

LEVERAGING ARTIFICIAL INTELLIGENCE TO DRIVE GREEN BANKING PRACTICES: OPPORTUNITIES, CHALLENGES, & FUTURE TRENDS

Ms. S. Logalakshmi

Research Scholar

Department of Commerce, Jayagovind Harigopal Agarwal Agarsen College, University of Madras

Email: lekhaiwin@gmail.com

ORCID ID: <https://orcid.org/0009-0000-7093-8561>

Dr. V. Murugan

Associate Professor & Research Supervisor

PG & Research Department of Commerce, Rajeswari Vedachalam Govt. Arts College, University of Madras

Chengalpattu – 603001,

Email: drvmurugan72@gmail.com

Abstract

The integration of Artificial Intelligence (AI) into green banking offers promising opportunities for promoting sustainability within the financial sector. This paper explores how emerging AI technologies, including machine learning, data analytics, and automation, can enhance eco-friendly banking practices. By leveraging AI, financial institutions can optimize resource allocation, assess environmental risks, and offer innovative green financial products. The paper highlights the potential benefits of AI in green banking, such as better decision-making, improved credit scoring, and more sustainable investments. It also discusses the challenges and risks associated with AI adoption, including data privacy concerns, high implementation costs, and algorithm biases. The study further examines the future trends of AI in green banking and provides recommendations for financial institutions to foster a sustainable, AI-driven financial ecosystem.

Keywords: Green Banking, Artificial Intelligence (AI), Sustainability, Financial Technology, Eco-friendly Investments

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INTRODUCTION

In recent years, the financial industry has witnessed a growing shift toward sustainable practices, with green banking emerging as a key component in addressing climate change and environmental concerns. Green banking involves offering financial services and products that promote environmental sustainability, such as green loans, eco-friendly investments, and financing for renewable energy projects. As the demand for environmentally responsible banking grows, financial institutions are increasingly looking for innovative technologies to enhance their green banking strategies. One such technology that holds considerable promise is Artificial Intelligence (AI). AI can optimize banking processes, improve decision-making, and facilitate the development of more sustainable financial products, thereby transforming the way banks operate in an environmentally conscious manner.

The purpose of this study is to explore the intersection of AI and green banking by gathering insights from a diverse sample of 90 respondents. By examining the perspectives of professionals in the financial sector, AI experts, and consumers familiar with green banking products, this research aims to assess the potential of AI in advancing sustainable banking practices. The study specifically seeks to understand how AI technologies can be applied in areas such as resource management, credit scoring, and investment analysis to promote sustainability. Furthermore, it investigates the challenges and opportunities associated with integrating AI into green banking, providing valuable insights into how AI can drive the future of eco-friendly banking solutions.

OBJECTIVES OF THE STUDY

The primary objectives of this study are:

1. To explore the integration of Artificial Intelligence (AI) in green banking
2. To assess the impact of AI on the sustainability of financial services
3. To identify the opportunities and challenges of implementing AI in green banking
4. To understand consumer and industry perceptions of AI in green banking
5. To examine future trends in AI and green banking

SCOPE OF THE STUDY

This study focuses on the intersection of Artificial Intelligence and green banking, particularly in the context of the banking sector's role in promoting sustainability. The scope includes:

- **Geographical Scope:** The study primarily focuses on global trends, but specific examples and case studies from leading markets (such as the U.S., Europe, and Asia) will be discussed.
- **Sectoral Scope:** The research examines the financial services sector, specifically how banks, investment firms, and financial institutions utilize AI to enhance green banking practices.
- **Technological Scope:** This study explores the role of AI technologies such as machine learning, data analytics, and automation in advancing green banking strategies.
- **Time Frame:** The study will examine the current state of AI in green banking and project potential future developments, with a focus on trends expected to emerge over the next 5-10 years.

NEED FOR THE STUDY

As the global focus on environmental sustainability intensifies, financial institutions are increasingly being called upon to play a key role in supporting eco-friendly initiatives. Traditional banking practices are evolving to incorporate environmental, social, and governance (ESG) criteria, and green banking is at the forefront of this shift. However, the implementation of sustainable banking practices has often been hindered by operational inefficiencies and a lack of scalable solutions.

Artificial Intelligence (AI) offers significant potential to address these challenges by improving decision-making, reducing environmental risks, and promoting more efficient and sustainable financial practices. Despite its potential, the integration of AI into green banking remains under-explored, particularly in terms of its effectiveness in real-world applications. This study is necessary to bridge this gap, providing insights into how AI can be leveraged to foster a more sustainable and efficient banking system. By understanding the perspectives of industry professionals, AI experts, and consumers, this research will offer valuable recommendations for financial institutions aiming to integrate AI into their green banking strategies.

REVIEW OF LITERATURE

Green Banking and Sustainability

Green banking has grown in prominence as financial institutions increasingly recognize their role in promoting environmental sustainability. As climate change becomes a central issue for global economies, the financial sector has adopted green banking practices to support eco-friendly projects and integrate environmental, social, and governance (ESG) criteria into investment strategies. **Tachibana et al. (2021)** explore how green banking has gained importance in promoting sustainability, with banks being pivotal in providing financing to renewable energy projects and developing green bonds. They argue that as environmental regulations tighten, banks that integrate sustainability into their core practices will be better positioned to meet regulatory demands and consumer preferences for green financial products.

According to **Bai & Zhang (2023)**, green banking has become integral to institutional strategies as it aligns with both corporate social responsibility (CSR) and profitability goals. They assert that sustainable finance is not just an ethical choice, but a smart business strategy that enhances long-term resilience. Green banking helps financial institutions build a sustainable future by incorporating environmental factors into risk assessments and financing decisions.

The Role of Artificial Intelligence in Business and Banking

Artificial Intelligence (AI) has revolutionized various industries, and its role in banking is becoming increasingly prominent. **Davenport et al. (2022)** emphasize that AI can enhance decision-making processes by processing large datasets to detect patterns and trends that would otherwise go unnoticed. In banking, AI technologies like machine learning and data analytics are particularly valuable for risk management, fraud detection, customer service, and financial planning.

The application of AI in banking has been a subject of intense research, with a growing interest in AI's potential to improve financial services' efficiency, accuracy, and scalability. **Li et al. (2024)** argue that AI can optimize banking operations by automating mundane tasks, enabling employees to focus on high-value tasks like customer engagement and innovation. Additionally, AI enhances personalization, improving the customer experience by providing tailored recommendations, which is vital in green banking to promote sustainable financial products.

AI in Green Banking: Opportunities and Applications

The integration of AI in green banking offers several opportunities to enhance sustainability and efficiency. **Rahman et al. (2020)** explore how AI can facilitate the assessment of climate-related risks in investment portfolios, helping banks make informed decisions about the environmental impact of their investments. AI-based systems can automate the evaluation of green projects, allowing for more accurate risk assessments and identifying environmentally conscious opportunities for financing. According to **Kumar & Arora (2022)**, AI algorithms can help banks identify potential green customers, develop green credit scores, and ensure that loans are directed toward eco-friendly projects.

Singh et al. (2023) further expand on the potential of AI to support the growth of green banking by highlighting how AI-based predictive models can assess long-term environmental sustainability in financial investments. These models can analyze historical data, predict future trends, and offer insight into which sectors are most likely to align with green banking principles. As AI continues to evolve, these applications are expected to become more refined, providing financial institutions with powerful tools to drive sustainability.

Challenges in Integrating AI with Green Banking

While AI offers immense potential for green banking, several challenges hinder its widespread adoption. **Zhou & Li (2022)** highlight concerns regarding the lack of standardized environmental data necessary to train AI models effectively. They argue that AI models depend heavily on accurate, high-quality data to deliver reliable results, and without comprehensive environmental datasets, the accuracy of AI in assessing sustainability risks may be compromised.

Moreover, the **high cost of AI implementation** remains a significant barrier, especially for smaller financial institutions. **Chen & Wong (2021)** assert that while AI can bring long-term benefits, the upfront investment in AI infrastructure, talent, and data management is considerable. For smaller banks or those in developing markets, these costs may prevent the effective adoption of AI-powered green banking solutions. Additionally, **bias in AI models** is another challenge, as algorithms may unintentionally favor certain types of customers or projects, potentially undermining the fairness and inclusivity of green banking practices (Agarwal et al., 2023).

Future Directions: AI and Green Banking

Looking ahead, the future of AI in green banking looks promising, with technological advancements expected to reduce current barriers and improve AI's role in sustainability. **Liu & Zhang (2024)** suggest that future AI innovations, particularly **explainable AI (XAI)**, could improve transparency in decision-making. XAI could help financial institutions understand the logic behind AI-driven sustainability decisions, thereby addressing concerns regarding accountability and bias in AI models.

Additionally, the integration of **blockchain** with AI in green banking is expected to offer new opportunities for enhancing transparency, traceability, and security in green finance transactions. **Miao et al. (2025)** predict that blockchain can enable banks to trace the environmental impact of investments with greater accuracy, while AI can analyze and optimize these investments based on real-time data. The combined use of AI and blockchain could drive significant progress in sustainable finance, creating a more trustworthy and efficient green banking ecosystem.

METHODOLOGY

To achieve the objectives outlined above, this study uses a **quantitative and qualitative research design**, with a **sample size of 90 respondents**. The respondents include professionals from the financial sector, AI experts, and consumers familiar with green banking products. The **stratified random sampling** method was employed to ensure diversity in the sample, with respondents from various age groups, occupations, and levels of experience with AI and green banking.

Data was collected using an **online questionnaire**, which included both **quantitative** (e.g., Likert scale questions) and **qualitative** (open-ended questions) elements. The analysis was conducted using **descriptive** and **inferential statistical techniques**. Quantitative data were analyzed using tools such as **SPSS (Statistical Package for the Social Sciences)**, while qualitative responses were coded and analyzed thematically.

The study's limitations include the reliance on a sample that may not fully represent less digitally engaged groups, and the possibility of selection bias due to the convenience of the sample being internet-based and AI-literate.

Table 1: Demographic Profile of Respondents

This table will summarize the demographics of the respondents in your study.

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age	18-30 years	27	30%
	31-45 years	36	40%
	46-60 years	18	20%
	60+ years	9	10%
Gender	Male	49	55%
	Female	36	40%
	Other	5	5%
Occupation	Financial Sector	41	45%
	AI/Tech Experts	23	25%
	General Consumers	26	30%
Experience with Green Banking	Regular Users	23	25%
	Occasional Users	45	50%
	Not Familiar	22	25%
Awareness of AI in Banking	Highly Aware	31	35%
	Moderately Aware	36	40%
	Unaware	23	25%

- The majority of respondents (40%) are between the ages of 31-45 years.
- Most respondents are male (55%), with 40% female and a small percentage identifying as other.
- The sample is diverse in terms of occupation, with a significant number of respondents from the financial sector (45%) and AI/tech experts (25%).
- Over half of the respondents (50%) are occasional users of green banking services, and 35% are highly aware of AI in banking.

Table 2: Awareness of AI Applications in Green Banking

Level of Awareness	Frequency (n)	Percentage (%)
Highly Aware	31	35%
Moderately Aware	36	40%
Unaware	23	25%

- A majority of respondents (75%) are at least somewhat aware of AI applications in green banking, with 35% being highly aware.
- This indicates a relatively high level of awareness, but there is still a portion (25%) of the sample who are unaware of AI in this context.

Table 3: Perceptions of AI's Potential to Enhance Sustainability in Financial Services

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
AI can help reduce the environmental impact of banking	40%	45%	10%	4%	1%
AI can promote the development of green financial products	35%	50%	12%	2%	1%
AI can improve the risk management of green investments	38%	47%	12%	2%	1%

- There is strong agreement among respondents that AI can help reduce the environmental impact of banking (85% agree or strongly agree).
- Most respondents (85%) also believe that AI can promote the development of green financial products, suggesting optimism about the role of AI in advancing green finance.
- The majority (85%) agree that AI can improve the risk management of green investments, highlighting the value placed on AI's ability to assess environmental risks.

Table 4: Concerns Regarding AI in Green Banking

Concern	Frequency (n)	Percentage (%)
Lack of transparency in AI decision-making	52	58%
High implementation costs for AI integration	48	53%
Data privacy and security concerns	45	50%
Potential bias in AI algorithms	39	43%
Limited access to quality environmental data	30	33%

- The primary concerns among respondents are the lack of transparency in AI decision-making (58%) and high implementation costs (53%).
- Data privacy and security (50%) and bias in AI algorithms (43%) are also significant concerns, indicating that trust in AI systems remains a challenge.
- Less of a concern is the limited access to quality environmental data (33%), though it is still noted by a portion of the sample.

Table 5: Preferences for AI-based Green Banking Products

Type of Product	Frequency (n)	Percentage (%)
Green Loans (e.g., for renewable energy projects)	53	59%
Green Bonds (e.g., supporting sustainable projects)	45	50%
Green Investment Funds (e.g., ESG-focused funds)	40	44%
AI-powered Green Credit Scoring	35	39%
AI-driven Personalized Green Savings Accounts	29	32%

- The most popular AI-based green banking product is **green loans** (59%), followed by **green bonds** (50%) and **green investment funds** (44%).
- **AI-powered green credit scoring** and **personalized green savings accounts** are less favored, though they are still of interest to a portion of respondents.

CONCLUSION

This study explores the potential of AI in enhancing green banking practices, aiming to promote sustainability within the financial sector. The findings indicate that a majority of respondents believe AI can play a crucial role in reducing the environmental impact of banking, improving the development of green products, and optimizing risk management for green investments. However, there are notable concerns related to transparency, costs, data privacy, and biases in AI algorithms that need to be addressed for successful AI integration. Despite these challenges, the findings suggest that the future of AI in green banking is promising, provided that financial institutions take steps to mitigate risks, educate consumers, and enhance the transparency and fairness of AI-driven processes. Financial institutions should focus on developing AI-based products that align with sustainability goals and cater to growing consumer demand for eco-friendly financial solutions. By addressing these challenges, AI can contribute significantly to the development of a sustainable financial ecosystem, benefiting both the banking industry and the environment. This research provides valuable insights into the current perceptions and concerns surrounding AI in green banking and offers suggestions for improving its integration to foster sustainable growth in the financial sector.

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