“GREEN LENDING IN THE AGE OF AI: RETHINKING RISK AND OPPORTUNITY IN LEBANON’S BANKING SECTOR”

Research Paper

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“Abstract”

In recent years, the concept of AI-enabled green lending has been progressively gaining popularity as an innovative tool to promote sustainable finance and achieve environmentally-friendly objectives in the banking industry. Using a quantitative approach with a survey, a hundred experts in the field were surveyed to examine their opinions on readiness, risks, and opportunities concerned with AI-enabled green lending in Lebanese banks. The results showed that there is a moderate AI readiness and optimism concerning opportunities with independent concerns related to risks like regulatory uncertainty, data privacy, and algorithmic bias. The results also showed that drivers like economic incentives and ESG compliance statistically outweighed barriers, with participants’ role and experience playing a significant part in the outcomes.

Keywords: AI readiness, green lending, ESG compliance, regulatory barriers, Lebanon

1 Introduction

1.1 Background of the study

With the progressively emerging trend of sustainability and the global shift towards sustainable financial solutions, green lending has become one of the mostly sought-after mechanisms within the banking sector, capable of optimizing environmental responsibility across the sector (Sule et al., 2024). By definition, a green loan is “a form of financing that enables borrowers to use the proceeds to exclusively fund projects that make a substantial contribution to an environmental objective” (The World Bank, 2021). This new form of financial lending seeks to align financial transactions with international sustainability goals, such as the United Nations’ Sustainable Development Goals and other climate ESG (Environmental, Social, and Governance) standards (Riyanti et al., 2025). Nevertheless, while this concept is trending worldwide, the case is different in the Lebanese context, as the financial sector is still limited by macroeconomic tensions, currency devaluation and volatility, as well as limited awareness on the importance of such loans.

However, the emergence of Artificial Intelligence (AI) has ignited hope among relevant stakeholders to overcome these challenges. As expressed by Oforgu et al. (2025), AI has emerged as the ultimate solution, capable of detecting fraudulent activities at early stages, predict repayment behaviors, optimize risk assessment frameworks, and help relevant stakeholders identify proper green investing opportunities. Yet, with Lebanon’s unique settings, regulatory uncertainties and outdated infrastructure, the adoption of AI is still limited (Kovic-Chahine, 2025), prompting further studies.

1.2 Significance of the study

This is a significant study because it addresses the way Artificial Intelligence (AI) is capable of revolutionizing green lending in the Lebanese banking sector, an industry that is struggling with heightened economic instability and regulatory problems due to ongoing tensions and lack of proper awareness concerning the significance of sustainable finance. With the ongoing sustainability developments worldwide, green loans have emerged as a fitting solution for the banking sector, despite its limited application in emerging economies like Lebanon. By addressing the particular role of AI and its use in green loans, this study addresses the challenges and opportunities of this innovation in the Lebanese context.

From a practical standpoint, the findings of this study are set to help relevant stakeholders, policymakers, and banking officials in Lebanon understand how AI can be used in green loans and its benefits in optimizing risk assessments, fraud detection, and capitalize on opportunities in a faster and more vigilant manner. The study will also specify the extent of the Lebanese banking sector's readiness to adopt this advanced technology, pinpointing potential challenges and proposed strategies for adoption.

From an academic perspective, this study contributes to the limited body of literature that addresses AI-powered green loans in the Lebanese context. The study highlights Lebanon as an essential case study, representative of emerging economies, to inform other comparable regions and settings on the way technology is capable of addressing environmental considerations while being aligned with financial expectations.

1.3 Study aim and objectives

Building on the identified challenges faced by the Lebanese banking sector and relevant stakeholders, this study aims at providing empirical evidence on how AI can optimize and redefine the risk/opportunity balance in green lending in Lebanon. To do so, the following research questions and objectives are crafted:

Table 1- Research Questions and Objectives

Research Question (RQ)	**Research Objective (RO)**
RQ1: How do Lebanese banks perceive the opportunities associated with AI-enabled green lending?	**RO1:** To assess perceived opportunities such as efficiency gains, market differentiation, ESG compliance, and customer acquisition.
RQ2: What risks do Lebanese banks associate with implementing AI in green lending practices?	**RO2:** To identify and evaluate perceived risks including credit default, data privacy issues, algorithmic bias, and regulatory non-compliance.
RQ3: What is the current level of AI readiness within Lebanese banks in relation to green lending initiatives?	**RO3:** To measure technological infrastructure, data availability, and staff expertise for AI integration in green lending.
RQ4: What factors drive or hinder the adoption of AI-enabled green lending in Lebanon's banking sector?	**RO4:** To determine key economic, regulatory, organizational, and cultural drivers and barriers to adoption.
RQ5: What is the relationship between AI readiness, perceived risks, and perceived opportunities in predicting adoption intentions?	**RO5:** To analyze the statistical relationships between AI readiness, risk perception, and opportunity perception as predictors of adoption intentions.

2 Literature Review

2.1 Green lending and sustainable finance

To begin with, in the growing context of sustainability and eco-friendly practices, green loans have emerged as a relevant financial instrument that is aligned with this growing trend (Al-Qudah et al., 2022). These loans are created to fund projects or initiative that have a general positive effect on the environment and that contribute to the efforts to combat climate change through the promotion of sustainable and eco-friendly practices. As elaborated by Di Tommaso et al. (2025), with the increasing acknowledgement of environmental responsibility and the importance of combatting the negative impact of climate change, green lending and loans have gained serious popularity in the financial sector.

Across the literature, several researchers provided definitions of green loans. For the sake of this study, green loans are defined as "a subset of sustainable finance specifically targeting environmentally friendly projects, ranging from renewable energy initiatives and energy-efficient building construction to sustainable agriculture and clean technology development" (Di Tommaso et al., 2025). The ultimate purpose of a green loan is to direct funds and capital towards environmentally-friendly activities that have a positive impact on the environment and society, thereby supporting the shift to a low-carbon and more sustainable economy. Globally, the concept of green lending has grown substantially over the last years, especially with the support of international frameworks like the United Nations' Sustainable Development Goals (2015) and the Paris Agreement (United Nations Climate Change, 2025). Typically, banks assess the proposed projects' environmental and social impact based on pre-defined terms and standards before offering the green loan, with a possibility of having preferential terms like lower interest rates and longer repayment periods to encourage the demand for this financial solution (Di Tommaso et al., 2025).

However, the application of this financial solution is not even across all regions. As specified by Chahal and Bansal (2025), while advanced economies are showing promising avenues for the adoption of green lending due to well-established green finance policies, emerging economies still struggle from various challenges like regulatory uncertainty, outdated infrastructure, unclear laws, lack of awareness, and economic instability. In Lebanon specifically, despite the urgent environmental and economic needs, green lending remains partially developed.

2.2 Challenges of green lending in Lebanon

In the specific context of Lebanon, the literature emphasizes the serious difficulties and challenges that are presented to the Lebanese banking sector, especially concerning the adoption of sustainable finance (Elammar, 2019). Lebanon, a country that has been struggling with unprecedented financial difficulties that exacerbated a crisis since 2019, is unable to invest in this innovative solution, neither financially nor through human resources. The financial crisis has weakened the Lebanese banking sector in terms of lending capacities and has affected the trust between investors/clients and banks, especially with the serious currency devaluation (Chlela & Mousawi, 2025). As a result, Lebanese banks struggle to find the needed resources to finance long-term sustainability-driven projects like renewable energy initiatives (Chlela & Mousawi, 2025).

The adoption of green lending in Lebanon is further complicated by regulatory ambiguities. While advanced economies are equipped with the appropriate policies and regulations that govern the application of green lending and provide a clear picture of the process (Agrawal et al., 2023), Lebanon falls short in this matter, as it lacks the needed guidance and regulatory oversight to successfully launch green loans. With this regulatory limitation, Lebanese banks are unable to appropriately

implement this innovative solution, potentially leading to problems in monitoring and reporting activities associated with it.

Moreover, studies like Abu Orabi's (2024) have emphasized the importance of public awareness when it comes to green finance products like green loans. In other words, without proper knowledge on the matter, demand will remain limited to a particular population, leading to the partial implementation of this financial solution. With Lebanon's lack of awareness effort on the matter, this concept remains underdeveloped.

2.3 Artificial intelligence in banking

Another revolutionary innovation that entered the banking world is Artificial Intelligence (AI). As argued by Bin Shafi et al. (2023), AI has revolutionized the financial world of today, with its different uses that include data-driven solutions and personalized banking services that are more customer-centric. In addition, with AI's ability to automate decision-making processes, reduce potential human bias, and synthesize large datasets, its use in the banking industry is now more efficient than ever (Maple et al., 2023). Similarly, academics like Ahmed and Iqbal (2025) have further highlighted the use of AI-enabled strategies in risk management across banks, especially with AI's ability to prematurely identify potential defaults and detect fraudulent activity with an unprecedented accuracy and speed compared to traditional methods.

Other researchers like Maple et al. (2023) explain that AI is an unprecedented opportunity in the banking world, as it allows banks to use modern types of data like digital payment or energy usages during decision-making processes. These new types of data can create new lending opportunities for clients who were conventionally excluded from the credit system. In the context of green lending, AI can help banks assess projects based on their environmental and social impact, beyond mere financial returns, in turn fostering meaningful and trustworthy relationships with clients and investors (Kaye, 2025).

Nevertheless, the literature and specifically Vousinas and Saluja (2025) assert that the use of AI in the banking system and other industries is generally inconsistent. In the case of advanced economies, the use of AI is facilitated through better digital systems and strong regulatory policies. However, in the case of emerging economies with weaker systems, several challenges can hinder the use of AI in the banking sector like an outdated infrastructure, poor IT system, and a lack of properly knowledgeable staff. Lebanon falls into the latter category, with a poor financial system that impedes the introduction of AI.

2.4 AI and green lending: opportunities and risks

After evaluating green lending and AI in the banking sector individually, this last section of the review addresses their intersection. According to the existing body of literature, this intersection presents both opportunities and risks. Starting with the opportunities, researchers like Hassanein and Tharwat (2024) emphasize the importance of AI in enhancing risk assessments, a key characteristic that can benefit green lending. For example, AI can provide reliable predictive analytics for a renewable energy project in terms of weather forecasting, aiding in more accurate evaluations for the acquirement of green loans. Another key opportunity is the ability of AI to streamline fraud detection, an essential factor in green lending and loan applications (Aslam & Tayyab, 2025). This opportunity is particularly relevant in regions with limited resources where any misuse of funds can further exacerbate negative environmental repercussions. Last but not least, the literature emphasizes the role of AI in optimizing regulatory oversight and proper ESG reporting (Kumbankyet, 2025). By automating key considerations like data collection, analysis, and synthesis, banks can optimize their image and reputation to investors with transparent reporting.

While several studies highlighted the opportunities associated with the intersection of AI and green lending, it is also worth mentioning that risks do exist. One major risk is the potential of algorithmic bias exacerbation by AI, as this technology replicates or amplifies existing data (Maple et al., 2023). If inequalities are already existing, AI is prone to exacerbate these inequalities and widen the gap. For example, if the bank's history is built on discriminatory conditions in loan applications, AI system may continue to limit access to green loans. Another major risk associated with AI in green lending is data privacy and cybersecurity (Hassanein & Tharwat, 2024). To generate accurate data, AI tools require large datasets which include sensitive and private data, since the main focus is loans. Without proper protection and cybersecurity measures, cyberattacks may happen, leading to the dissemination of delicate data. Another major challenge that is also highly applicable to the context of Lebanon is regulatory uncertainty (Qi et al., 2025). Currently, there are no detailed frameworks that contextualize the use of AI in banking or in green lending. Therefore, Lebanese banks risk facing ambiguities when adopting AI in green lending, leading to discrepancies in application. Last but not least, technological readiness is another major issue. The Lebanese banking sector still operates on outdates IT infrastructures, making the integration of green lending and AI difficult and costly (Al Waary, 2025).

3 Methodology

3.1 Research design

To answer the established research questions, this study adopted a quantitative research design, leveraging a cross-sectional survey. A quantitative approach was chosen for this study to generate statistically significant results and empirical evidence on how AI can optimize and redefine the risk/opportunity balance in green lending in Lebanon. This research design was also chosen due to its objectivity and the absence of bias that may limit the reliability and reproducibility of the findings, especially considering the sensitive nature and the impact of the topic (Munther et al., 2024).

3.2 Target population and sampling strategy

The study aimed at generating actionable recommendations to aid the Lebanese banking sector in its quest to integrate AI in green lending. To do so, a purposive sampling strategy was used to recruit 100 knowledgeable experts in the field like credit officers, risk managers, sustainability experts and senior executives in Lebanese banks. This sampling strategy ensures that the outcomes are reliable and originate from experts in the field (Tajik et al., 2024).

3.3 Data collection tool and variables measured

To gather the needed information, this study leveraged a structured, Likert-scale style questionnaire addressing four major variables:

1. **Perceived Opportunities:** efficiency gains, market differentiation, customer acquisition, ESG compliance
2. **Perceived Risks:** credit default, data privacy, algorithmic bias, regulatory non-compliance
3. **AI Readiness:** technological infrastructure, data availability, staff expertise
4. **Adoption Drivers and Barriers:** economic, regulatory, organizational, cultural

3.4 Data analysis

To analyze the data generated from the surveys, the Statistical Package for the Social Sciences (SPSS) is used to generate descriptive statistics and inferential tests including correlations and regressions to

examine the relationships between AI readiness, risks, opportunities, and potential adoption intentions by Lebanese banks.

All in all, the following Table 2 summarizes the key methodological aspects adopted for this study:

Table 2- Methodology Details

Aspect	Details
Research Design	Quantitative cross-sectional survey
Target Population	Credit officers, risk managers, sustainability officers, and senior executives in Lebanese commercial banks
Sampling Method	Purposive sampling to target relevant decision-makers
Data Collection Tool	Structured questionnaire with Likert-scale items
Key Variables Measured	1. **Perceived Opportunities:** efficiency gains, market differentiation, customer acquisition, ESG compliance 2. **Perceived Risks:** credit default, data privacy, algorithmic bias, regulatory non-compliance 3. **AI Readiness:** technological infrastructure, data availability, staff expertise 4. **Adoption Drivers and Barriers:** economic, regulatory, organizational, cultural
Data Analysis Techniques	Descriptive statistics, correlation analysis, and multiple regression modeling
Purpose of Analysis	To identify the most significant predictors of AI-enabled green lending adoption

4 Results and Findings

In this section of the study, the findings generated from the statistical analyses are presented according to the five research questions established.

RQ1: How do Lebanese banks perceive the opportunities associated with AI-enabled green lending?

The results related to RQ1 are summarized in Table 3 below:

Table 3- Summary of Key Statistical Tests for RQ1

Test	Key Result	Interpretation
Reliability (Cronbach's Alpha)	.81 (2 items)	Good internal consistency between items.
KMO & Bartlett's Test	KMO = .500; Bartlett's χ^2 (1) = 51.38, $p < .001$	Sampling adequacy is modest but significant, supporting factor analysis.
Factor Analysis	1 factor extracted, Eigenvalue =	Both items load strongly (.906, -.906),

	1.64; variance explained = 82.0%	indicating they measure one underlying construct.
Descriptive Statistics	Mean = 5.14; SD = 1.02 (scale 1–7)	Respondents overall agreed that AI offers opportunities (efficiency, differentiation).

Findings (RQ1):

The findings associated with the first research question showed that the participants have a positive perception when it comes to AI-enabled green lending, especially in its ability to advance Lebanese banks and improve their efficiency and market differentiation. The reliability result showed an acceptable threshold ($\alpha = .81$), and the factor analysis also affirmed that both measured items represent a single coherent construct. Last but not least, the descriptive statistics affirmed that there is a strong agreement between respondents that AI offers opportunities (Mean=5.14), suggesting that AI-enabled green lending is a solution with opportunities in the Lebanese banking sector.

RQ2: What risks do Lebanese banks associate with implementing AI in green lending practices?

Next, the findings for RQ2 are summarized in Table 4 below:

Table 4- Summary of Key Statistical Tests for RQ2

Test	Key Result	Interpretation
Reliability (Cronbach's Alpha)	.86 (3 items)	High internal consistency across risk items.
KMO & Bartlett's Test	KMO = .723; Bartlett's χ^2 (3) = 142.90, $p < .001$	Good sampling adequacy; suitable for factor analysis.
Factor Analysis	1 factor extracted, Eigenvalue = 2.36; variance explained = 78.6%	Strong loadings (.902, -.904, .854) confirm risks form a single dimension.
Descriptive Statistics	Mean = 8.18; SD = 1.77 (scale 1–11)	Respondents rated risks moderately high, showing concern about adoption.

Findings (RQ2):

Lebanese bankers identified several risks of AI adoption in green lending, including data privacy, algorithmic bias, and regulatory non-compliance. Reliability was strong ($\alpha = .86$), and factor analysis confirmed that these risks cluster into a single factor, explaining nearly 80% of the variance. Descriptive results show a relatively high mean score (8.18/11), suggesting that risk perception is strong. This highlights that while banks see opportunities, they remain cautious about data and governance challenges.

RQ3: What is the current level of AI readiness within Lebanese banks in relation to green lending initiatives?

The findings related to the current level of AI readiness within Lebanese banks when it comes to green lending initiatives are summarized in Table 5 below:

Table 5- Summary of Key Statistical Tests for RQ3

Test	Key Result	Interpretation
Reliability	.79 (2 items)	Acceptable consistency between

(Cronbach's Alpha)		readiness items.
KMO & Bartlett's Test	KMO = .500; Bartlett's χ^2 (1) = 100.72, $p < .001$	Marginal adequacy but statistically valid.
Factor Analysis	1 factor extracted, Eigenvalue = 1.80; variance explained = 90.1%	Both items loaded strongly (-.949, .949), indicating coherence.
Descriptive Statistics	Mean = 5.18; SD = 0.82 (scale 1–7)	Perceptions of readiness are moderate.

Findings (RQ3):

The statistical results concerning AI readiness within Lebanese banks were moderate. The Cronbach's Alpha for both items was acceptable with $\alpha = .79$ with an equally acceptable factor analysis that confirmed that both items (infrastructure and staff expertise) are related to the same construct. Perceptions of readiness were also moderate, with a mean score of 5.17, indicating that participants do believe in Lebanese banks' capacity to be exposed to AI-led green lending but may be not fully ready. These findings are consistent with Lebanon's broader structural problems, related to regulatory, financial, and technological shortcomings.

RQ4: What factors drive or hinder the adoption of AI-enabled green lending in Lebanon's banking sector?

The statistical findings for the factors that drive or hinder the adoption of AI-enabled green lending in Lebanese banks are summarized in Table 6 below:

Table 6- Summary of Key Statistical Tests for RQ4

Test	Key Result	Interpretation
Reliability (Cronbach's Alpha)	.84 (2 items)	Good internal consistency between adoption driver and barrier items.
Descriptive Statistics	Barrier (Regulatory Uncertainty): M = 2.20, SD = 1.29; Driver (Incentives/ESG Pressures): M = 3.22, SD = 1.28	Banks see regulatory uncertainty as a moderate barrier, while economic and ESG incentives are stronger drivers.
Paired-Samples T-Test	$t(99) = -4.27$, $p < .001$	Drivers were rated significantly higher than barriers, indicating that opportunities outweigh constraints.
Correlation	$r = -.74$, $p < .001$	Strong negative relationship: where barriers are seen as high, drivers are seen as weaker, and vice versa.
ANOVA (by Role)	$F(4,94) = 4.36$, $p = .003$ (barriers); $F(4,94) = 4.03$, $p = .005$ (drivers)	Significant differences in perceptions by job role, especially between Risk Managers and ESG Officers.
ANOVA (by Experience)	$F(3,96) = 4.73$, $p = .004$ (barriers); ns for drivers	More experienced bankers (>20 years) perceive regulatory barriers as stronger than junior staff.

Findings (RQ4):

Findings show that drivers of AI-enabled green lending in Lebanon outweigh barriers. Reliability was strong ($\alpha = .84$). Regulatory uncertainty was rated lower ($M = 2.20$), while economic incentives and ESG pressures scored higher ($M = 3.22$), indicating adoption momentum. A paired-samples t-test confirmed drivers significantly exceeded barriers ($p < .001$), and correlation analysis revealed that banks perceiving higher regulatory risks downplayed drivers. ANOVA highlighted that ESG officers were more optimistic than risk managers, whereas senior bankers (>20 years) perceived barriers more strongly, reflecting caution shaped by Lebanon's regulatory volatility.

RQ5: What is the relationship between AI readiness, perceived risks, and perceived opportunities in predicting adoption intentions?

Last but not least, the results related to RQ5 are addressed in Table 7 below:

Table 7- Summary of Key Statistical Tests for RQ5

Test	Key Result	Interpretation
Reliability (Cronbach's Alpha)	.83 (3 subscales combined)	Good internal consistency across the scales for opportunities, risks, and readiness.
Descriptive Statistics	Opportunities: M = 5.14, SD = 1.02; Risks: M = 8.18, SD = 1.77; AI Readiness: M = 5.18, SD = 0.82	Banks recognize both opportunities and risks, but also report moderate readiness.
Pearson Correlation	Opportunities ↔ AI Readiness: r = .234, p = .019; Risks ↔ AI Readiness: r = .005, p = .958; Opportunities ↔ Risks: r = -.070, p = .491	Opportunities are positively associated with readiness; risks show no significant relationship with readiness.
Spearman Correlation	Opportunities ↔ AI Readiness: ρ = .225, p = .025; Risks ↔ AI Readiness: ρ = .039, p = .699; Opportunities ↔ Risks: ρ = -.062, p = .541	Nonparametric tests confirm the same pattern as Pearson.

Findings (RQ5):

Last but not least, the results showed that the participants reported that Lebanese banks have moderate levels of opportunities with M=5.14 and readiness (M=5.18), alongside high-risk perceptions (M=8.18). In addition, the correlation analysis showed that AI readiness and opportunities are statistically positively correlated ($r = .234$, $p < .05$), affirming that when banks are more optimistic about the benefits of AI in green lending, they are more likely to be prepared in terms of expertise and infrastructure. However, the correlation analysis showed that there is no statistically significant relationship between perceived risks and readiness ($r = .005$, $p = .958$) or opportunities ($r = -.070$, $p = .491$). Overall, adoption intentions appear to be shaped more by readiness and perceived opportunities than by risk concerns.

5 Discussion and Implications

5.1 Discussion of the findings

This study aimed at providing empirical evidence on how AI can optimize and redefine the risk/opportunity balance in green lending in Lebanon. To do so, five research questions were established. Starting with RQ1, the results affirmed that banks positively perceive AI-enabled green lending, as they considered it a driver for ESG compliance, efficiency, and unique market differentiation. These findings are aligned with the outcomes of Chen et al.'s study (2024), which suggest that green lending can be seen as an opportunity to attract capital, especially in emerging economies like Lebanon.

Moving on, for RQ2, the study highlighted key risks related to AI-enabled green lending like data privacy, algorithmic bias, regulatory ambiguities, all of which are strongly addressed in the literature (Bahangulu & Owusu-Berko, 2025). However, the findings revealed that these risks did not diminish the perceived readiness or opportunity associated with this innovative solution, showing a practical way to manage the risks.

For RQ3, the results revealed that AI readiness is moderate, with some Lebanese banks being more ready than others in terms of skilled personnel or infrastructure, a finding that is reflected by Kovic-Chahine (2025). With banks that were more ready, they perceived more opportunities, revealed that optimistic thoughts about this new innovation can build the needed skills to adopt AI-enabled green lending.

The next RQ4 revealed that perceived drivers for adoption are stronger than barriers. The findings revealed that economic considerations and ESG pressures were more influential than regulatory uncertainty (Sule et al., 2024). More specifically, the results showed that ESG officers had more optimism than risk managers, highlighting the impact of participants' professions on the adoption of such innovation.

Last but not least, for RQ5, readiness and opportunity perceptions reinforced each other, while risk concerns stayed separate. This means banks are motivated more by positive factors than by fear, consistent with Riyanti et al. (2025).

5.2 Implications of the findings

The findings generated from this study have several key implications for the Lebanese banking sector and relevant stakeholders like policymakers and investors. In general, the findings affirmed that AI-enabled green lending can be employed as a key solution in today's finance world while balancing risks versus benefits effectively.

One major implication of this study is that Lebanese banks should work on optimizing and building their infrastructure capacity. The concept of AI-enabled green lending is innovative and complex, necessitating major investments in key areas like data systems, analytics tools, secure software platforms and other IT-related features to ensure that the proposed green projects are well-aligned with ESG principles. The findings also showed that Lebanese banks are expected to update their existing structure to align with the new technology, all to make the process of implementation smoother and eliminate any unnecessary risks.

Another major implication that can be derived from the findings is that Lebanese banks are in urgent need of staff training. The introduction of AI-enabled green lending is not a mere added feature to existing banking systems. This new technological feature necessitates a high level of knowledge and understanding from employees at all levels, from loan officers to managers. All employees should

understand the way AI tools work and the way to integrate ESG principles in related decision-making processes. This training should be continuous, involving key principles related to finance, technology, and sustainability. By doing so, employees are continuously up-to-date on any structural change related to AI-enabled green lending and employees would feel part of a cohesive organizational culture that aims at advancing knowledge.

Another essential implication to highlight is that cross-departmental collaboration is key to ensure smooth integration of AI-enabled green lending. All responsible teams associated with this new technology are expected to closely work together, especially with the findings of this study on the impact of optimism when it is balanced with appropriate risk management. When relevant stakeholders come together and collaboratively make decisions, the chances of success are heightened and potential risks are simultaneously decreased. This way, employees can learn together, make mistakes together, and optimize AI-enabled green lending also together.

Moreover, this study highlighted the potential risk of regulatory uncertainty, especially in the context of Lebanon that is already grappling with political and regulatory pressures. With a new and very advanced technology like AI-enabled green lending, ambiguous rules exponentially affect the integration in Lebanese banks, exacerbating feelings of hesitancy. Therefore, this study highlights the need to create robust and clear rules by Lebanese policymakers to encourage the use of AI in the banking sector and in green lending specifically. Leveraging international frameworks and benchmarks, Lebanese policymakers can reduce stakeholders' fears of implementing this new financial solution and can instill confidence in trying this new approach that not only serves them financially but also environmentally and socially.

Furthermore, this study showed that Lebanese banks can leverage global ESG trends and economic incentives to encourage adoption of AI-enabled green lending. For example, Lebanese banks can highlight the benefits of adopting this financial solution like lower interest rates, long repayment periods, tax breaks and other examples to enhance demand. These benefits make the concept of green lending more appealing, contributing simultaneously to sustainability goals while optimizing the bank's reputation.

The adoption of AI-enabled green lending is also an opportunity for Lebanese banks to advance their presence in international markets, aligning with global trends. This adoption can enhance Lebanese banks' brand image, situating it with other international financial institutions due to the comparable standards and networks they both employ. As a result, the Lebanese banking system can regain the trust of international investors and organizations, making the possibility of collaborations, funding, and partnerships more accessible.

Last but not least, the study's findings show that Lebanese banks can start small, using pilot projects with small-scale ranges before fully embracing AI-enabled green lending. In other words, the full integration of this new financial solution was shown to be complex and excessively intricate. If Lebanese banks started slow through the testing of AI tools for example or small-scale data gathering and synthesis of green loan-related data, they can detect problems or inconsistencies at small scales, minimizing major risks and financial repercussions. This proposal can also help build confidence among relevant stakeholders in navigating this new technology, encouraging a progressive wider adoption of this approach.

All in all, Table 8 below summarizes this study's key implications and their expected outcomes:

Table 8- Key Study Implications

Implication	Description / Key Actions	Expected Outcome
Capacity-Building	Invest in AI technology, data systems, and analytics tools	Smoother AI adoption, reduced risks, and better decision-making.

	compatible with existing banking processes.	
Staff Training	Provide continuous training combining finance, ESG, and AI knowledge for all staff levels.	Employees gain confidence and skills to use AI tools effectively and innovate.
Cross-Department Collaboration	Encourage ESG, risk, and compliance teams to work together, share knowledge, and make joint decisions.	Better risk management, higher project success, and organizational learning.
Economic Incentives & ESG Pressures	Leverage tax breaks, preferential rates, and international green funds to motivate adoption.	Increased participation in green financing and improved reputation.
Regulatory Clarity	Policymakers to create clear AI and ESG rules, reporting standards, and risk protocols.	Reduced uncertainty, higher experimentation, and compliance with standards.
Pilot Projects	Start with small-scale AI-enabled green lending initiatives to test tools and gather data.	Builds organizational confidence and provides proof-of-concept for broader adoption.
Alignment with Global Trends	Integrate AI and ESG strategies to comply with international standards and networks.	Access to partnerships, funding, and enhanced competitiveness.
Integrated Approach for Growth	Combine technology, training, collaboration, regulations, and pilots for a cohesive strategy.	Sustainable growth, improved competitiveness, and alignment with national and global sustainability goals.

6 Conclusion

In conclusion, this study addressed the way Lebanese banks perceive the idea of AI-enabled green lending in terms of opportunities, risks, and overall readiness to introduce this new invention across Lebanese banks. The results revealed that banks' sense of readiness and opportunities complement and support each other, while risks are individually perceived. In other words, the adoption of this new financial solution is more driven by optimistic views and banks' ability rather than fear. Key drivers like ESG compliance were shown to be more statistically influential than barriers like regulatory uncertainty, showing promising avenues for the Lebanese banking sector. Last but not least, the findings revealed that there is a statistical in the perception of AI-enabled green lending depending on participants' roles and experience levels, affirming that organizational culture is another important factor to consider.

Looking ahead, future studies are encouraged to conduct comparative analyses to see the difference between the Lebanese context and other settings facing crises. Future studies could also widen the sample and involve different banks, and examine the impact of local and regional partnerships on AI-enabled green lending adoption.

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