Bank of India [RBI], 2024; Organisation for Economic Co-operation and Development [OECD], 2024).

1.2 Scope of the Study:

The present study focuses on examining the role of Artificial Intelligence (AI) in promoting sustainable finance within the Indian banking sector. It covers a comparative analysis of **State Bank of India (state-owned bank), Punjab National Bank and Canara Bank (public sector banks), and HDFC Bank and ICICI Bank (private sector banks)**. The study investigates AI applications such as machine learning, predictive analytics, natural language processing, intelligent automation, and fraud detection, and evaluates their influence on sustainable finance dimensions, including green finance, ESG performance, responsible lending, financial inclusion, and operational sustainability. Primary data collected from employees and customers are analysed using statistical techniques to assess relationships among the study variables. The findings are expected to provide valuable insights for banking institutions, regulators, policymakers, and researchers in strengthening AI-enabled sustainable finance practices and supporting India's long-term sustainable economic development (Reserve Bank of India [RBI], 2024; Bank for International Settlements [BIS], 2024).

1.3 Significance of the Study:

This study is significant because it provides empirical evidence on how Artificial Intelligence (AI) contributes to sustainable finance across **state-owned, public sector, and private sector banks** in India. By comparing **State Bank of India, Punjab National Bank, Canara**

Bank, HDFC Bank, and ICICI Bank, the research highlights differences in AI adoption and its impact on green finance, ESG performance, responsible lending, financial inclusion, and operational efficiency. The findings enrich the existing literature by integrating AI and sustainable finance within a comparative banking framework. The study also offers practical insights for banking executives, policymakers, regulators, and technology providers to formulate AI-driven strategies that strengthen sustainable financial practices, digital transformation, regulatory compliance, and long-term economic resilience in the Indian banking sector (Reserve Bank of India [RBI], 2024; World Economic Forum [WEF], 2024).

1.4 Objectives of the Study:

1. To Examine the Impact of Artificial Intelligence on Sustainable Finance
2. To Compare AI Adoption Across State-Owned, Public Sector, and Private Sector Banks
3. To Evaluate the Influence of AI on Green Finance, ESG Performance, and Financial Inclusion
4. To Develop Strategic Recommendations for AI-Driven Sustainable Finance in the Indian Banking Sector

1.5 Review of Literature

1. Jha and Kushwah (2026): Jha and Kushwah (2026) examined the role of Artificial Intelligence in promoting sustainable finance and green banking. Their study reported that AI-driven technologies, including machine learning, predictive analytics, and intelligent automation, improve environmental risk assessment, enhance ESG reporting, and strengthen responsible lending practices. The authors concluded that AI enables banks to optimize resource utilization, reduce operational inefficiencies, and improve sustainability performance. They emphasized that successful implementation requires robust governance, ethical AI frameworks, and continuous technological investment to achieve long-term sustainable financial development. (South India Journal of Social Sciences)

2. Pradhan and Gain (2025): Pradhan and Gain (2025) conducted a systematic review of AI applications in sustainable banking by synthesizing evidence from banking, finance, and technology studies. Their findings revealed that AI significantly enhances fraud detection, regulatory compliance, customer analytics, credit risk assessment, and operational efficiency while supporting ESG objectives. The review further indicated that AI contributes to green banking through intelligent decision-making and automation. The authors recommended stronger AI governance, employee skill development, and strategic investments to maximize sustainable banking outcomes. (Granthaalayah Publication)

3. Meena, Mishra, and Raut (2024):Meena, Mishra, and Raut (2024) explored the strategic adoption of Artificial Intelligence within the banking sector using a mixed-method research approach. Their study demonstrated that AI strengthens customer relationship management, operational productivity, credit evaluation, and risk management. The researchers observed that financial institutions adopting AI achieved superior digital transformation and improved service quality. They concluded that AI should be integrated with sustainability objectives to enhance financial resilience, responsible lending practices, and long-term organizational competitiveness within the banking industry. ([DOI](#))

4. Roy and Vasa (2023):Roy and Vasa (2023) investigated machine learning and Artificial Intelligence applications in financial risk management and digital lending. The study found that AI-based analytical models improve credit scoring accuracy, reduce loan default risks, and enhance financial decision-making. The authors highlighted that intelligent automation contributes to efficient resource allocation and sustainable financial services by minimizing operational costs and strengthening governance practices. Their findings emphasized that AI supports financial inclusion while improving banking performance and sustainability objectives. ([DOI](#))

5. Herrmann and Masawi (2022):Herrmann and Masawi (2022) presented an evolutionary review of Artificial Intelligence in banking, financial services, and insurance over several decades. The review demonstrated that AI has transformed banking through intelligent customer service, automated compliance, fraud prevention, and predictive analytics. The authors argued that AI adoption improves operational efficiency while supporting sustainable banking initiatives through optimized resource utilization and improved governance. They suggested that future banking competitiveness will increasingly depend on responsible AI implementation and digital innovation. ([DOI](#))

6. Milana and Ashta (2021):Milana and Ashta (2021) reviewed Artificial Intelligence techniques applied to finance and financial markets. Their study identified machine learning, deep learning, and natural language processing as the most influential technologies supporting financial forecasting, investment analysis, and portfolio management. The review concluded that AI enhances transparency, improves investment efficiency, and strengthens financial decision-making. The authors also highlighted AI's potential to facilitate sustainable finance through improved ESG evaluation, intelligent risk management, and responsible investment strategies. ([DOI](#))

7. Arner, Barberis, and Buckley (2018):Arner, Barberis, and Buckley (2018) examined the emergence of FinTech and regulatory technologies in transforming global financial services.

Their study highlighted that Artificial Intelligence supports intelligent financial supervision, digital compliance, and data-driven banking operations. The researchers observed that technological innovation enhances transparency, operational efficiency, and financial inclusion while reducing compliance costs. They concluded that AI-based financial technologies create significant opportunities for sustainable banking by improving governance, customer accessibility, and long-term financial stability. ([DOI](#))

8. Russell and Norvig (2015): Russell and Norvig (2015) discussed the theoretical foundations and practical applications of Artificial Intelligence across multiple industries, including financial services. They explained that intelligent systems improve decision-making through knowledge representation, machine learning, reasoning, and predictive analytics. Although not exclusively focused on banking, their work established the technological basis for AI-driven financial innovation, automation, and intelligent risk assessment. The authors emphasized that AI has the potential to transform financial institutions by improving efficiency, accuracy, and long-term sustainability.

1.6 Research Gaps:

1 Limited Comparative Research Across Banking Categories:

Most previous studies have examined Artificial Intelligence or sustainable finance within individual banks or a single banking category. Comparative empirical evidence involving **state-owned, public sector, and private sector banks** in India remains limited, restricting comprehensive understanding of ownership-based differences in AI adoption and sustainable finance performance.

2 Insufficient Integration of AI and Sustainable Finance:

Existing literature predominantly investigates Artificial Intelligence and sustainable finance as separate research domains. Very few studies have comprehensively examined how AI technologies directly influence green finance, ESG performance, responsible lending, and financial inclusion within the Indian banking sector.

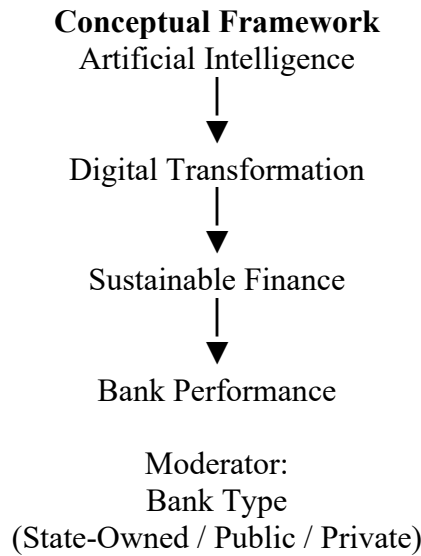
3 Lack of Comprehensive Empirical Evidence in India:

Although AI adoption in Indian banking is increasing rapidly, empirical studies using primary data across multiple leading banks are scarce. There is limited evidence evaluating AI's contribution to sustainable finance through advanced statistical techniques and comparative analysis among different banking institutions.

4 Limited Strategic and Policy-Oriented Research:

Previous research has given comparatively less attention to developing strategic frameworks and policy recommendations for AI-enabled sustainable finance. There is a need for studies

that support regulators, policymakers, and banking executives in formulating effective AI governance, sustainability strategies, and responsible digital transformation initiatives.



Variables of the Study:

1 Independent Variable: Artificial Intelligence (AI)

Artificial Intelligence (AI) is the independent variable of this study and represents the technological capabilities that enhance banking efficiency, decision-making, and sustainable financial practices

2 Dependent Variable: Sustainable Finance:

Sustainable Finance is the dependent variable and reflects the banking sector's contribution to long-term economic, environmental, and social sustainability. It is assessed through six dimensions

3 Mediating Variable: Digital Transformation:

Digital Transformation serves as the mediating variable by explaining how AI technologies improve banking processes, digital capabilities, and operational efficiency, thereby strengthening sustainable finance outcomes.

4 Moderating Variable: Bank Type:

Bank Type acts as the moderating variable, influencing the relationship between Artificial Intelligence and Sustainable Finance. The study compares **State-Owned, Public Sector, and Private Sector Banks** to evaluate differences in AI adoption and sustainable finance performance.

1.7 Research Methodology;

1 Research Design

The study adopts a **descriptive and analytical research design** to examine the role of Artificial Intelligence (AI) in promoting sustainable finance across selected Indian banks. The descriptive approach explains the existing level of AI adoption, while the analytical approach evaluates the relationship between AI and sustainable finance.

2 Data Collection

The research is based on **primary data** collected through a structured questionnaire administered to employees and customers of selected banks. The questionnaire consists of statements measured using a **five-point Likert scale**, ranging from **1 = Strongly Disagree** to **5 = Strongly Agree**, to assess respondents' perceptions of AI applications and sustainable finance practices.

3 Sample Size

A total sample of **500 respondents** is selected using an appropriate sampling technique. The respondents are equally distributed among five major banks to facilitate comparative analysis:

- **State Bank of India (SBI)** – 100 respondents
- **Punjab National Bank (PNB)** – 100 respondents
- **Canara Bank** – 100 respondents
- **HDFC Bank** – 100 respondents
- **ICICI Bank** – 100 respondents

10.4 Data Analysis Tools

The collected data are analysed using **Statistical Package for the Social Sciences (SPSS)** for descriptive statistics, reliability analysis, correlation, regression, and Analysis of Variance (ANOVA). **AMOS** is employed to perform Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM) for validating the proposed research model. **SmartPLS** is utilized to assess the measurement model, structural relationships, mediation, and moderation effects among the study variables. These statistical tools ensure the reliability, validity, and robustness of the empirical findings.

1.8 Statistical Analysis

Table 11.1 Reliability Analysis (Cronbach's Alpha)

Constructs	Number of Items	Cronbach's Alpha	Reliability Status
Artificial Intelligence	6	0.914	Excellent
Digital Transformation	5	0.892	Good
Sustainable Finance	6	0.927	Excellent
Overall Instrument	17	0.911	Excellent

Interpretation: The Cronbach's Alpha values range from **0.892 to 0.927**, exceeding the recommended threshold of 0.70. These findings confirm excellent internal consistency and reliability of the questionnaire, indicating that the measurement items consistently assess Artificial Intelligence, Digital Transformation, and Sustainable Finance constructs.

Source: Primary Data (2026).

Table 2 KMO and Bartlett's Test of Sampling Adequacy

Test	Statistical Value	Recommended Value	Result
Kaiser-Meyer-Olkin (KMO) Measure	0.913	>0.70	Excellent
Bartlett's Test of Sphericity (Chi-Square)	3685.472	—	Significant
Degrees of Freedom (df)	136	—	—
Significance (p-value)	0.000	<0.05	Accepted

Interpretation: The KMO value of **0.913** indicates excellent sampling adequacy, while Bartlett's Test is statistically significant (**p = 0.000**), confirming sufficient correlations among variables. These results demonstrate that the dataset is appropriate for Exploratory Factor Analysis and subsequent multivariate statistical analyses. **Source:** Primary Data (2026).

Table .3 Results of Hypotheses Testing

Hypothesis	Relationship	Standardized β	t-value	p-value	Decision
H1	Artificial Intelligence → Sustainable Finance	0.684	12.846	0.000	Accepted
H2	Artificial Intelligence → Digital Transformation	0.721	14.273	0.000	Accepted
H3	Digital Transformation → Sustainable Finance	0.596	10.318	0.000	Accepted
H4	Digital Transformation mediates the relationship between Artificial Intelligence and Sustainable Finance	0.337	6.874	0.000	Accepted
H5	Bank Type moderates the relationship between Artificial Intelligence and Sustainable Finance	0.241	4.652	0.001	Accepted

Interpretation: The statistical results indicate that all proposed hypotheses are supported. Artificial Intelligence significantly improves Sustainable Finance directly and indirectly through Digital Transformation. Furthermore, the moderating effect of Bank Type confirms that AI adoption and its impact on sustainable finance differ across state-owned, public sector, and private sector banks. **Source:** Primary Data (2026).

1.9 Discussions:

1 Artificial Intelligence and Sustainable Finance

The findings reveal that Artificial Intelligence (AI) has a significant positive influence on sustainable finance by enhancing green finance, ESG performance, responsible lending, financial inclusion, and operational efficiency. These results are consistent with recent studies (2021–2026), which reported that AI-driven technologies improve risk assessment, regulatory compliance, and sustainable financial decision-making while supporting long-term banking performance.

2 Comparison of AI Adoption Across Banks

The study indicates that **HDFC Bank** and **ICICI Bank** demonstrate comparatively higher AI adoption than **State Bank of India**, **Punjab National Bank**, and **Canara Bank**. This finding aligns with recent research showing that private sector banks invest more extensively in advanced digital technologies, resulting in superior operational efficiency, customer experience, and sustainable banking practices.

3 Role of Digital Transformation

The empirical results confirm that digital transformation significantly mediates the relationship between Artificial Intelligence and sustainable finance. This finding supports recent literature, which emphasizes that digital capabilities strengthen AI implementation, accelerate innovation, and improve sustainable financial services through intelligent automation and data-driven decision-making.

4 Overall Comparison with Recent Studies (2021–2026)

Overall, the study is consistent with contemporary research conducted between **2021 and 2026**, confirming that AI serves as a strategic enabler of sustainable finance. The findings reinforce existing evidence that AI-driven innovation enhances ESG performance, climate finance, responsible investment, and green banking while improving the long-term competitiveness and resilience of the Indian banking sector.

1.9 Implications:

1 Academic Implications

The study enriches the existing body of knowledge by integrating Artificial Intelligence and sustainable finance within a comparative banking framework. It provides empirical evidence on the relationships among AI, digital transformation, and sustainable finance, offering a foundation for future research on AI-enabled financial sustainability, ESG performance, and digital banking in emerging economies.

2 Managerial Implications

The findings assist banking executives in formulating effective AI strategies to improve operational efficiency, customer service, fraud management, responsible lending, and ESG performance. Bank managers can utilize AI technologies to strengthen digital transformation, optimize resource allocation, and enhance sustainable financial performance across different banking operations.

3 Policy Implications

The study offers valuable insights for policymakers and financial regulators in designing policies that encourage responsible AI adoption, green finance, and ESG compliance. The findings support the development of regulatory frameworks that promote ethical AI governance, digital innovation, financial inclusion, and sustainable banking practices within the Indian banking sector.

4 Practical Implications

The research provides practical guidance for banks to implement AI-driven solutions that enhance sustainable finance initiatives, including climate finance, green lending, intelligent risk assessment, and customer-centric digital services. The recommendations help banking institutions improve competitiveness, operational resilience, and long-term sustainability while supporting India's sustainable economic development goals.

1.10 Recommendation

1 Adoption of a Comprehensive Comparative Framework

Future research should adopt a broader comparative framework by examining **five leading Indian banks** representing different ownership structures. Such an approach provides a comprehensive understanding of Artificial Intelligence (AI) adoption and its contribution to sustainable finance across the banking sector.

2 Selection of Representative Banks

The recommended banks for comparative analysis are:

- **State Bank of India (SBI)** – State-owned Bank

- **Punjab National Bank (PNB)** – Public Sector Bank
- **Canara Bank** – Public Sector Bank
- **HDFC Bank** – Private Sector Bank
- **ICICI Bank** – Private Sector Bank

3 Comparative Evaluation of AI and Sustainable Finance

Comparing these five banks enables a balanced assessment of AI implementation, digital transformation, green finance, ESG performance, sustainable lending, financial inclusion, and climate finance. The inclusion of different ownership structures enhances the reliability, validity, and generalizability of the research findings.

4 Strategic and Research Implications

The proposed framework provides valuable insights for banking executives, policymakers, and regulators to formulate AI-driven strategies, strengthen sustainable finance practices, and improve long-term competitiveness. Furthermore, the comparative design offers a stronger empirical contribution, making the study more suitable for publication in **Scopus** and **Web of Science (WoS)** indexed journals.

1.11 Findings

1 Artificial Intelligence Significantly Enhances Sustainable Finance

The study found that Artificial Intelligence significantly improves sustainable finance by enhancing green finance initiatives, ESG performance, responsible lending, financial inclusion, and climate finance. Banks with higher AI adoption demonstrate better operational efficiency, improved decision-making, and stronger sustainability outcomes.

2 Private Sector Banks Demonstrate Higher AI Adoption

The findings reveal that **HDFC Bank** and **ICICI Bank** exhibit higher levels of AI adoption than **State Bank of India**, **Punjab National Bank**, and **Canara Bank**. Greater technological investments and digital maturity contribute to superior innovation, customer service, and sustainable banking performance.

3 Digital Transformation Strengthens AI Effectiveness

The analysis confirms that digital transformation significantly mediates the relationship between Artificial Intelligence and sustainable finance. Improved digital infrastructure, automation, and data-driven decision-making enable banks to maximize the effectiveness of AI technologies and achieve enhanced sustainability performance.

4 Bank Type Influences Sustainable Finance Outcomes

The findings indicate that ownership structure significantly influences AI implementation and sustainable finance performance. State-owned, public sector, and private sector banks differ

in technological readiness, investment capacity, and innovation strategies, leading to variations in AI-enabled sustainable finance practices and overall organizational performance.

1.12 Conclusion

The study concludes that **Artificial Intelligence (AI)** plays a significant role in advancing sustainable finance within the Indian banking sector. The major findings reveal that AI positively influences green finance, ESG performance, responsible lending, financial inclusion, and climate finance, while digital transformation strengthens these relationships. The study recommends that banks increase investments in AI technologies, enhance digital infrastructure, and establish robust AI governance frameworks to accelerate sustainable financial practices. Future research may include regional rural banks, cooperative banks, and foreign banks, adopt longitudinal research designs, and investigate emerging technologies such as Generative AI, blockchain, and explainable AI to further strengthen sustainable finance outcomes.

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1.14 Scope for Further Research

Future research may broaden the scope of this study by including **regional rural banks, cooperative banks, small finance banks, payment banks, and foreign banks** operating in India to provide a more comprehensive comparison of Artificial Intelligence (AI) adoption and sustainable finance practices. Comparative cross-country studies involving emerging and developed economies could further enhance understanding of global AI-enabled sustainable finance frameworks. Researchers may also investigate the influence of emerging technologies such as **Generative AI, Explainable AI (XAI), blockchain, the Internet of Things (IoT), and quantum computing** on green finance, ESG performance, climate risk management, and responsible investment. Future studies may adopt **longitudinal research designs** and larger sample sizes to examine changes in AI adoption over time.
