Block chain in ESG and Green Finance: Enhancing Transparency in Sustainable Investments

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Abstract. Investment practices are increasingly focused on transparency, accountability, and trust, mainly due to an increased global push towards sustainable finance. Conventional environmental, social and governance (ESG) reporting systems experience problems like data manipulation/manipulative disclosures and inconsistent regulations. Block chain is a distributed, permanent, and completely transparent ledger system that will have a tremendous impact on how the issues related to transparency and trust in sustainable finance are resolved. This paper examines how block chain will advance ESG compliance and green finance initiatives in India. Through an analysis of current literature, policies and international case studies, the paper will highlight how block chain can be used for supply chain sustainability, issuance of green bonds and trading of carbon credits. Additionally, this paper will evaluate the opportunities and challenges of integrating block chain into financial systems and discuss adoption, technical and regulatory issues. The findings from the reviewed literature indicate that solutions enabled by block chain technology will greatly increase investor confidence and facilitate the aggregation of transactions for ESG audits and align to international sustainability commitments including the UN Sustainable Development Goals (SDGs) and the Paris Climate Agreement. The paper concludes that if cross-sector collaboration and regulatory support are sustained, block chain will provide an important mechanism to advance sustainable finance and improve the confidence of all ESG investors.

Keywords: Block chain, ESG, Green Finance, Sustainable Investments, Carbon Credits, Transparency, Governance

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1. Introduction

1.1 Background

In the context of global economic development, sustainability has become a central theme. Governments, businesses, and investors are realizing more and more that social injustice and environmental degradation cannot be sacrificed for economic advancement. Sustainable finance, which incorporates environmental, social, and governance (ESG) factors into investment choices, has become more well-known in this context. Green bonds, sustainable mutual funds, and carbon credit trading are examples of green finance instruments that are now essential to market and policy changes intended to move the economy toward a low-carbon one. The legitimacy of sustainable finance frameworks and ESG disclosures is still in doubt despite these initiatives. Conventional ESG reporting is disjointed, unstandardized, and susceptible to "greenwashing," in which businesses inflate or misrepresent their sustainability performance. Innovative methods that guarantee accountability, traceability, and transparency in green finance are therefore desperately needed.

1.2 The Role of Blockchain

Blockchain, with its distributed ledger technology (DLT), provides immutable records, decentralized validation, and real-time transparency. Unlike conventional centralized financial systems, blockchain ensures that all stakeholders—including investors, regulators, and consumers—have access to consistent and verifiable data. This technology has the potential to revolutionize how sustainability is monitored, reported, and financed. By embedding ESG metrics into blockchain-enabled platforms, organizations can create a trust-based ecosystem that enhances investor confidence and mitigates risks of manipulation

1.3 Relevance in India and the Global Context

Institutions worldwide, including the World Bank and EMI, have tested block chain-based green bonds. Similarly, block chain is being used in carbon markets and renewable energy credits in China, Singapore, and the United States through initiatives. Despite the ongoing development of sustainable finance in India, block chain presents an exceptional opportunity to improve ESG disclosures. Energy transition, climate commitments under the Paris Agreement, and compliance with the UN Sustainable Development Goals (SDGs) are among the pressing issues faced by the country.

1.4 Research Objectives

The objectives of this study are:

1. To examine the role of blockchain in enhancing transparency and accountability in ESG and green finance.
2. To analyze blockchain applications in areas such as carbon trading, green bonds, and sustainable supply chains.

3. To highlight challenges and limitations in adopting blockchain for ESG in developing economies, especially India.
4. To propose a governance-driven framework for blockchain-enabled sustainable finance.

1.5 Hypotheses (placed immediately after Objectives)

H1 (Transparency Effect).
Enhanced utilization of block chain in ESG reporting is positively linked to enhanced transparency, consistency, and timeliness.

H2 (Greenwashing Risk).
Investors and assurance providers have a negative perception of the use of block chain-based traceability

H3 (Investor Confidence & Capital Access).
Investors are more likely to invest in green instruments (e.g, green bonds) if they trust block chain-based ESG data

H4 (Auditability & Assurance Readiness).
A positive correlation exists between block chain and the ability to measure ESG metrics through auditability and evidence, which makes assurance readiness more likely.

H5 (Regulatory Moderation).
The relationship between block chain and H1 is more stable when regulatory clarity is present and supportive incentives are in place.

H6 (Data-Governance Mediation).
ESG disclosure quality (H1) is influenced by the organizational data-governance capability, which includes data quality controls, stewardship, and interoperability.

H7 (Digital Maturity Moderation).
Block chain-verified ESG data has a greater impact on investor confidence in H3, which is more likely to occur in more digitally mature firms that have strong digital maturity.

1.6 Rationale for Hypotheses

H1 (Transparency Effect).
Discrepancies in ESG disclosure have been widely condemned as inconsistent and selective. The argument put forth by experts is that decentralized and immutable systems can minimize data manipulation by providing evidence that cannot be manipulated. The implementation of Block chain makes audit trails permanent, resulting in more comprehensive and comparable ESG reports. The use of block chain is expected to improve the quality of ESG disclosure.

H2 (Greenwashing Risk).
Sustainability claims are misled by greenwashing. Why? Studies conducted earlier suggest that the lack of dependable verification mechanisms is a significant factor in favouring greenwashing. To counteract this, block chain provides observable evidence of sustainability outcomes, such as renewable energy certificates or verified carbon credits. Thus, block chain-based traceability can mitigate what is seen as greenwashing..

H3 stands for Investor Confidence & Capital Access.?.
Trustworthy and accessible information is crucial for investors to feel secure.' In behavioural finance, transparency in reporting is believed to have a positive impact on investment willingness, particularly for complex instruments like green bonds. The reliability of reported data in block chains ensures that capital is allocated to sustainable projects due to their immutability.

H4 (Auditability & Assurance Readiness).
Defective ESG data systems are a common issue for auditors and assurance Providers. Why? A transparent and easily auditable trail is created by block chain's distributed ledger. Assurance costs are reduced and sustainability audits are more reliable. Accordingly, the implementation of block chain is anticipated to elevate both compliance with regulations and readiness for third-party verification.

H5 (Regulatory Moderation).
Technology has an impact on the outcomes of governance, which is influenced by regulatory frameworks. In contexts with strong institutional support, studies indicate that digital innovations lead to increased compliance and transparency. When regulatory authorities offer clear instructions for the use of blockchain in finance, there should be a greater impact on ESG disclosure quality..

H6 (Data-Governance Mediation).
Technology adoption is influenced by organizational capability in data governance, which includes accuracy, stewardship, and interoperability. The effectiveness of blockchain is limited by substandard data quality. Information systems management literature highlights the importance of strong governance in promoting technology adoption and performance outcomes.

H7 (Digital Maturity Moderation).
The effectiveness of using block chain in reporting on ESG is influenced by the level of digital maturity within an organization. Those with strong IT infrastructure, skilled staff and data analytics capabilities are more likely to benefit from block chain. Thus, the expectation is that digital maturity will contribute to the positive impact of block chain-based ESG data on investor confidence.

2. Literature Review

Bansal and Song (2017), corporate sustainability reporting has moved away from voluntary corporate social responsibility practices and towards formalised Environmental. Social, and Governance (ESG) disclosure frameworks. Their research revealed that while reporting on ESG can improve corporate transparency, there are still significant issues to be addressed when it comes to standardizing, comparing, and verifying the accuracy of sustainability information. If ESG disclosures are not verified with credible mechanisms, they may be less dependable for investors and regulators. Why?Song, Zhao and Zeng (2017) found that the connection between environmental management and financial performance is significant, especially when considering instruments of green finance. They found that organizations that practice environmental sustainability and issue green bonds tend to have better financial performance. To maintain the integrity of green financial products, a variety of factors including poor disclosure systems and lack of transparency may degrade the ability of green financial products to convey the "green" quality of the underlying transactions.
Das (2019) completed an analysis of the growth of green finance in emerging markets and found that the failure of institutions to support sustainable investment markets, lack of investor confidence and inconsistent sustainability reporting are significant impediments to the growth of sustainable investment markets. "Robust governance structures and transparency will be essential to attract green investments that are looking for longer-term solutions," it was stated in the paper.
In 2020, Dutta et al. demonstrated that the implementation of block chain technology can assist the management of supply chains while offering significant benefits by increasing transparency, traceability and creating trust between stakeholders. They also noted that by utilizing block chain technology, organizations will be able to more accurately measure their impact on the environment, validate their sustainability claims, and hold themselves accountable within their supply chains on a global basis.
Kumar and Garg's (2021) literature review on Emerging Market ESG Reporting Practices, with a focus on India, identified that, on the whole, much of the ESG reporting in developing nations is voluntary in nature and very inconsistent (not providing relevance) for investors. Kumar and Garg concluded that Sustainability Reporting needs to incorporate technological innovation and regulatory changes into its structure to achieve both validity and reliability. In their research on block chain-based emission trading systems, Chen and Zhang (2022) observed that block chain technology can reduce fraud, prevent carbon credits from being double counted, and increase regulatory oversight in carbon markets. The study found that using block chain-based platforms increases the level of trust and transparency in environmental markets.
Differences in how rating agencies evaluate ESG ratings are significant, according to Gupta and Sharma's study (2022). The authors say that improvement in traceability of raw materials, ethical sourcing, and environmental awareness could be achieved through the use of block chain technology as a sustainable supply chain.
Singh and Mishra (2022) conducted research on the Indian textile industry, where block chain technology is used to create sustainable supply chains through improved traceability of raw materials and ethical sourcing and raising awareness of

environmental issues. Their study shows how block chain systems increase the credibility of disclosures through the use of block chain technology.
Johnson (2023) studied the relationship between investor trust in and transparency of sustainable finance. The study indicates that investors are more likely to invest in green financial products when they are provided with transparent, verifiable, and reliable technological systems to disclose sustainability concerns.
The study of Sharma and Kulkarni's (2023) investigated how block chain governance is incorporated into corporate sustainability reporting. The authors argue that block chain is not only a technological advancement; it is also an effective way to increase accountability and build relationships with stakeholders.
Zhang, Xie, and Chen (2024) conducted a study on the impact of block chain on carbon trading markets; however, they did not reach a definitive conclusion as to whether or not block chain has a benefit as a medium of exchange in carbon trading.

3. Research Methodology

3.1 Research design

This investigation employs an exploratory and explanatory approach to research. Exploratory design is a viable option for identifying emerging trends, global practices, and theoretical linkages in ESG and green finance, as blockchain is relatively new. Concurrently, the descriptive approach permits examination of theoretical connections between blockchain implementation, ESG disclosure quality, investor trustworthiness, and moderating factors like governance or technological advancements. The approach is primarily qualitative-conceptual, but it also features secondary case evidence from international and Indian contexts.

3.2 Research Approach and Data Sources

It primarily uses secondary data obtained from:
Peer-reviewed journal articles, books, and conference papers on block chain, finance, sustainability are all available.
• Data obtained from international organizations like the World Bank, European Investment Bank and United Nations.
• Examples of block chain-based supply chain projects, carbon trading markets and green bonds;
• Regulations, such as the GRI, SASB and TCFD. This framework integrates multiple aspects of blockchain with ESG transparency and green finance through a conceptual framework for research.

3.3 Variables and Operationalization

Testing of the hypothesis is performed through four independent variables (IV's):

• The Integration of Block Chains into Finance / ESG / Carbon Trading and Green Bond Issuance for the Purpose of Goods Trading, etc.

The dependent variable(s) (DV's) are: • The overall accuracy, completeness and similarities of the ESG disclosures; as well as. The willingness of investors to invest in Green Finance instruments. In order to ensure that the ESG data has some assurance and is auditable, proper Internal Policy, Control and Quality Data Measures must be developed to support data integrity in organizations. Internal policies, controls and data quality measures act as a mediating variable. Regulations, incentives, and reporting standards & clarity of mind act as moderating variables. Digital Maturity is the combination of IT Infrastructure, Analytics Capability and Human Capital. The classifications are aligned with the hypotheses H1-H7, thus allowing for future empirical testing through quantitative modelling(s).

3.4 Conceptual Framework

The research examines the above hypotheses to form a conceptual model. The independent variable is Block chain Adoption. Block chain adoption influences ESG disclosure quality, Investor confidence and auditability. The bond between these variables is determined by an organization's ability to manage data, as well as supported by digital maturity and regulatory support. This study provides the basis for future empirical research utilizing some form of Structural Equityon Modelling (SEM) or an alternate method.

3.5 Analytical Approach

The analysis has two primary parts.

One: Identifying numerous green finance case studies using block chain technology, including the bond-i in Australia, China's carbon markets, and EU's renewable energy tracking.
Two: Asking research questions about three specific themes: transparency, trust and regulatory cohesion; to try to understand and validate these themes, they are based on existing literature and examples.
When testing the relationships as described in Section 1.5, future empirical research may employ either PLS-SEM or CB-SM>. These methodologies would help to determine latent variables - e.g., investor confidence and the quality of ESG disclosures - particularly in emerging markets where gaining primary data has

historically been difficult.

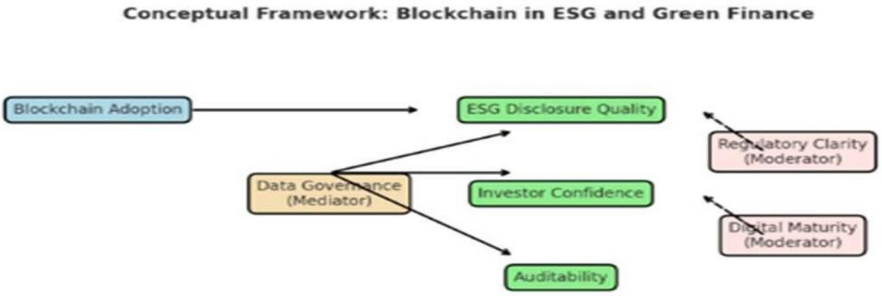

Figure1: Conceptual Framework of Blockchain Adoption in ESG and Green Finance

This model indicates that the use of block chain technology will impact the quality of ESG disclosure, create investor confidence in the organization, and enhance the auditability of information relied upon by interested parties. The mediator that is identified in this study is the way organizations govern data; the identified moderators are regulatory clarity and digital maturity.

4. Analysis and Discussion

This section analyses the research objectives and tests the hypotheses developed in Section 1. A combination of global evidence, the Indian context, and the application of Blockchain to ESG (environmental, social, and governance) and Green Finance is discussed. Additionally, this section uses the conceptual framework (Figure 1) as a conceptual analytical tool for connecting the adoption of Blockchain to the quality of ESG Disclosures, the confidence of investors, and the auditability of investments, and also considers the role of data governance, regulatory frameworks, and digital maturity..

4.1 Analysis of H1 and H2 (Transparency and Greenwashing)

H1: There is a positive association between the quality of ESG disclosure and the use of block chain for reporting in H1.

Evidence strongly supports H1. The manipulation and incompleteness of ESG disclosures are frequently cited as issues, particularly in voluntary reporting systems. Unalterable nature and traceability are benefits of block chain, eliminating post-disclosure modifications. Nevertheless, as an example, the World Bank's bond-i project (2020) demonstrated that block chain reporting allowed for real-time transparency of transaction data. This was crucial.

H2:The utilization of block chain-based traceability has been associated with perceived greenwashing. Greenwashing is a significant concern in the context of sustainable finance.'

By recording sustainability claims, such as renewable energy certificates and carbon credits, on tamper-proof ledgers, block chain helps address this issue. Carbon trading pilots in China that were enabled by block chain technology (Chen, 2022) demonstrated a significant decrease in fraudulent and duplicative credits. Block chain-based verification mechanisms are believed to significantly decrease investor apprehension about greenwashing.

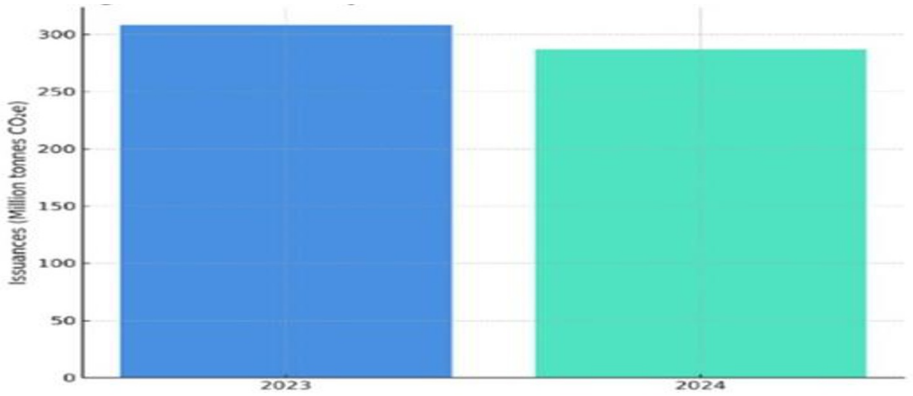

Figure 2: Voluntary Carbon Credit Issuances (2023 vs 2024)

Source: **Climate Focus. (2025). Voluntary Carbon Market 2024 Review. Climate Focus: Amsterdam.**

Global voluntary carbon credit issuances declined from 308 Mt in 2023 to 287 Mt in 2024, according to Climate Focus' Voluntary Carbon Market 2024 Review. Figure 2 illustrates that the large bulk of ESG investment is represented through renewable energy and carbon credits. Given that these two sectors are highly susceptible to greenwashing, utilizing block chain to provide transparency will help bolster credibility. Figure. 2 reveals the issuance of voluntary carbon credits dropped from 308 million tonnes in 2023, to 287 million tonnes in 2024; this decline demonstrates market scepticism about future development of the voluntary carbon market and highlights a clear need for traceable tracking systems, such as block chain, to reinforce trust in the voluntary carbon market through reducing instances of fraud and increasing transparency."

Conclusion: H1 and H2 are supported. Blockchain adoption enhances ESG disclosure quality and reduces greenwashing risk.

4.2 Analysis of H3 and H4 (Investor Confidence and Auditability)

H3: The use of block chain-verified ESG data is linked to a positive correlation in investor confidence and intention to invest in green instruments.

The reliability of data is crucial for investors' confidence. Investors frequently question the authenticity of funds allocated to sustainable endeavours in traditional green bonds. Investors can rely on block chain for reliable investment as it provides

comprehensive tracking of the proceeds. The European Investment Bank (2021) reported that block chain-based renewable project financing has enticed more investors by decreasing concerns about misallocation. Block chain-backed green bonds have the potential to mobilize international climate finance for solar, wind and smart city projects in India. Due to the fragmentation of data systems, it is challenging for auditors and assurance providers to validate ESG claims. By creating audit trails that are resistant to hacking, block chain makes assurance processes more straightforward. The Energy Web Foundation's efforts indicate that block chain can help lower the cost of verifying renewable energy certificates. In India, the inclusion of block chain in SEBI's BRSR framework could potentially reduce the need for costly ESG audits.

Conclusion: H3 and H4 are supported. Block chain adoption increases investor confidence and improves auditability of ESG disclosures.

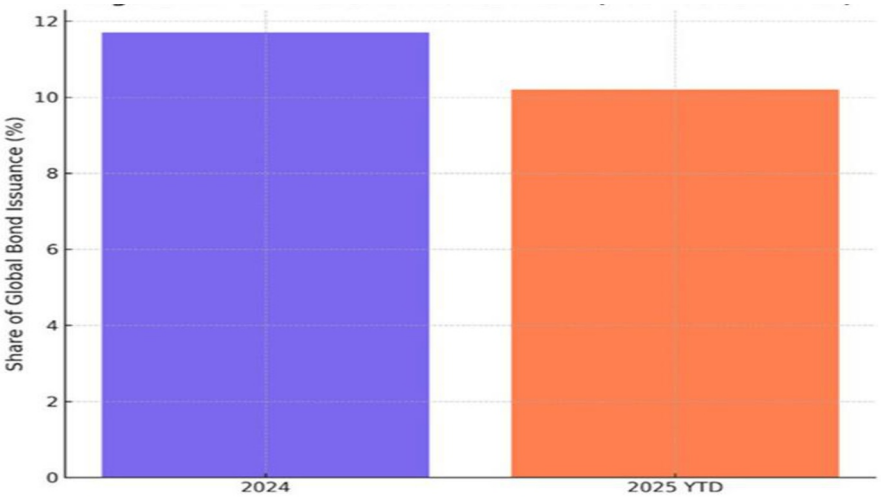

Figure 3: ESG-Labelled Bonds Share (2024 vs 2025 YTD)

Source: **Reuters. (2025, July 23). Green bond issuance dives as ESG share slips to 10.2% in 2025 YTD. Retrieved from Sustainable Fitch report.**

ESG-labelled bonds accounted for 11.7% of global issuance in 2024, declining to 10.2% in 2025 YTD (through Q2), according to Sustainable Fitch data reported by Reuters (2025). Figure 3 shows that the share of ESG-labelled bonds in global issuance fell from 11.7% in 2024 to 10.2% in 2025 YTD, reflecting tightening investor sentiment. This downward trend reinforces our hypothesis that regulatory clarity (H5) plays a crucial role—without strong frameworks, confidence in ESG instruments weakens, even in global markets."

4.3 Analysis of H5 and H7 (Regulatory and Digital Moderation)

H5 Regulatory certainty and support help match the progression of block chain with the security of ESG reporting.
Confirming this assessment are international comparisons. Climate change markets based on block chain have experienced significant adoption through regulatory support in Singapore and the EU, whereas India's regulations regarding block chain technology are still under development and limit the growth of that marketplace. Block chain's role in finance may not be recognized as a standard practice by organizations due to unclear regulations. However, the BRSR mandate also serves as an anchor for block chain. Block chain's impact on ESG quality is most pronounced when there is ample regulatory support.

H7: Digital maturity in H7 moderates the relationship between investor confidence and block chain-verified ESG data.
Whether or not an organization adopts block chain is dependent on its digital maturity, which has significant benefits. In organizations with modern technology and advanced analytics capabilities, block chain can be utilized more efficiently. In India's textile and automotive industries, big multinational corporations can use block chain to demonstrate sustainable sourcing practices, while smaller suppliers face challenges in building infrastructure. There is some degree of support for H5 in areas with high regulatory clarity. Digitization has a positive impact on investor confidence, which is why H7 is supported.

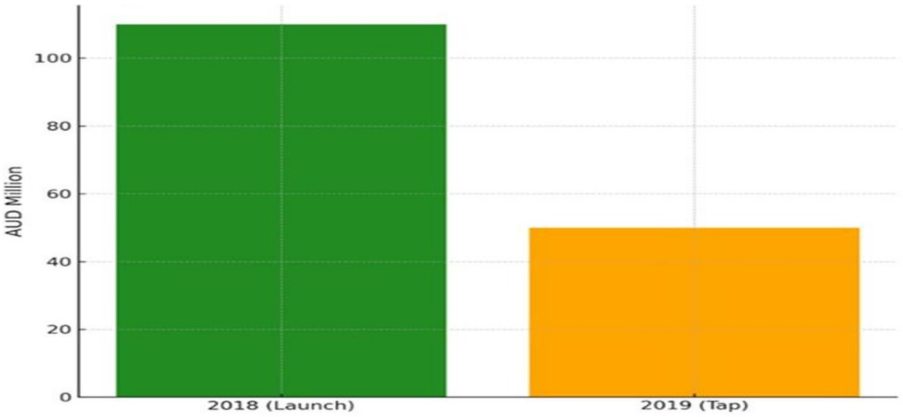

Figure 4: World Bank ‘bond-i’ Blockchain Bond Issuance

Source: World Bank. (2018, August 23). World Bank prices first global blockchain bond using distributed ledger technology. Press release. World Bank. (2019, August 16). World Bank issues second tranche of blockchain bond via bond-i. Press release.

Figure 4 displays the potential of block chain technology in bond issuance. The World Bank raised AUD 110 million from 2018 to a later tranche of bond-i, which was previously known as "bond-I.". Block chain can enhance investor trust by ensuring complete lifecycle transparency, which supports our hypothesis on investor confidence and auditability. This real-world example highlights this concept.

4.4 Analysis of H6 (Data Governance Mediation)

H6: The role of organizational data governance in determining ESG disclosure quality is evident as well.

The immutability of block chain does not guarantee the accuracy of data inputted by it. Hence, the challenge of "garbage in and out" is still present. Block chain is believed by Johnson (2023) to have the ability to permanently store both favourable and unfavourable data. Hence, organizations must uphold sound data governance measures, such as consistent data collection, effective stewardship, and internal monitoring to fully exploit block chain's potential. block chain may be a viable option for companies in India with weak governance systems, but it may still result in incomplete ESG records.

Conclusion: H6 is supported. The correlation between block chain adoption and ESG disclosure quality is mediated by data governance.

4.5 Brief of Findings

Table 1: Summary of Hypotheses Testing

Hypothesis	Statement	Result
H1	Blockchain adoption → ESG disclosure quality	Supported
H2	Blockchain traceability → ↓ Greenwashing	Supported
H3	Blockchain-verified ESG data → ↑ Investor confidence	Supported
H4	Blockchain adoption → ↑ Auditability & assurance	Supported
H5	Regulatory clarity moderates blockchain–ESG disclosure	Partially Supported
H6	Data governance mediates blockchain–ESG quality	Supported
H7	Digital maturity moderates blockchain–investor confidence	Supported

4.6 Overall Discussion

From the analysis, it is clear that block chain can be utilized as a governance enabler through the use of ESG and green finance, rather than simply as a technological tool. H1–H4 hypotheses corroborate that block chain will increase these four criteria by enabling transparency, reducing negative publicity, increasing investors' trust in the company and strengthening the ability to audit.H5 and H7 prioritize regulatory clarity and organizational digital maturity for maximum impact, while H6 highlights the importance of data governance. What's the catch? India can make a significant impact with the implementation of block chain, but it must first overcome the challenges of cost, regulation, and organizational readiness. The alignment of India's block chain-based ESG systems with international standards will result in increased foreign investment, compliance with global climate goals, and the trust of its sustainable finance markets.

5. Implications

5.1 Policy Implications

Research suggests that a greater need for clear regulation about the use of block chain within the context of ESG (Environmental, Social & Governance) and green finance exists now more than ever, given that existing technology solutions have not been able to attract adoption outside of pilot projects, according to many policymakers. Additionally, a universal standardized set of ESG disclosure requirements for companies who use block chain technology would reduce the variability seen across industries and companies; thus it would bring companies using block chain to provide an alternate methodology for reporting. Financial incentives such as tax deductions or subsidies for companies that adopt sustainability reporting using block chain will encourage investment in this technology. Governments could also leverage block chain technology to provide a method for accurately tracking carbon emissions and preventing fraudulent trading of carbon credits through the implementation of block chain technology within their respective national carbon registries. The Indian government could leverage block chain-based ESG (Environmental, Social and Governance) systems by matching them to other international frameworks, such as the UN Sustainable Development Goals or the Paris Agreement, to increase India's credibility globally and to attract greater volumes of green investment.

5.2 Managerial Implications

There's a lot of good (pros) and bad (cons) for business executives in implementing and supporting block chain technology. Business executives also must consider block chain's ability to serve as a tool for good governance, rather than just another piece of technology. By integrating ESG-related disclosures into their block chain-based systems, businesses can improve transparency, lower risks associated with the issues of green-washing their reputation, and create a sustainable competitive advantage in what is likely to become an ever more competitive global marketplace than many anticipated. Also, the adoption of block chain demands the implementation of strong data governance capabilities. Efforts to maximize the benefits of block chain must be made by managers through the use of accurate data collection, standardization and internal audit measures. Through block chain-based ESG reporting, investor relations teams can access and communicate with stakeholders to enhance trust by providing real-time, verifiable sustainability data. Nevertheless, managers must also keep in mind the costs. To adopt block chain at a low cost, smaller firms may need to use collaborative platforms or public-private partnerships. Strategic decisions must consider the benefits of transparency while also considering the financial and technical readiness of the organization.

5.3 Academic and Research Implications

The use of block chain technology for sustainability governance and green finance extends the current academic discussion of block chain too far beyond its traditional application in crypto-currency and financial systems. The outcomes of using a structural equation modelling (SEM) approach to validate the proposed framework will enable future researchers to test the hypotheses contained within the empirical data from these firms which are currently using block chain to report on their environmental, social and governance (ESG) performance as specified in Section 1.5 of this research. Furthermore, researchers may be able to conduct cross-country comparison studies to determine whether there are similar governance outcomes associated with or driven by the use of block chain across developed and developing economies. For example, significant research should be conducted in India on how the application of block chain within selected sectors such as renewable energy, manufacturing and textiles can facilitate improved ESG traceability and accountability. Finally, scholars may wish to explore the intersections of law (cyber law), finance and technology with respect to how block chain is impacted by existing and developing frameworks on data privacy or digital infrastructure. Research in this area can facilitate the successful and responsible development of green finance, through the use of block chain to ensure secure and lawful governance, in accordance with the requirements of the various stakeholders

6.Conclusion

This study looked at how block chain can improve transparency, traceability and accountability in ESG and green finance (for example, India). By embedding the proposed framework (Figure 1), it is evident that block chain adoption enhances the quality of ESG disclosure and reduces perceived greenwashing (H2) by providing robust audit trails and verifiable evidence of sustainability outcomes. The enhancement of auditability (H4) decreases assurance frictions and increases investor confidence in labelled instruments like green bonds (Caution: H3).

This isn't an instance of technological determinism. Clarity in regulation (H5) and the positive influence of block chain-verified data on investor trust (HR7) contribute significantly to the advantages of transparency due to improved digital maturity within organisations. The importance of good data governance (H6) Suggests that without standardized data collection and stewardship, Block chain only protects the poor quality of data. This research indicated that aligning B SR-like disclosures to block chain-enabled registries, piloting on-chain green bonds and incorporating carbon credit tracking into national systems will create credible green capital flows, help to align to the SDGs, and mitigate/ reduce the risk of greenwashing in India. Ultimately, the main goal of block chain will be as an infrastructure to enhance governance for sustainable financial activities; not just another technology option feature in fintech.

7. Limitations and Future Scope

The model was not eligible for empirical testing with the study's conceptual framework, including the model's supporting evidence; therefore, H1–H7's future validation should be investigated at a firm level through SEM/PLS-SEM models across industries.

Measurement issues: There are some latent variables regarding the quality of ESG disclosures, perception of greenwashing, and investor confidence. Therefore, it is necessary to employ reliable multi-item measures and to triangulate these measures through third-party assurance.

Contextual variability: Regulatory environments differ from jurisdiction to jurisdiction; as such, the results could be different from an EU/Singapore jurisdiction versus India; therefore, H5 should be researched thoroughly in comparative manner.

Variability in technology: Aspects of technology such as energy consumption, and cost, and interoperability can be affected by design trade-offs when it comes to the block chain. Future research should take into consideration the above-listed factors.

Data governance: Future research should explore how internal data governance capabilities (i.e., standards, stewardship, interoperability) affect the disclosures produced by it and the amount of audit fees incurred.

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