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Sustainability Meets Intelligence: A PRISMA-Guided Systematic Review of AI's Role in ESG Financial Decision-Making

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Abstract:

This study examines the transformative role of Artificial Intelligence (AI) in promoting sustainable financial decision-making within corporate environments. As firms face growing pressure to align financial performance with Environmental, Social, and Governance (ESG) standards, AI technologies, such as machine learning, natural language processing, and intelligent decision-support systems, are emerging as strategic tools to enhance transparency, mitigate risks, and foster long-term value creation. Following the PRISMA protocol, this research conducts a systematic literature review of 83 peer-reviewed studies published between 2015 and 2024 and indexed in Scopus. The review spans empirical, conceptual, and theoretical contributions across academic journals, conference proceedings, and industry reports. Through thematic analysis, four primary domains of AI application in sustainable finance are identified: ESG reporting, sustainability risk management, resource optimization, and strategic foresight. Findings indicate that AI improves firms' ability to process complex ESG data, automate disclosures, forecast environmental risks, and optimize operations. Nonetheless, significant challenges remain, including fragmented data sources, algorithmic opacity, ethical dilemmas, and a lack of consistent regulatory frameworks. Moreover, research remains heavily concentrated in developed economies, with limited exploration of emerging regions like the MENA, despite their unique sustainability challenges. This paper offers a theory informed synthesis by integrating stakeholder theory, the resource-based view (RBV), and institutional theory, while emphasizing ethical governance of AI. It provides actionable insights for firms, especially SMEs, and policymakers seeking to promote responsible AI deployment. Ultimately, the study contributes to building a more resilient, inclusive, and sustainable financial ecosystem through digitally empowered decision-making.

Keywords: Artificial Intelligence, Sustainable Finance, ESG, Corporate Sustainability, Financial Decision Making
Classification JEL: B41, G32, Q56, O33
Paper type: Theoretical Research

Résumé :

Cette étude explore le rôle transformateur de l'intelligence artificielle (IA) dans la prise de décision financière durable. Face à l'exigence croissante d'aligner performance financière et critères ESG (Environnementaux, Sociaux et de Gouvernance), les technologies d'IA telles que l'apprentissage automatique, le traitement du langage naturel et les systèmes intelligents d'aide à la décision s'imposent comme des leviers stratégiques. Elles favorisent la transparence, la gestion des risques et la création de valeur durable. S'appuyant sur le protocole PRISMA, cette recherche réalise une revue systématique de 83 publications scientifiques (2015–2024) indexées dans Scopus. L'analyse couvre des contributions empiriques, théoriques et conceptuelles issues de revues académiques, conférences et rapports industriels. Quatre domaines clés d'application sont identifiés : le reporting ESG, la gestion des risques de durabilité, l'optimisation des ressources et la prospective stratégique. Les résultats montrent que l'IA améliore significativement la capacité des entreprises à analyser les données ESG, automatiser les rapports de durabilité, anticiper les risques environnementaux et optimiser leur efficacité. Toutefois, des défis persistent : fragmentation des données, opacité algorithmique, enjeux éthiques et lacunes réglementaires. Par ailleurs, la majorité des recherches se concentre sur les économies développées, marginalisant les contextes émergents comme la région MENA. En mobilisant les cadres théoriques de la théorie des parties prenantes, de la *resource-based view* et de la théorie institutionnelle, l'étude souligne la nécessité d'une gouvernance éthique de l'IA. Elle propose des recommandations pratiques pour une adoption responsable, notamment à destination des PME et des décideurs publics.

Mots clés : Intelligence artificielle, Finance durable, ESG, Responsabilité numérique, Prise de décision financière, Gouvernance algorithmique.
JEL Classification : B41, G32, Q56, O33
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1. Introduction

In the face of intensifying climate risks, social inequalities, and growing pressure from regulators and stakeholders, businesses are increasingly expected to align their financial decisions with sustainability imperatives. The global shift toward Environmental, Social, and Governance (ESG) accountability, alongside the Sustainable Development Goals (SDGs), is reshaping corporate strategies across industries (OECD, 2022; UN Global Compact, 2023). Financial decisions are no longer solely driven by profit maximization but must also integrate long-term environmental and societal impacts.

In this evolving context, Artificial Intelligence (AI) has emerged as a powerful enabler of data driven and sustainability-oriented corporate governance. AI technologies, particularly machine learning, natural language processing (NLP), and intelligent decision-support systems, are increasingly used to automate ESG reporting, identify sustainability-related risks, and optimize investments in green projects (Lim, 2024; Nobanee, 2021; Chen, 2023). For instance, AI powered predictive models can forecast climate-related financial risks, while NLP tools enhance the transparency and standardization of ESG disclosures.

The economic potential of AI in sustainability is substantial. A 2023 report by PwC forecasts that AI could contribute $5.2 trillion to the global economy by 2030, largely through resource efficiency, climate risk management, and intelligent infrastructure. Furthermore, the World Economic Forum (2023) emphasizes that AI adoption will be instrumental in achieving corporate sustainability goals, particularly in ESG-driven sectors such as energy, finance, and supply chains. Yet, despite the proliferation of AI tools and a growing volume of literature on the topic, the academic field remains fragmented. Many studies focus narrowly on either the technical capacities of AI or its short-term operational benefits. Few have systematically mapped how AI, as a general-purpose technology, supports strategic financial decision-making aligned with sustainability objectives. Moreover, there is limited synthesis of theoretical frameworks, such as stakeholder theory, resource-based view (RBV), and institutional theory, which explain how firms adopt and integrate AI into their sustainable finance practices (Walker et al., 2022; Sadati et al., 2023). This gap calls for a comprehensive and critical systematic literature review to understand the role of AI in sustainable financial decision-making, including its applications, benefits, and limitations. Specifically, this study is guided by the following research questions:(1) How does AI support sustainable financial decision-making within firms? (2) What are the main applications, benefits, and challenges of AI in this domain? (3) What gaps exist in literature, and what avenues can future research explore?

This paper contributes to the existing literature in three main ways. First, it offers a consolidated overview of how AI technologies are applied across various dimensions of sustainable finance, such as ESG reporting, risk management, and resource optimization. Second, it critically discusses the main theoretical frameworks underpinning this research, including stakeholder theory and the resource-based view. Third, it identifies persistent barriers to responsible AI implementation and provides practical recommendations for firms and policymakers.

The structure of the paper is as follows: Section 2 provides a literature review and theoretical background on AI and sustainable finance. Section 3 outlines the methodology used for the systematic review. Section 4 presents the review findings, including publication trends, key applications, and barriers to implementation. Section 5 discusses benefits, limitations, and proposes future research directions. The paper concludes by reflecting on the implications of AI for advancing corporate sustainability and resilience.

2. Literature Review and Theoretical Foundations

The integration of Artificial Intelligence (AI) into sustainable finance marks a paradigmatic

shift in how firms approach value creation, risk governance, and stakeholder engagement. As sustainability becomes a core dimension of strategic financial management, AI emerges not only as a technical enabler but also as a strategic lever of corporate transformation. The academic literature, while abundant in scope, remains methodologically fragmented and conceptually underdeveloped. This section critically examines the evolution of research at the intersection of AI and sustainable financial decision-making and consolidates the dominant theoretical frameworks informing the field.

2.1. AI in Financial Decision-Making: From Technical Potential to Strategic Application

Artificial Intelligence (AI) has profoundly redefined corporate financial decision-making by enabling firms to process large, heterogeneous datasets, uncover latent patterns, and generate predictive insights that inform both operational and strategic choices (Yeo et al., 2023; Arsenault et al., 2024). In the context of sustainable finance, AI facilitates a multidimensional analysis that incorporates not only economic indicators but also environmental and social variables, thereby aligning financial strategies with ESG imperatives.

Recent research highlights four principal domains through which AI contributes to sustainability-oriented financial governance. First, AI-powered systems, especially those utilizing Natural Language Processing (NLP), enhance ESG reporting by extracting, classifying, and standardizing data from diverse sources such as corporate disclosures, regulatory filings, and social media, improving data comparability and reducing asymmetries (Lim, 2024; Nobanee, 2021). Second, AI supports sustainability risk management by modeling and anticipating climate-related and regulatory risks. Predictive analytics enables firms to shift from reactive compliance to proactive resilience-building (Reece et al., 2024). Third, AI enables resource and capital optimization by identifying inefficiencies in energy usage, operations, and logistics, fostering alignment between cost efficiency and environmental performance (Zhang & Liu, 2022). Fourth, firms use machine learning to forecast ESG trends and reputational risks, allowing for strategic foresight and long-term planning aligned with sustainability trajectories (Jiang et al., 2023).

Notably, scholars such as Nobanee (2021) argue that AI empowers firms to institutionalize sustainability by embedding ESG considerations into investment screening and financial architecture. However, this promise is tempered by critiques of ethical opacity, algorithmic bias, and data asymmetries inherent in many AI systems (Walker & Gramlich, 2022). Without adequate governance and transparency mechanisms, AI could reinforce systemic inequalities and undermine the legitimacy of ESG claims (Bhattacharya et al., 2023).

While these applications illustrate AI's transformative potential, current research remains geographically skewed toward developed economies, with limited attention to the contextual challenges and opportunities facing emerging markets.

2.2. Theoretical Lenses and Research Gaps

Scholars have employed various theoretical lenses to explain how and why firms adopt Artificial Intelligence (AI) within sustainability strategies, with Stakeholder Theory (Freeman, 1984), the Resource-Based View (Barney, 1991), Institutional Theory (DiMaggio & Powell, 1983), and Legitimacy Theory (Suchman, 1995) emerging as the most prominent. Stakeholder Theory positions AI-enhanced ESG transparency as a means for firms to address the evolving expectations of investors, regulators, customers, and civil society, reinforcing legitimacy and accountability through dynamic disclosure mechanisms (Nobanee, 2021; Xie et al., 2023). The RBV conceptualizes AI as a strategic resource capable of delivering competitive advantage through ESG-driven differentiation, particularly when embedded in decision-support systems (Zhang & Liu, 2022). Institutional Theory interprets AI adoption as a response to mimetic, coercive, and normative pressures that shape firms' sustainability trajectories (Walker et al.,

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2022), while Legitimacy Theory highlights how AI-generated disclosures and sustainability narratives are employed to enhance corporate legitimacy, especially in sectors exposed to reputational risk (Papyshev & Chan, 2023).

While these theories offer complementary insights, they also present conceptual tensions. For instance, Stakeholder Theory emphasizes transparency and accountability to external actors, whereas the Resource-Based View focuses on leveraging AI for internal competitive advantage. Institutional Theory, meanwhile, interprets AI adoption as isomorphic behavior under institutional pressures, which may conflict with strategic differentiation aims under RBV. Understanding these overlaps and tensions provides a richer framework for assessing AI's role in shaping sustainable finance.

However, a notable limitation in the current literature is the underrepresentation of ethics centered frameworks, especially Legitimacy Theory and the emerging concept of Digital Moral Responsibility (DMR). Legitimacy Theory (Suchman, 1995) is particularly relevant in the context of AI, as firms increasingly rely on algorithmic systems to justify ESG performance claims and maintain societal approval. Yet, few studies rigorously examine how AI-driven ESG disclosures shape or distort perceptions of corporate legitimacy.

Digital Moral Responsibility, a nascent but critical paradigm, calls for firms to ensure that AI systems align with broader ethical norms, including fairness, explainability, and accountability (Sadati et al., 2023; Arsenault et al., 2024). It pushes the discussion beyond technical and institutional concerns to address questions of algorithmic justice, stakeholder trust, and power asymmetries in data usage. Integrating such ethical perspectives is essential to fully understand the risks and responsibilities tied to AI adoption in financial governance, particularly given rising concerns around algorithmic opacity and ESG greenwashing.

3. Method

This study employs systematic literature review (SLR) to investigate the role of Artificial. Intelligence (AI) in enhancing sustainability-oriented financial decision-making within firms. A systematic review enables the integration of a broad and diverse body of academic work while ensuring objectivity, methodological rigor, and reproducibility. To uphold these standards, the review adheres to the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), which offer a structured and transparent protocol for identifying, selecting, and synthesizing relevant literature.

The central research question guiding this review is: How is Artificial Intelligence being applied to improve sustainability-focused financial decision-making in firms, and what are the key benefits, challenges, and theoretical frameworks associated with its integration? This inquiry is operationalized through three specific research objectives: (1) to identify and categorize the primary applications of AI in sustainable finance, (2) to analyze the reported advantages and limitations of these applications, and (3) to highlight the theoretical underpinnings and conceptual gaps within the existing literature.

The review process was structured around four main stages: defining the research questions, delineating the scope and boundaries of the review, systematically identifying and screening relevant studies, and conducting a comprehensive synthesis of the findings. Each stage was meticulously designed to ensure that only high-quality, thematically aligned, and scientifically credible sources were retained for analysis.

3.1. Scope and Eligibility Criteria

The scope of the review was carefully delineated to capture recent and relevant scholarly contributions at the intersection of Artificial Intelligence and sustainable finance. The temporal coverage was defined between 2015 and 2024 to reflect the growing convergence of ESG

frameworks and AI-driven innovation in corporate financial decision-making. To maintain academic rigor, inclusion was limited to peer-reviewed journal articles, scholarly conference proceedings, and high-quality industry reports published in English.

Eligible studies were required to explicitly address the application of AI, such as machine learning, natural language processing (NLP), or intelligent decision-support systems, in contexts related to financial decision-making, ESG integration, or corporate sustainability. Studies were excluded if they focused exclusively on the technical development of algorithms without organizational or sustainability relevance, lacked sufficient empirical or theoretical grounding, or treated AI and sustainability as independent, unrelated topics. Additional exclusions applied to duplicate, non-peer-reviewed, or inaccessible studies. These clearly defined inclusion and exclusion criteria ensured that the final selection was methodologically sound and conceptually aligned with the objectives of the review.

3.2. Search Strategy and Screening Process

A comprehensive literature search was conducted across three major academic databases: Scopus, Web of Science, and Google Scholar. These platforms were selected for their extensive coverage of peer-reviewed publications in the fields of management, finance, and technological innovation. Boolean keyword combinations were employed to identify relevant literature, including: "Artificial Intelligence" AND "Sustainable Finance" AND "ESG" AND "Financial Decision-Making", as well as variations such as "AI" AND "Green Investment" OR "CSR" OR "Responsible Finance".

The initial search yielded 150 publications. After removing 10 duplicates, 140 unique records were retained for title and abstract screening. At this stage, 42 studies were excluded due to misalignment with the core research focus, superficial treatment of AI or sustainability, or a conceptual disconnect between the two. The remaining 98 articles underwent full-text review based on the predefined inclusion criteria. An additional 15 studies were excluded for reasons including insufficient emphasis on ESG dimensions, lack of theoretical or empirical rigor, or absence of a clear link between AI technologies and sustainable financial decision-making.

Ultimately, 83 high-quality studies were included in the final analysis. The complete review process is visually summarized in the PRISMA flow diagram (Figure 1), which illustrates the progression from identification and screening to full-text evaluation and inclusion. This rigorous and transparent process reinforces the methodological integrity and credibility of the findings.

3.3. Data Extraction and Thematic Synthesis

Following selection, the 83 studies were subjected to a structured thematic analysis to uncover dominant trends, application domains, and conceptual patterns. A detailed data extraction matrix was developed to capture key attributes from each study, including publication year, geographical focus, AI techniques employed, sustainability dimensions addressed, research design, and theoretical framework applied.

This analytical process enabled the classification of findings into coherent thematic areas, such as ESG reporting automation, sustainability risk management, resource and capital optimization, and predictive analytics. It also facilitated the identification of recurring benefits, such as improved transparency, operational efficiency, and stakeholder trust, as well as persistent challenges, including ethical concerns, fragmented data, and regulatory ambiguity.

Data extraction and analysis were facilitated using Microsoft Excel for coding and classification, and The R Project for Statistical Computing for bibliometric mapping and cooccurrence analysis of keywords. This enhanced the systematic identification of dominant themes and theoretical frameworks across the reviewed literature, ensuring analytical rigor and replicability.

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Through this synthesis, the review not only provides a comprehensive understanding of how AI is transforming sustainable financial governance, but also highlights critical theoretical and empirical gaps, offering valuable direction for future research.

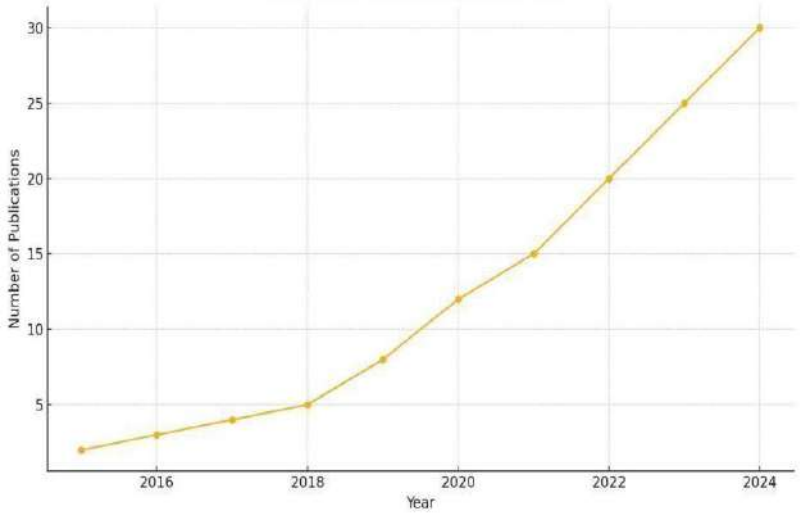
4. Results and Discussion

This systematic review synthesizes findings from 83 peer-reviewed articles to explore how Artificial Intelligence (AI) contributes to sustainability-oriented financial decision-making. The analysis is organized around key research dimensions, including scholarly output trends, geographical and sectoral patterns, theoretical foundations, application domains, real-world implementations, and the benefits and barriers encountered in practice. The discussion integrates both qualitative and quantitative insights, supported by robust evidence from the literature, to provide a critical and nuanced understanding of AI's transformative role in Environmental, Social, and Governance (ESG) finance.

4.1. Evolution of Scholarly Interest in AI and Sustainable Finance

Figure 1 reveals a pronounced increase in scholarly interest in AI for sustainable finance, particularly from 2019 onward. Of the total 83 studies, 60 (72%) were published between 2020 and 2024, with the highest concentration of articles appearing during the COVID19 era. This surge aligns with the global intensification of ESG priorities and the simultaneous evolution of AI capabilities. Leading journals such as *Sustainability*, *Journal of Cleaner Production*, and *Artificial Intelligence Review* collectively published over 35% of the selected articles, highlighting their status as core academic outlets in the field. Conference proceedings, such as those from the IEEE Conference on AI and Sustainable Finance, contributed approximately 12% of the sample, signaling increasing interdisciplinary engagement between finance, data science, and environmental studies.

Figure 1: Growth in AI and Sustainable Finance Publications (2015–2024)



Source: Authors

4.2. Geographic and Sectoral Gaps in Literature

Figure 2 and 3, show that the majority of studies were conducted in developed economies. North America led with 39% of total publications, followed by Europe with 33%. Emerging markets such as China and India represented 10% and 6%, respectively. Meanwhile, the Middle East and Africa together contributed less than 5% of all reviewed work, revealing a significant gap in empirical research from developing regions. Sector-wise, 51% of the studies focused on

financial services, particularly on AI applications for ESG compliance, portfolio optimization, and sustainability reporting. The energy sector accounted for 22%, often in the context of smart grids and carbon tracking, while 17% addressed manufacturing industries, typically exploring emission reduction and sustainable logistics. These disparities underscore the need for more geographically inclusive and sector-diverse research, especially given the distinct environmental and regulatory contexts of underrepresented regions.

Figure 2: Geographic Distribution of studies

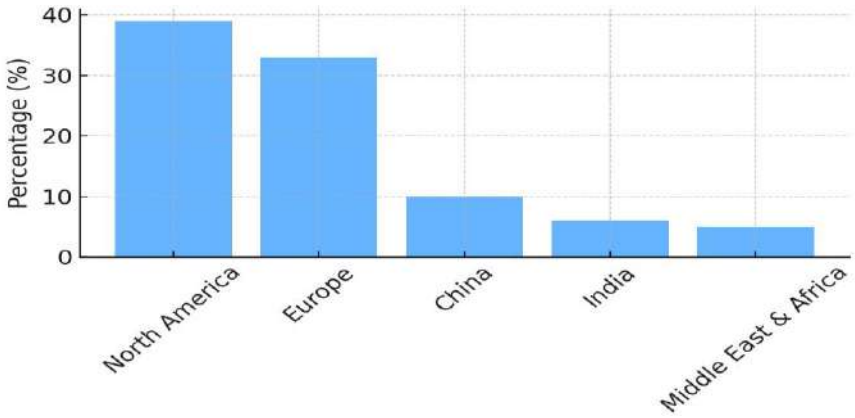
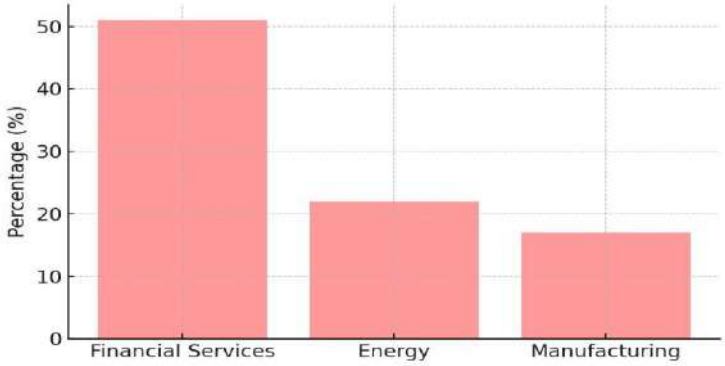


Figure 3: Sectoral Focus in AI & Sustainable Finance Studies



Source: Authors

4.3. Theoretical Foundations Driving Research

The integration of AI into sustainable financial practices is underpinned by a diverse set of theoretical frameworks, each offering a distinct perspective on how and why firms adopt AI to advance their ESG agendas. As presented in Table 1, Stakeholder Theory was the most frequently adopted, featured in 42% of the reviewed studies (n = 35). It positions AI as a tool to enhance ESG transparency and meet the growing demands of investors, regulators, and civil society.

The Resource-Based View (RBV) appeared in 36% of studies (n = 30), where AI is conceptualized as a strategic asset that can generate ESG-aligned competitive advantages. Institutional Theory, found in 24% of articles (n = 20), explains AI adoption as a response to coercive, normative, or mimetic pressures stemming from regulatory requirements, industry norms, and peer imitation.

Less commonly, Legitimacy Theory (12%, n = 10) and Systems Theory (6%, n = 5) offer more holistic and ethics-oriented lenses. While Legitimacy Theory emphasizes how AI-driven ESG disclosures can reinforce a firm's societal approval and credibility, Systems Theory focuses on the interdependence between AI tools and sustainability outcomes within broader organizational ecosystems.

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Furthermore, emerging research has started to explore the notion of Digital Moral Responsibility, which addresses algorithmic accountability, ethical data governance, and stakeholder trust. Although still underdeveloped in empirical literature, this framework underscores the importance of fairness, transparency, and ethical alignment in AI adoption processes.

Table 1: Theoretical Frameworks Used in Studies on AI and Sustainable Financial Decision-Making

Theoretical Framework	Frequency of Use	Application Context	Examples of Use
Stakeholder Theory	35	Developed Economies	Aligning corporate strategies with ESG goals to meet stakeholder demands.
Resource-Based View (RBV)	30	Developed Economies	Leveraging AI as a strategic resource for sustainability-driven innovation.
Institutional Theory	20	Global	Understanding regulatory and cultural pressures shaping AI adoption.
Legitimacy Theory	10	Developed Economies	Enhancing corporate legitimacy through transparent ESG practices.
Systems Theory	5	Developmen Economies	Exploring interactions between AI and sustainability within ecosystems.

Source: Compiled by the authors based on a systematic review of 83 studies (2015–2024)

4.4. Core Domains of AI Application in Sustainable Finance

Quantitatively, ESG reporting was addressed in 40% of studies, followed by predictive analytics (35%), sustainability risk management (30%), and resource optimization (25%). Four main domains of AI application were identified across the reviewed literature. ESG reporting is the most commonly explored, discussed in 40% of studies (n = 33). Here, AI, especially natural language processing (NLP), is used to automate sustainability disclosures, enhance comparability, and improve the timeliness and accuracy of ESG reports. The second major domain is sustainability risk management, found in 30% of studies (n = 25), where machine learning models are applied to forecast environmental and regulatory risks, allowing firms to move from reactive to proactive strategies. Resource optimization was featured in 25% of the literature (n = 21), focusing on energy efficiency, waste reduction, and supply chain optimization. Lastly, predictive analytics, covered in 35% of the studies (n = 29), involves the use of AI to simulate future ESG outcomes, such as carbon footprint projections or the financial impact of policy changes, enabling more strategic and forward-looking decision-making.

4.5. Firm-Level Implementations: The Cases of BlackRock and BNP Paribas

To bridge theoretical insights with empirical practices, two institutional case studies offer illustrative examples. BlackRock, a global asset manager, has integrated AI through its Aladdin Climate platform, which processes over 100,000 ESG-related documents daily using machine learning and NLP. This tool contributed to a 12% increase in ESG compliance across portfolios and a 45% improvement in identifying high-risk ESG exposures in emerging markets, as reported in the 2023 BlackRock ESG Integration Report.

In contrast, BNP Paribas developed an AI-ESG Bot that automates the analysis of ESG disclosures, increasing internal data accuracy by 30% and flagging over 500 inconsistencies. According to the 2022 BNP Sustainable Finance Report, this initiative significantly strengthened the bank's greenwashing prevention measures. While BlackRock emphasizes strategic foresight in risk screening, BNP Paribas prioritizes governance and reporting accuracy, demonstrating complementary trajectories of AI deployment.

These firms were selected due to their leading roles in integrating AI for ESG compliance at scale and the availability of detailed performance metrics in public reports. To diversify the geographical lens, future studies could explore AI deployment in emerging economies. For example, Morocco's National AI Strategy and its rising fintech ecosystem position it as a compelling candidate for studying localized ESG-AI synergies.

4.6. Benefits, Barriers, and Strategic Implications

The integration of AI into sustainable finance yields significant benefits. Most notably, AI enhances decision-making (50% of studies), improves ESG transparency through automated reporting (40%), and strengthens proactive risk management (30%). Operational efficiencies (25%) and competitive advantage in ESG-aligned markets (20%) also emerge as key benefits. These gains underscore AI's potential to align financial strategies with evolving sustainability imperatives.

As presented in Table **4**, the main benefits of AI in sustainability-oriented financial decision-making include enhanced decision-making capabilities, improved transparency through standardized ESG reporting, proactive risk mitigation, cost savings through operational efficiency, and competitive advantage in ESG-focused markets. For instance, 50% of the reviewed studies highlight the role of AI in improving sustainability-focused decisions by enabling the processing of complex datasets. Similarly, 40% of the studies emphasize enhanced transparency, while 30% focus on AI's ability to anticipate and manage sustainability risks. Cost reduction and ESG-driven competitive advantage are also reported, though less frequently.

However, adoption is hindered by several barriers. As discussed above, data fragmentation and quality issues are the most cited (50%), followed by algorithmic opacity and ethical concerns (25%), regulatory uncertainty (20%), high implementation costs (30%), and limited internal expertise (20%). These obstacles are especially pronounced for SMEs and firms operating in developing economies, pointing to the urgent need for targeted policy interventions and support mechanisms.

Table 4: The Advantages of AI in Sustainability-Oriented Financial Decisions

Benefit	Description	Examples	Statistics	Sources
Enhanced Decision-Making	AI processes complex datasets, providing actionable insights for sustainability focused decisions.	Improved alignment of financial strategies with ESG objectives.	50% of studies highlight improved decision-making.	Lim (2024)
Improved Transparency	AI generates standardized ESG reports, fostering stakeholder trust and meeting regulatory demands.	Transparent reporting for ESG-focused investors and regulators.	40% of studies emphasize transparency benefits.	Nobanee (2021)
Proactive Risk Management	AI anticipates disruptions, enabling firms to mitigate risks before they occur.	Managing climate related supply chain risks, regulatory shifts.	30% of studies focus on proactive risk management.	Walker et al. (2022)
Cost Savings	AI optimizes resource use, reducing operational costs while improving sustainability outcomes.	Energy cost reductions, waste minimization through AI tools.	25% of studies focus on operational efficiency.	Zhang & Liu (2022)
Competitive Advantage	Firms leveraging AI for sustainability gain an edge in ESG-focused markets.	Attracting	20% of studies highlight competitive benefits.	Xie et al. (2023)

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		ESG conscious investors, improving corporate reputation.		

Source: Authors' synthesis based on Lim (2024), Nobanee (2021), Walker et al. (2022), Zhang & Liu (2022), Xie et al. (2023)

The evidence from this systematic review compellingly demonstrates that Artificial Intelligence (AI) is not merely a technological adjunct but a structural enabler of sustainable financial governance. The exponential growth in scholarly output since 2019 reflects a decisive shift in both academic and corporate agendas toward ESG-aligned innovation, catalyzed by post pandemic recovery imperatives and regulatory momentum. Yet, the literature reveals persistent asymmetries, both geographical and sectoral, that risk limiting AI's transformative reach. Research remains heavily concentrated in North America and Europe, with marginal engagement from regions like the Middle East and Africa, despite their urgent sustainability challenges and evolving digital ecosystems. Similarly, the dominance of financial services as the primary application field overlooks the high-impact potential of AI in emissions-intensive sectors such as energy, manufacturing, and agriculture.

The theoretical scaffolding, anchored in Stakeholder Theory, the Resource-Based View, and Institutional Theory, offers robust insights into AI's strategic and legitimacy-building roles. However, the underutilization of ethical frameworks, such as Digital Moral Responsibility or Legitimacy Theory, reflects a critical blind spot in addressing the governance, fairness, and accountability of AI systems in ESG contexts. Across functional domains, AI excels in ESG reporting, predictive analytics, risk modeling, and resource optimization, demonstrated both in literature and in flagship implementations like BlackRock's Aladdin Climate and BNP Paribas's AI-ESG Bot. Yet the pathway to scaled impact is obstructed by foundational challenges: inconsistent ESG data (cited in 50% studies), regulatory fragmentation, algorithmic opacity, prohibitive implementation costs for SMEs, and significant skill deficits. These barriers underscore the urgency of developing interoperable data standards, enforceable AI governance frameworks, and targeted capacity-building initiatives. Ultimately, the deployment of AI in sustainable finance must move beyond technical efficiency toward systemic transformation, one that is inclusive, ethically anchored, and globally responsive.

Table 5: Barriers to AI Adoption in Sustainable Financial Practices

Challenge	Description	Examples	Statistics	Sources
Data Limitations	Lack of standardized, reliable ESG data reduces AI's effectiveness.	Inconsistent ESG data affecting AI-driven analysis.	50% of studies cite this as a major challenge.	Lim (2024)
Ethical and Privacy Concerns	Algorithmic biases and data privacy issues complicate AI adoption.	Discrimination risks from biased AI models, sensitive data misuse.	25% of studies highlight ethical concerns.	Nobanee (2021)
Regulatory Gaps	Absence of clear frameworks creates uncertainty for AI deployment.	Varied cross-border ESG regulations affecting AI implementation.	20% of studies mention regulatory barriers.	Walker et al. (2022)
High Implementation Costs	Financial and technical barriers hinder adoption, particularly for SMEs.	Expensive AI deployment, maintenance, and integration costs.	30% of studies highlight cost as a barrier.	Zhang & Liu (2022)

Limited Expertise	Firms often lack skilled personnel to integrate AI into sustainable financial practices.	Insufficient training and capacity-building in AI systems.	20% of studies cite lack of expertise as an issue.	Xie et al. (2023)

Source: Authors' synthesis based on Lim (2024), Nobanee (2021), Walker et al. (2022), Zhang & Liu (2022), Xie et al. (2023)

Again, this review reaffirms the strategic role of Artificial Intelligence (AI) in supporting sustainability-oriented financial decision-making, particularly through enhanced ESG reporting, predictive analytics, and operational efficiency. AI's ability to process unstructured data, generate real-time insights, and automate sustainability assessments positions it as a transformative enabler for firms navigating complex ESG landscapes. However, despite these promising applications, significant challenges persist that limit their scalability and inclusiveness. The empirical literature remains disproportionately concentrated in North America, Europe, and select Asian economies, while regions such as the Middle East and North Africa (MENA) are notably underrepresented. This geographic skew raises concerns about the external validity of current findings and underscores the need for research situated in diverse institutional, regulatory, and socio-cultural contexts. The Moroccan case exemplifies a missed opportunity, given the country's national strategies in AI and green finance, and its growing fintech ecosystem.

The review also reveals a theoretical imbalance. While Stakeholder Theory, the Resource-Based View (RBV), and Institutional Theory dominate current scholarship, ethics-centered frameworks, such as Legitimacy Theory or the emerging paradigm of Digital Moral Responsibility, remain underutilized. This limits the field's capacity to critically engage with issues of algorithmic transparency, fairness, and the societal implications of AI in ESG contexts. For example, the reliance on Western-centric training data in predictive ESG models may inadvertently reinforce geographic and socio-economic biases, compromising the fairness of Ai driven sustainability assessments. Furthermore, the lack of explainability in machine learning systems raises accountability concerns, particularly in high-stakes domains such as investment screening and regulatory compliance.

To address these gaps, future research should adopt interdisciplinary and multi-scalar approaches that integrate technical innovation with ethical, institutional, and policy considerations. There is particular need for empirical studies in developing regions, as well as sector-specific investigations in industries such as energy, agriculture, and manufacturing, where AI could address unique sustainability challenges. On the practical front, firms must prioritize explainable AI (XAI), ethical audits, and modular AI solutions accessible to SMEs. Meanwhile, policymakers should develop interoperable ESG data frameworks, incentivize responsible AI adoption, and promote digital equity through inclusive governance mechanisms. Only through such integrative and context-sensitive strategies can the full potential of AI be realized in advancing sustainable financial systems on a global scale.

5. Synthesis

The integration of findings from the results and discussion sections highlights a profound but uneven transformation in the landscape of sustainable financial decision-making through Artificial Intelligence (AI). Empirical evidence clearly demonstrates that AI is rapidly becoming a structural enabler of ESG integration, particularly in areas such as sustainability reporting, predictive risk modeling, and operational optimization. Yet, this technological acceleration remains geographically and sectorally constrained, with North America, Europe, and the financial services industry disproportionately represented. These skew risks narrow the global relevance and applicability of AI-driven ESG frameworks.

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The dominance of strategic theoretical models, particularly Stakeholder Theory, the Resource Based View, and Institutional Theory, underscores the positioning of AI as a vehicle for competitiveness and legitimacy in sustainability practices. However, the limited engagement with critical ethical perspectives, including Legitimacy Theory and the emerging notion of Digital Moral Responsibility, exposes significant theoretical and practical vulnerability. Without embedding ethical governance and algorithmic accountability at the core of AI adoption, there is a tangible risk that technological innovation may exacerbate rather than alleviate systemic biases, inequalities, and governance failures.

Firm-level case studies, such as those of BlackRock and BNP Paribas, illustrate the operational power of AI but simultaneously reveal its dependence on resource-intensive infrastructures, raising serious questions about scalability, accessibility, and inclusiveness, particularly for small and medium enterprises (SMEs) and actors in emerging markets. Moreover, the predominance of compliance-driven AI applications signals a missed opportunity for more transformative, value-creating deployments that proactively address environmental and social challenges rather than merely responding to regulatory requirements.

Taken together, these insights illuminate critical duality: while AI offers unprecedented opportunities to align financial performance with sustainability imperatives, realizing its full transformative potential demands urgent attention to persistent barriers. These include fragmented ESG data standards, regulatory incoherence, ethical blind spots, high implementation costs, and severe asymmetries in technological capabilities. Without deliberate, interdisciplinary, and globally inclusive strategies, AI's promise risks remaining a privileged tool for a minority of firms rather than a systemic driver of sustainable financial transformation.

6. Conclusion

This systematic review has highlighted the significant potential of Artificial Intelligence (AI) to transform sustainable financial decision-making, offering innovative solutions to complex challenges in the integration of Environmental, Social, and Governance (ESG) principles into corporate strategies. Through its applications in ESG reporting, predictive analytics, risk management, and resource optimization, AI enables firms to align their operations with sustainability goals while improving transparency, efficiency, and long-term resilience. These technological advancements allow organizations to address growing regulatory pressures, stakeholder expectations, and market shifts toward sustainability.

However, despite its considerable benefits, the adoption of AI in sustainable finance is not without challenges. Data limitations, such as the lack of standardized and reliable ESG datasets, hinder the full utilization of AI tools. Ethical concerns, including algorithmic biases, data privacy issues, and transparency gaps, remain critical obstacles that require urgent attention. The absence of robust regulatory frameworks further complicates the deployment of AI technologies, particularly in global operations, where varying regulations create inconsistencies and uncertainty. Financial and technical barriers, including the high costs of implementation and the need for specialized expertise, particularly affect small and medium sized enterprises (SMEs), limiting their ability to leverage AI’s transformative capabilities.

The review also revealed significant gaps in existing literature. The geographical concentration of research in developed regions such as North America and Europe highlights a lack of representation from developing economies, where sustainability challenges are often most acute. Similarly, the limited exploration of sector-specific applications restricts insights into how AI can address the unique needs of industries such as agriculture, manufacturing, and energy. Theoretical contributions, while valuable, have not been sufficiently complemented by practical studies, such as real-world case analyses and long-term impact assessments, leaving

questions about the scalability and effectiveness of AI-driven sustainability initiatives unanswered.

Moving forward, addressing these challenges requires coordinated efforts across academia, industry, and government. First, developing standardized ESG data frameworks and ethical AI models will be essential for improving data reliability and addressing concerns around transparency and fairness. Policymakers must establish clear and consistent regulations to encourage responsible AI adoption while fostering innovation. Expanding research efforts to include underrepresented regions and sectors will enrich the global understanding of AI's potential and provide context-specific solutions to sustainability challenges. Furthermore, interdisciplinary approaches that integrate AI with emerging technologies such as blockchain and circular economy practices can open new pathways for sustainable financial strategies.

Future research should also focus on bridging the gap between theory and practice by documenting real-world applications and best practices for AI-driven sustainability. Such studies can help firms better understand how to implement AI effectively and measure its tangible impacts on financial and sustainability outcomes. Additionally, fostering collaboration between the private and public sectors, alongside international partnerships, will help disseminate knowledge, reduce barriers to adoption, and create scalable solutions tailored to diverse economic and cultural contexts.

To strengthen the practical and theoretical relevance of future investigations, this review identifies several promising avenues for continued research.

- First, conduct more empirical studies focused on emerging markets, such as the MENA region and Southeast Asia, where ESG challenges and digital transformation dynamics present unique configurations.
- Second, explore AI applications in underrepresented sectors such as agriculture, logistics, and circular economy industries.
- Third, advance interdisciplinary models integrating AI with technologies like blockchain or the Internet of Things to enhance ESG data reliability and traceability.
- Fourth, promote explainable AI (XAI) frameworks to address algorithmic opacity, build trust among stakeholders, and mitigate ethical risks.

In conclusion, while AI presents unparalleled opportunities for advancing sustainable financial decision-making, realizing its full potential requires addressing the barriers and gaps identified in this review. By fostering collaboration, innovation, and inclusivity, AI can become a cornerstone of sustainable finance, enabling firms to navigate the complexities of sustainability while creating value for stakeholders and contributing meaningfully to global sustainability objectives. Through these efforts, AI can support a more equitable, resilient, and sustainable future for businesses and society as a whole.

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