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ARTIFICIAL INTELLIGENCE AS A CATALYST FOR GREEN BANKING PERFORMANCE: A CONCEPTUAL FRAMEWORK FOR SUSTAINABLE BANKING

Nikhita Chitawadagi¹ and Dr. Chandrashekar M. Mathapati²

¹Research Scholar, Department of PG Studies and Research in Management, Karnataka State Akkamahadevi Women University, Vijayapura, Karnataka, India; ²Assistant Professor, Department of PG Studies and Research in Management, Karnataka State Akkamahadevi Women University, Vijayapura, Karnataka, India

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*Corresponding author:

Nikhita Chitawadagi

ABSTRACT

The increasing emphasis on environmental sustainability has encouraged financial institutions to adopt green banking practices that support environmentally responsible operations and sustainable finance objectives. Simultaneously, advances in Artificial Intelligence (AI) have transformed the banking sector by enhancing operational efficiency, decision-making capabilities, risk management, and customer service. Despite growing scholarly interest in both AI and green banking, existing research has largely examined these domains independently, resulting in limited understanding of how AI contributes to green banking performance. This study addresses this gap by developing a conceptual framework that explains the role of AI as a catalyst for enhancing green banking performance. Drawing upon literature related to artificial intelligence, green banking, sustainable finance, ESG governance, and digital transformation, the study proposes a four-dimensional framework consisting of AI Capabilities, Green Banking Enablers, Green Banking Performance, and Sustainable Banking Ecosystem. The framework suggests that AI capabilities such as machine learning, predictive analytics, natural language processing, and intelligent automation facilitate environmentally responsible banking practices through paperless banking, resource optimization, sustainable lending, environmental risk assessment, and ESG monitoring. These mechanisms contribute to improved green banking performance and support the development of a sustainable banking ecosystem. The study contributes to the literature by integrating AI and green banking within a unified theoretical perspective and identifying future research directions for scholars and practitioners. The findings highlight the strategic importance of AI in supporting sustainable banking transformation and advancing environmental sustainability objectives within the financial sector.

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INTRODUCTION

The increasing severity of climate change, environmental degradation, and resource depletion has intensified global efforts toward sustainable development. Governments, businesses, and financial institutions are increasingly expected to align their operations with environmental sustainability goals and contribute to the transition toward a low-carbon economy. In this context, the banking sector has emerged as a critical facilitator of sustainable development due to its central role in financing economic activities and influencing investment decisions. Financial institutions are no longer evaluated solely on the basis of profitability and financial performance; they are also expected to demonstrate

environmental responsibility and support sustainable economic growth. The concept of green banking has gained considerable attention as a strategic response to environmental challenges and sustainability concerns. Green banking refers to banking practices that promote environmentally responsible and socially sustainable economic activities while minimizing the ecological footprint of banking operations. These practices include paperless banking, digital transactions, green financing, sustainable lending, energy-efficient operations, and the integration of environmental considerations into financial decision-making processes. Through such initiatives, banks contribute to environmental protection while enhancing

operational efficiency and long-term organizational sustainability.

Over the past decade, technological advancements have significantly transformed the banking industry. The emergence of digital banking, financial technology (FinTech), big data analytics, cloud computing, blockchain, and artificial intelligence (AI) has revolutionized the way financial services are designed, delivered, and managed. Among these technologies, artificial intelligence has become one of the most influential innovations shaping the future of banking. AI encompasses a range of technologies, including machine learning, natural language processing, predictive analytics, computer vision, and intelligent automation, which enable systems to perform tasks that traditionally require human intelligence. In the banking sector, AI applications have expanded rapidly across customer service, fraud detection, credit assessment, risk management, compliance monitoring, and operational decision-making. Recent years have witnessed increasing scholarly interest in understanding the role of financial technologies in advancing sustainability objectives within the banking sector. A systematic review conducted by Rahman *et al.* (2024) identified a growing body of literature highlighting the importance of FinTech in supporting sustainable banking practices and promoting environmentally responsible financial services.

Beyond operational efficiency and customer experience, AI has recently been recognized as a potential enabler of sustainability initiatives within the banking industry. Recent studies suggest that AI-driven technologies contribute to paperless banking, resource optimization, environmental monitoring, and sustainable operational practices, thereby supporting the objectives of green banking (Vijay & Karthigeyan, 2025). AI-driven technologies can support paperless banking, optimize resource utilization, improve energy management, enhance environmental risk assessment, strengthen ESG monitoring, and facilitate sustainable lending decisions. Through predictive analytics and intelligent automation, AI can assist financial institutions in identifying environmentally responsible investment opportunities, reducing operational waste, and improving sustainability-related performance outcomes. Consequently, the integration of AI into banking operations has the potential to strengthen green banking initiatives and accelerate the achievement of sustainable development objectives.

Despite the growing interest in both artificial intelligence and green banking, existing academic literature remains fragmented. A substantial body of research has examined the adoption of AI in banking, focusing primarily on operational efficiency, customer satisfaction, digital transformation, and financial performance. Similarly, numerous studies have explored green banking practices, environmental sustainability, and sustainable finance. However, limited attention has been given to understanding how AI capabilities contribute specifically to green banking performance. Current research often treats artificial intelligence and green banking as separate streams of inquiry, resulting in a lack of comprehensive theoretical frameworks that explain the mechanisms through which AI can facilitate environmentally sustainable banking practices. Furthermore, recent discussions on sustainable finance have highlighted the need for innovative approaches that integrate technological advancement with environmental responsibility. As financial institutions

increasingly adopt AI-driven solutions, there is a growing need to conceptualize the relationship between AI capabilities and green banking outcomes.

Understanding this relationship is essential for banks seeking to balance technological innovation with sustainability objectives and for policymakers aiming to promote environmentally responsible financial systems. Against this backdrop, the present study seeks to develop a conceptual framework that explains the role of artificial intelligence as a catalyst for green banking performance. By synthesizing existing literature on artificial intelligence, sustainable finance, and green banking, the study proposes a theoretical model illustrating how AI capabilities can facilitate operational transformation, support environmental sustainability initiatives, and enhance green banking performance. In addition, the study identifies key research gaps and outlines future research directions to guide scholars and practitioners in exploring the intersection of AI and sustainable banking.

The study contributes to the existing body of knowledge in three important ways. First, it integrates two emerging research domains—artificial intelligence and green banking—within a unified conceptual framework. Second, it explains the theoretical pathways through which AI-driven technologies can influence environmental and sustainability outcomes in banking operations. Third, it provides a future research agenda for scholars interested in examining the role of advanced technologies in promoting sustainable financial ecosystems. Ultimately, the study argues that artificial intelligence has the potential to serve as a strategic catalyst for enhancing green banking performance and supporting the broader objectives of sustainable development.

Evolution of Green Banking and Sustainable Finance: The concept of sustainable development gained global prominence following the publication of the Brundtland Report in 1987, which defined sustainable development as meeting the needs of the present without compromising the ability of future generations to meet their own needs. As concerns regarding climate change, environmental degradation, and resource depletion intensified, sustainability gradually became an important consideration across various sectors of the global economy, including the financial services industry. The banking sector plays a significant role in economic development by mobilizing savings, allocating credit, facilitating investments, and supporting industrial growth. However, the environmental consequences of financed projects have increasingly drawn attention to the responsibility of financial institutions in promoting sustainable development. This realization led to the emergence of sustainable finance, a financial approach that integrates environmental, social, and governance (ESG) considerations into investment and lending decisions. Jeucken (2001) argued that financial institutions play a critical role in promoting sustainable development by integrating environmental considerations into financial decision-making and investment practices.

Green banking emerged as a practical extension of sustainable finance. The term refers to banking activities that encourage environmentally responsible practices while reducing the ecological footprint of banking operations. Green banking encompasses a broad range of initiatives, including paperless banking, digital banking services, green loans, renewable energy financing, sustainable investment products, environmentally responsible procurement, and energy-efficient

branch operations. Through these practices, banks seek to balance profitability with environmental stewardship and social responsibility. Recent research on Green AI adoption suggests that banking institutions are increasingly exploring AI-enabled sustainability practices to support environmental objectives while maintaining operational efficiency (Chandran *et al.*, 2025). Bihari (2011) highlighted that green banking extends beyond environmental responsibility and encompasses strategic efforts to align banking operations with sustainable development goals. The development of green banking can be traced through several phases. Initially, environmental concerns were addressed primarily through corporate social responsibility initiatives and philanthropic activities. Subsequently, financial institutions began incorporating environmental risk assessments into lending decisions, particularly for projects with potential ecological impacts. The introduction of international frameworks such as the Equator Principles, Principles for Responsible Banking, and the United Nations Sustainable Development Goals further accelerated the integration of sustainability into banking operations.

In emerging economies such as India, green banking gained momentum through regulatory encouragement and increasing awareness of climate-related risks. Banks introduced digital banking channels, electronic statements, online fund transfers, and mobile banking applications to reduce paper consumption and operational waste. Simultaneously, financial institutions expanded financing support for renewable energy projects, green infrastructure, sustainable agriculture, and environmentally responsible enterprises. Recent developments indicate that green banking has evolved beyond merely reducing paper usage and energy consumption. Contemporary green banking increasingly focuses on climate risk management, sustainable investment strategies, ESG reporting, carbon footprint reduction, and responsible financing practices. Consequently, green banking has become an integral component of sustainable finance and a critical mechanism for supporting global sustainability objectives. Masukujaman and Aktar (2013) emphasized that green banking initiatives contribute not only to environmental protection but also to long-term organizational sustainability and responsible banking practices. Despite significant progress, the implementation of green banking practices continues to face several challenges, including high implementation costs, technological limitations, regulatory uncertainty, and difficulties in measuring environmental performance outcomes. These challenges have encouraged researchers and practitioners to explore innovative technological solutions capable of enhancing the effectiveness and scalability of green banking initiatives. Among these emerging technologies, artificial intelligence has attracted considerable attention due to its potential to transform banking operations while simultaneously supporting sustainability goals.

Artificial Intelligence in Banking: Artificial Intelligence (AI) has emerged as one of the most transformative technologies of the Fourth Industrial Revolution. Broadly defined, AI refers to the capability of computer systems to perform tasks that traditionally require human intelligence, including learning, reasoning, problem-solving, pattern recognition, language understanding, and decision-making. According to Davenport and Ronanki (2018), successful AI implementation in organizations is typically associated with process automation, cognitive insights, and customer engagement, all of which have become increasingly relevant within the banking

industry. Advances in machine learning, deep learning, natural language processing, and predictive analytics have significantly expanded the practical applications of AI across industries, particularly within the financial services sector. Recent evidence suggests that AI-powered FinTech innovations are reshaping banking operations by enhancing process efficiency, improving customer experiences, and supporting sustainability objectives. Bethapudi *et al.* (2025) argue that AI-driven digital transformation has become a critical factor in enabling modern banks to achieve both operational excellence and environmentally responsible banking practices. The rapid growth of digital banking, increasing customer expectations, and rising competitive pressures have accelerated the adoption of AI-driven solutions across various banking functions. Today, AI technologies are extensively utilized in customer relationship management, fraud detection, risk assessment, credit scoring, anti-money laundering compliance, cybersecurity, investment advisory services, and process automation. The growing adoption of AI in banking can be viewed as part of the broader FinTech transformation occurring within the financial services industry. Rahman *et al.* (2024) observed that technological innovations are increasingly being integrated into sustainable banking initiatives, creating opportunities for more efficient and environmentally responsible banking operations.

One of the most significant contributions of AI in banking is the automation of repetitive and resource-intensive tasks. Intelligent automation enables financial institutions to process large volumes of transactions, verify customer information, monitor suspicious activities, and generate compliance reports with greater speed and accuracy than traditional manual processes. This not only improves operational efficiency but also reduces administrative costs and minimizes human error. Machine learning algorithms have further enhanced decision-making capabilities within banks. By analyzing vast amounts of structured and unstructured data, AI systems can identify hidden patterns, predict customer behavior, evaluate creditworthiness, and detect fraudulent transactions in real time. Predictive analytics enables banks to make more informed lending decisions, manage risks more effectively, and allocate resources efficiently. Consequently, AI contributes to improved financial performance while strengthening organizational resilience.

Another important application of AI is the enhancement of customer experience. AI-powered chatbots, virtual assistants, and personalized recommendation systems provide customers with faster, more convenient, and highly customized banking services. These technologies improve accessibility and engagement while reducing dependence on physical branch infrastructure. The growing shift toward digital customer interactions has further reinforced the strategic importance of AI within modern banking ecosystems. Garrido-Merchán *et al.* (2026) argue that artificial intelligence is emerging as a foundational technology within sustainable finance, enabling more effective decision-making, ESG evaluation, sustainability reporting, and environmentally responsible investment strategies. AI technologies can support environmental monitoring, optimize energy consumption, improve resource allocation, facilitate paperless banking, and strengthen ESG reporting mechanisms. Furthermore, AI-driven analytics can assist banks in evaluating environmental risks, identifying sustainable investment opportunities, and assessing the long-term sustainability implications of lending

decisions. The concept of Green AI has emerged in response to growing concerns regarding the environmental impact of artificial intelligence systems. Green AI emphasizes the development and deployment of AI technologies that achieve desired outcomes while minimizing computational costs and environmental impacts (Verdecchia *et al.*, 2023). Despite these benefits, the adoption of AI in banking also raises concerns related to data privacy, algorithmic bias, ethical governance, cybersecurity risks, and energy consumption associated with large-scale computational systems. These concerns have given rise to the concept of responsible AI and sustainable AI, emphasizing the need to balance technological innovation with ethical and environmental considerations. As banks increasingly pursue both digital transformation and sustainability objectives, AI has begun to occupy a strategic position at the intersection of technological advancement and environmental responsibility. This convergence provides a compelling foundation for examining how AI capabilities can contribute to green banking performance, an area that remains relatively underexplored in existing literature.

Artificial Intelligence as a Catalyst for Green Banking Performance: The convergence of technological innovation and sustainability has created new opportunities for financial institutions to enhance their environmental performance while maintaining operational efficiency. Among emerging technologies, Artificial Intelligence (AI) has gained significant attention due to its ability to transform traditional banking processes and support sustainable development objectives. While existing literature has independently examined AI adoption in banking and the evolution of green banking practices, limited attention has been devoted to understanding how AI functions as a catalyst for green banking performance. This section proposes that AI serves as an enabling mechanism through which banks can achieve environmental sustainability goals, improve operational efficiency, and strengthen responsible banking practices. Green banking performance refers to the extent to which banking institutions successfully implement environmentally sustainable practices and achieve positive environmental outcomes through their operations, products, and services. Such performance may be reflected in reduced paper consumption, lower energy utilization, efficient resource management, sustainable financing decisions, environmental risk management, and alignment with broader sustainability objectives. Achieving these outcomes often requires substantial operational transformation, which can be facilitated by AI-driven technologies.

One of the primary contributions of AI to green banking performance lies in promoting paperless and digital banking ecosystems. According to Vijay and Karthigeyan (2025), AI-enabled systems facilitate digital documentation, automated workflows, and intelligent transaction processing, significantly reducing paper consumption and improving operational sustainability within banking institutions. Traditional banking operations have historically relied on extensive documentation, physical record keeping, and paper-based customer interactions. AI-powered digital platforms, intelligent document processing systems, and automated workflows enable banks to reduce dependency on paper-intensive processes. Through digital onboarding, electronic verification, automated customer support, and intelligent data management systems, banks can significantly minimize resource consumption while improving service delivery efficiency.

These findings are consistent with the observations of Vijay and Karthigeyan (2025), who identified resource optimization and environmental sustainability as key outcomes of AI adoption in the banking sector. Machine learning algorithms can analyze operational data to identify patterns of resource utilization and recommend energy-efficient practices. Intelligent systems can optimize data center operations, monitor energy consumption across branch networks, and improve infrastructure utilization. By enabling more efficient use of organizational resources, AI supports the environmental objectives associated with green banking initiatives. Another significant contribution of AI relates to environmental risk assessment and sustainable lending practices. Traditionally, evaluating environmental risks associated with lending and investment decisions has been a complex and resource-intensive process. AI-driven predictive analytics can process large volumes of environmental, financial, and operational data to identify sustainability-related risks and opportunities. This capability enables banks to make more informed lending decisions, support environmentally responsible projects, and strengthen green financing initiatives. Consequently, AI enhances the integration of environmental considerations into financial decision-making processes. AI further supports green banking through enhanced compliance monitoring and ESG assessment. Regulatory expectations regarding sustainability reporting and environmental governance have increased substantially in recent years. AI-powered monitoring systems can analyze large datasets, identify compliance deviations, generate automated reports, and facilitate real-time monitoring of sustainability indicators. Such capabilities improve transparency, accountability, and governance while reducing the administrative burden associated with sustainability reporting.

Fraud detection and risk management also contribute indirectly to green banking performance. AI-based fraud detection systems improve operational efficiency by identifying suspicious activities and reducing financial losses. Efficient risk management practices support institutional stability and enable banks to allocate resources more effectively toward sustainable initiatives. In this manner, AI contributes not only to financial resilience but also to the long-term sustainability objectives of banking institutions. The relationship between AI and green banking performance can therefore be understood as a multi-stage process. AI capabilities such as machine learning, predictive analytics, natural language processing, and intelligent automation facilitate operational transformation within banks. These transformations lead to paperless banking, optimized resource utilization, improved environmental risk assessment, enhanced ESG monitoring, and sustainable lending practices. Collectively, these outcomes contribute to improved green banking performance and support the development of a sustainable banking ecosystem. Based on the synthesis of existing literature, this study proposes that AI does not directly generate sustainability outcomes. Instead, AI acts as a strategic enabler that strengthens the mechanisms through which green banking initiatives are implemented and managed. The effectiveness of green banking performance therefore depends not only on the adoption of AI technologies but also on how these technologies are integrated into organizational sustainability strategies and operational practices. Accordingly, Artificial Intelligence may be conceptualized as a catalyst that accelerates the transition from traditional banking models toward environmentally responsible and sustainable banking systems. By enhancing

efficiency, improving decision-making, and supporting environmental governance, AI possesses the potential to play a transformative role in the future development of green banking.

Proposed Conceptual Framework: Based on the analysis of existing literature on artificial intelligence, sustainable finance, and green banking, this study proposes a conceptual framework illustrating the role of Artificial Intelligence as a catalyst for green banking performance. The framework builds upon recent conceptual developments in AI-enabled sustainable finance, particularly the integrative taxonomy proposed by Garrido-Merchán *et al.* (2026), which highlights the growing role of AI in supporting sustainability-oriented financial decision-making. The framework integrates technological capabilities with sustainability-oriented banking practices and demonstrates how AI-driven transformation can contribute to the development of a sustainable banking ecosystem. The proposed framework consists of four interconnected dimensions: AI Capabilities, Green Banking Enablers, Green Banking Performance, and Sustainable Banking Ecosystem. The framework assumes that AI capabilities do not directly produce sustainability outcomes; rather, they facilitate operational and strategic transformations that strengthen green banking initiatives and improve environmental performance.

AI Capabilities: The first dimension of this framework comprises the core technological capabilities of artificial intelligence that are increasingly being adopted within the banking sector. These capabilities include:

- **Machine Learning (ML):** Enables banking systems to analyze large datasets, identify patterns, and generate predictive insights for informed decision-making.
- **Predictive Analytics:** Assists banks in forecasting risks, customer behavior, environmental impacts, and investment opportunities through data-driven analysis.
- **Natural Language Processing (NLP):** Facilitates intelligent customer interactions, automated document processing, and efficient information management.
- **Intelligent Automation:** Automates repetitive and resource-intensive tasks, reducing operational inefficiencies and minimizing human intervention.

Collectively, these AI capabilities provide the technological foundation for transforming traditional banking operations into more efficient, responsive, and sustainability-oriented systems.

Green Banking Enablers: This represents the operational mechanisms through which AI contributes to green banking initiatives. AI-driven capabilities support several key enablers of green banking, including:

- **Paperless Banking:** Digital documentation, electronic verification, and automated workflows significantly reduce paper consumption and administrative waste.
- **Resource Optimization:** AI facilitates efficient utilization of energy, infrastructure, and operational resources through intelligent monitoring and predictive management systems.
- **Sustainable Lending Practices:** Advanced analytics assist banks in evaluating environmental risks and identifying environmentally responsible lending opportunities.

- **Environmental Risk Assessment:** AI-powered tools enable more accurate assessment of climate-related and environmental risks associated with financial activities.
- **ESG Monitoring and Reporting:** Intelligent systems support real-time tracking, evaluation, and reporting of environmental, social, and governance performance indicators.
- These enablers serve as the operational bridge connecting technological innovation with sustainability objectives.

Green Banking Performance: The third dimension focuses on the outcomes generated through the effective implementation of AI-supported green banking practices. Green banking performance may be reflected through several indicators:

- **Environmental Efficiency:** Reduction in resource consumption, energy usage, and operational waste.
- **Carbon Footprint Reduction:** Lower environmental impact resulting from digital banking and optimized operational processes.
- **Sustainable Operations:** Integration of environmentally responsible practices into day-to-day banking activities.
- **Responsible Financing:** Increased support for sustainable projects, renewable energy initiatives, and environmentally conscious investments.
- **Regulatory and ESG Compliance:** Enhanced ability to meet sustainability reporting requirements and environmental governance standards.
- The framework proposes that improved green banking performance is achieved when AI capabilities effectively strengthen the implementation of green banking enablers.

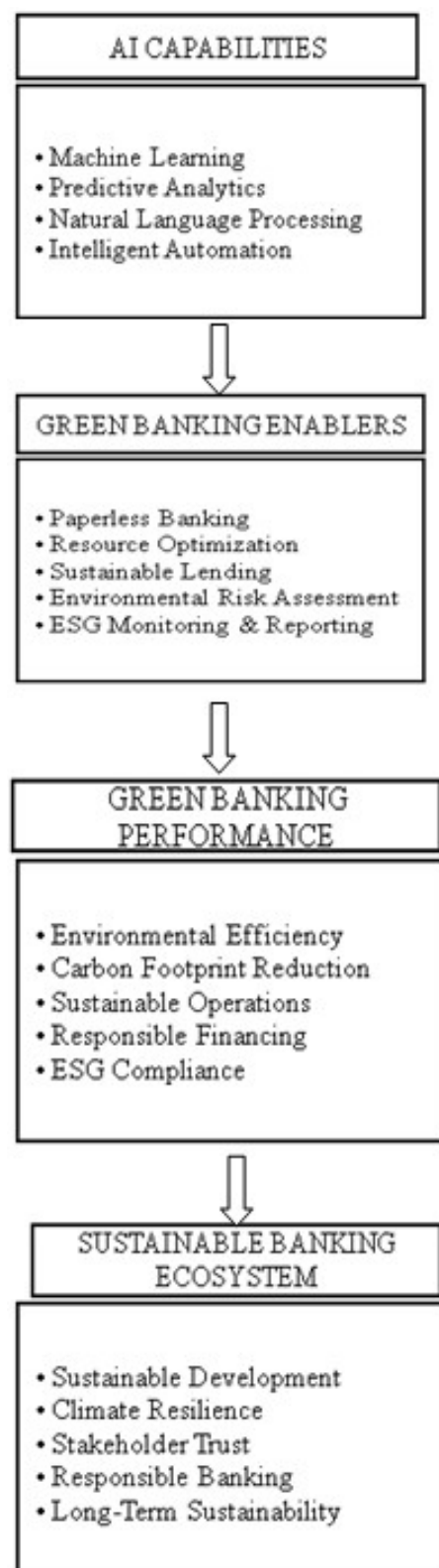
Sustainable Banking Ecosystem: The final dimension represents the broader long-term outcome of AI-enabled green banking transformation. As financial institutions improve their environmental performance, they contribute to the development of a sustainable banking ecosystem characterized by:

- Environmentally responsible banking practices.
- Enhanced stakeholder trust and transparency.
- Stronger alignment with Sustainable Development Goals (SDGs).
- Improved climate resilience and sustainable finance initiatives.
- Long-term economic, environmental, and social sustainability.

The sustainable banking ecosystem reflects the ultimate objective of integrating technological innovation with environmental responsibility within the financial sector.

Conceptual Relationship: This perspective is also consistent with Garrido-Merchán *et al.* (2026), who emphasize that AI applications generate sustainability outcomes indirectly through organizational processes, decision-support mechanisms, and operational transformation. These practices improve green banking performance, which subsequently contributes to the creation of a sustainable banking ecosystem. Thus, AI functions as a strategic catalyst that accelerates the transition from conventional banking models toward sustainability-oriented banking systems.

The proposed framework extends existing literature by integrating artificial intelligence and green banking within a unified theoretical model. It provides a foundation for future empirical investigations while offering practical insights for banking institutions seeking to leverage AI technologies in support of sustainability objectives.



Source: Developed by the Author based on the synthesis of literature from AI in Banking, Green Banking, Sustainable Finance, and ESG studies.

Research Gap and Future Research Agenda

Research Gap: The growing importance of sustainability and technological innovation has resulted in increasing academic interest in both green banking and artificial intelligence. Existing literature has extensively examined green banking practices, sustainable finance initiatives, environmental risk management, and the adoption of digital technologies within the banking sector. Similarly, numerous studies have explored the application of artificial intelligence in banking operations, particularly in areas such as fraud detection, customer service, risk assessment, compliance management, and operational efficiency.

Although recent studies have begun exploring the contribution of AI to green banking initiatives (Vijay & Karthigeyan, 2025), existing research remains largely descriptive and focuses primarily on the potential benefits of AI adoption rather than developing comprehensive theoretical models that explain how AI capabilities translate into measurable green banking performance outcomes. Rahman *et al.* (2024) provided a comprehensive review of FinTech and sustainable banking literature and identified several future research directions, the review also highlighted the fragmented nature of existing research. Specifically, limited attention has been devoted to developing theoretical frameworks that explain how emerging technologies such as artificial intelligence contribute to green banking performance. Consequently, the relationship between AI capabilities, green banking enablers, and sustainability outcomes remains insufficiently conceptualized. Most existing studies investigate AI primarily from the perspective of technological adoption, operational effectiveness, customer satisfaction, or financial performance. Conversely, research on green banking largely focuses on environmental initiatives, sustainable lending, customer awareness, and regulatory compliance. Consequently, the intersection between these two domains remains relatively underexplored.

Although Garrido-Merchán *et al.* (2026) provided a comprehensive taxonomy of AI applications within sustainable finance, limited attention has been devoted to examining how these AI capabilities specifically influence green banking performance. Existing frameworks largely focus on investment and finance perspectives, creating opportunities for further conceptual development within the banking domain. A review of the literature indicates that current research is fragmented and lacks an integrated theoretical framework explaining how AI capabilities contribute to green banking outcomes. Existing studies often discuss AI as a digital transformation tool or green banking as an environmental strategy, without adequately examining the mechanisms through which AI-driven technologies facilitate sustainable banking practices. Furthermore, limited scholarly attention has been given to understanding how AI-supported processes such as intelligent automation, predictive analytics, environmental risk assessment, and ESG monitoring influence green banking performance. Another notable gap concerns the absence of a comprehensive conceptual model linking AI capabilities, operational transformation, green banking enablers, and sustainability outcomes. While researchers acknowledge the potential benefits of AI for sustainability, there is insufficient theoretical explanation regarding the pathways through which these benefits are generated within banking institutions. This lack of conceptual clarity restricts the development of future

Figure 1. Proposed Conceptual Framework: Artificial Intelligence as a Catalyst for Green Banking Performance

empirical investigations and limits practical understanding among policymakers and banking practitioners. Moreover, recent advancements in sustainable finance, climate risk management, and ESG governance have created new opportunities for AI applications that remain largely unexplored in existing banking literature. As banks increasingly adopt AI-driven technologies, there is a growing need for theoretical frameworks capable of explaining how technological innovation can support environmental sustainability objectives within the financial sector. In response to these gaps, the present study develops a conceptual framework that integrates artificial intelligence and green banking performance within a unified theoretical perspective. The framework contributes to the literature by identifying key AI capabilities, green banking enablers, performance outcomes, and sustainability impacts, thereby providing a foundation for future research and theory development.

Future Research Agenda: The conceptual framework proposed in this study opens several promising avenues for future research. First, future scholars may empirically examine the relationships proposed within the framework using quantitative, qualitative, or mixed-method approaches. Empirical validation of the framework would enhance understanding of the extent to which AI capabilities contribute to green banking performance across different institutional contexts. Second, future studies may investigate the influence of specific AI technologies, such as machine learning, natural language processing, intelligent automation, and predictive analytics, on various dimensions of green banking performance. Such investigations could provide deeper insights into the relative effectiveness of different AI applications in promoting sustainability objectives.

Third, comparative studies may explore variations in AI-enabled green banking practices across public sector banks, private sector banks, cooperative banks, and digital-only financial institutions. Comparative analyses would improve understanding of contextual factors influencing the adoption and effectiveness of AI-supported sustainability initiatives.

Fourth, future research may examine the role of organizational factors such as leadership commitment, technological readiness, innovation culture, regulatory support, and sustainability orientation in strengthening the relationship between AI adoption and green banking performance. These factors may act as important mediators or moderators within the proposed framework. Fifth, researchers may investigate the implications of AI-driven sustainability initiatives for broader environmental, social, and governance (ESG) outcomes. As ESG considerations continue to gain importance within global financial systems, understanding the contribution of AI to ESG performance represents a significant area for future scholarly inquiry. Sixth, future studies may explore the ethical and sustainability challenges associated with AI adoption in banking. Issues related to algorithmic bias, data privacy, transparency, accountability, and the environmental footprint of AI systems require further examination to ensure responsible and sustainable technological development. Consistent with the future research recommendations proposed by Rahman *et al.* (2024), further investigation is needed to understand the role of advanced technologies in supporting sustainable banking and environmental performance. Finally, longitudinal studies may assess the long-term impact of AI-enabled green banking initiatives on organizational sustainability, climate resilience, and sustainable development

objectives. Such research would contribute to a more comprehensive understanding of how technological innovation can support the transition toward sustainable financial ecosystems. Overall, the proposed future research agenda highlights the substantial opportunities available for advancing knowledge at the intersection of artificial intelligence, green banking, and sustainable finance. By addressing these research directions, future scholars can further refine theoretical understanding and provide valuable insights for banking practitioners, policymakers, and sustainability stakeholders.

CONCLUSION

The increasing emphasis on environmental sustainability has transformed the role of financial institutions from traditional intermediaries to active contributors to sustainable development. As climate change, environmental degradation, and resource scarcity continue to pose significant challenges to global economies, the banking sector is under growing pressure to adopt environmentally responsible practices and support sustainable financial systems. In this context, green banking has emerged as an important strategy through which banks can reduce their environmental footprint, promote sustainable investments, and contribute to broader sustainability objectives. Simultaneously, the rapid advancement of Artificial Intelligence (AI) has revolutionized banking operations by enhancing efficiency, improving decision-making, strengthening risk management, and facilitating digital transformation. While previous studies have extensively examined AI adoption in banking and the implementation of green banking practices, limited attention has been devoted to understanding how AI can serve as a catalyst for enhancing green banking performance. The existing literature largely treats these domains as separate areas of inquiry, resulting in a fragmented understanding of their potential interrelationship.

This study addressed this gap by developing a conceptual framework that integrates artificial intelligence and green banking within a unified theoretical perspective. The framework proposes that AI capabilities, including machine learning, predictive analytics, natural language processing, and intelligent automation, function as strategic enablers of environmentally responsible banking practices. Through mechanisms such as paperless banking, resource optimization, sustainable lending, environmental risk assessment, and ESG monitoring, AI can facilitate operational transformation and improve green banking performance. The findings of recent studies, including Bethapudi *et al.* (2025), indicate that AI-driven digital transformation is increasingly influencing both operational performance and sustainability outcomes within the banking sector, reinforcing the strategic importance of AI-enabled green banking initiatives. The proposed framework further suggests that enhanced green banking performance contributes to the development of a sustainable banking ecosystem characterized by responsible financing, environmental stewardship, regulatory compliance, stakeholder trust, and long-term sustainability. Accordingly, AI should not be viewed solely as a technological innovation aimed at improving operational efficiency, but also as a strategic instrument capable of supporting environmental and sustainability objectives within the banking sector. The study contributes to the existing body of knowledge in several ways. First, it bridges the gap between the literature on artificial

intelligence and green banking by establishing a theoretical linkage between these emerging fields. Second, it offers a structured conceptual framework that explains the pathways through which AI can influence green banking outcomes. Third, it provides a comprehensive future research agenda that may guide subsequent empirical investigations and theoretical developments in this area. From a practical perspective, the findings highlight the importance of integrating AI-driven technologies into sustainability strategies and green banking initiatives. Banking institutions can leverage AI to improve environmental performance, strengthen ESG compliance, enhance resource efficiency, and support sustainable finance objectives. Policymakers and regulators may also benefit from understanding the role of AI in promoting environmentally responsible banking systems and facilitating the transition toward a sustainable economy. In conclusion, the convergence of artificial intelligence and green banking represents a promising avenue for advancing sustainable finance and responsible banking practices. As technological innovation continues to reshape the financial services industry, AI has the potential to become a critical catalyst in the pursuit of environmental sustainability and long-term economic resilience. Future research and practical implementation efforts should explore this evolving intersection to maximize the benefits of both technological advancement and sustainable development.

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