

Sustainable Shifts in Finance: How Green Policies Influence the Adoption of Green ICT in the Banking Sector

Daniel Koloseni^{1*}  | Justus Mwemezi² 

¹Faculty of Computing and Mathematics, The Institute of Finance Management, Tanzania

²Faculty of Insurance and Banking, The Institute of Finance Management, Tanzania

*Correspondence to: Daniel Koloseni, Faculty of Computing and Mathematics, The Institute of Finance Management, Tanzania.

E-mail: daniel.koloseni@ifm.ac.tz

Abstract: The banking industry is increasingly expected to harmonize financial intermediation with sustainability and digital transformation goals. To improve operational capabilities, reduce environmental impacts, and comply with Environmental, Social, and Governance (ESG) regulations, Tanzanian banks are gradually deploying environmentally sustainable banking practices and information and communication technology (ICT) systems. This study evaluated the moderating effect of green policies while examining the impacts of social, environmental, and economic sustainability on green banking operations and green ICT uptake. The study was guided by the Triple Bottom Line (TBL) paradigm. Partial Least Squares Structural Equation Modelling (PLS-SEM) was used to analyse data collected from commercial banks. The results showed that green banking operations strongly encourage the adoption of green ICT ($\beta = 0.438$, $p = 0.000$), while social sustainability ($\beta = 0.067$, $p = 0.000$), economic sustainability ($\beta = 0.562$, $p = 0.000$), and environmental sustainability ($\beta = 0.105$, $p = 0.000$) have substantial impacts on green banking operations. Additionally, green policies favourably moderate the relationships of social sustainability ($\beta = 0.159$, $p = 0.001$) and environmental sustainability ($\beta = 0.165$, $p = 0.000$) with green banking operations. Green policies also have considerable impacts on green banking operations ($\beta = 0.302$, $p = 0.000$) and green ICT uptake ($\beta = 0.295$, $p = 0.001$). The study informs policymakers and banking institutions in emerging economies about the benefits of promoting ecologically conscious banking practices and investing in green technology. Our study contributes by integrating sustainability aspects, green policies, green banking practices, and green ICT adoption into a single model.

Keywords: Banking industry, green banking, green ICT adoption, green policies, sustainability, Tanzania, triple bottom line.

Article info: Received 6 July 2026 | revised 28 September 2026 | accepted 8 October 2026 | published 23 October 2026

Recommended citation: Koloseni, D., & Mwemezi, J. (2026). Sustainable Shifts in Finance: How Green Policies Influence the Adoption of Green ICT in the Banking Sector. *Indonesian Journal of Sustainability Accounting and Management*, 10(2), 479–494. <https://doi.org/10.20448/ijSAM.v10i2.9576>

INTRODUCTION

Recently, Tanzania has witnessed a surge in ICT-supported innovation initiatives within the financial sector. These ICT initiatives have transformed how the financial industry operates, enabling it to serve customers more efficiently. Today, investing in ICT is essential to remain competitive. Also, ICT drives the perceived value of banking services to customers, user satisfaction, and the impetus of the firms to compete in the market (Cuevas-Vargas, Parga-Montoya, & Fernández-Escobedo, 2022; Hu, Chohan, & Liu, 2022; Lee, 2022; Singh & Sharma, 2023). As a result of the ICT investment, there has been a reduction in bureaucratic processes when



Copyright © 2026 by the author(s). This article is published under the Creative Commons Attribution (CC BY 4.0) license. Anyone may reproduce, distribute, translate and create derivative works of this article (for both commercial & non-commercial purposes), subject to full attribution to the original publication and author(s). The full terms of this license may be seen at <http://creativecommons.org/licenses/by/4.0/legalcode>

accessing services, a decrease in the carbon footprint due to less paperwork, improved compliance with regulatory standards, and increased service delivery efficiency. Moreover, these ICT initiatives have allowed banks to invest in energy-efficient data centres, cloud computing, and virtual servers. Additionally, the initiatives have enabled banks to offer sustainable services remotely, thereby reducing clients' need to travel to access banking services in person.

Overall, ICT initiatives have shown a proven ability to drive green transformation in the financial sector (Mandari, 2025). Green transformation in the banking sector encompasses green banking, which is closely linked to the growing use of green ICT in the industry. According to Aslam, Khan, Chen, and Rahman (2025) green banking refers to environmentally conscious banking practices that aim to reduce the ecological impact of banking operations while fostering sustainable economic development. Paperless banking, energy-efficient infrastructure, green financing, environmentally conscious investment strategies, sustainable lending methods, along with adherence to ESG standards, are all part of green banking (Aslam et al., 2025; Gazi et al., 2024). Financial institutions can concurrently achieve long-term financial sustainability, environmental preservation, and operational efficiency through green banking efforts.

Recently, the government of Tanzania has laid down a couple of policies and guidelines related to finance, such as the Bank of Tanzania Strategic Plan 2025/2026 – 2029/2030, Guidelines on Climate-Related Financial Risks and Disclosures, and the National Board of Accountants and Auditors (NBAA) sustainability reporting standard, with an inclination to address climate change (Bank of Tanzania, 2025a, 2025b). For instance, as of January 2024, financial institutions, such as banks, are obliged to indicate in their financial reports their compliance with Environmental, Social, and Governance (ESG) principles in their annual financial statements (National Board of Accountants and Auditors (NBAA), 2024). These eco-friendly (i.e., green) policies play a crucial role in shifting financial operations towards mitigating climate change (Roy, 2024; Tariq et al., 2022). Green policies play a pivotal role in enhancing sustainability and improving financial performance (Aslam & Jawaid, 2023; Du et al., 2022; Miroshnychenko, Barontini, & Testa, 2017). While the impact of green policies on financial performance has been documented in the literature, scholarly work on their influence on green ICT adoption in the Banking sector is scarce. On top of that, little is known about its moderating impact on banks' decisions to adopt green ICT or venture into green ICT initiatives. Additionally, the influence of the sustainability dimensions (environmental, social and economic) on green banking operations has rarely been explored in Tanzania.

To close these gaps, the current study addresses four research questions:

1. How do social, environmental, and economic sustainability influence green banking operations?
2. How do green banking operations influence green ICT adoption?
3. What is the effect of green policies on green banking operations and green ICT adoption?
4. How do green policies moderate the relationships between sustainability dimensions and green banking operations?

The results of this study make several significant contributions to theory, practice, and policy. The study extends the Triple Bottom Line approach theoretically by incorporating green policy mechanisms and the adoption of green ICT into a single sustainability model. It provides strategic insights for banking managers and financial institutions who wish to speed up their move towards environmentally responsible banking and achieve sustainable digital transformation. From a policy standpoint, the study provides governments and regulators with insights into how effectively green policies support environmentally friendly banking practices and strengthen climate-responsive financial systems. Importantly, the study adds to the body of knowledge on sustainability accounting and management in the Global South. It demonstrates how ESG-related regulatory requirements might influence green banking practices and sustainable digital transformation, using Tanzanian data to expand sustainability research beyond developed-market contexts.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Theoretical Framework

The current study employs the TBL, integrated with green policies and green banking operations, to assess the adoption of Green ICT in Banks. TBL embodies social, environmental, and economic sustainability constructs for assessing sustainable development (Liao, 2023). TBL serves as a roadmap for businesses and governments to incorporate sustainable practices, reduce their carbon emissions, and improve social welfare, all of which align with international agendas such as the Sustainable Development Goals (SDGs). For instance, it addresses issues such as SDG 12 (Responsible consumption and production), SDG 13 (Climate action), and SDG 8 (Decent work and economic growth) (Nica, Chiriță, & Georgescu, 2025). In summary, it is a dominant logic for studying business sustainability (Svensson et al., 2016).

Therefore, its extensive use in studying sustainable development in the context of green and climate change makes it an ideal framework for examining green ICT adoption. The study's theoretical framework consists of six (6) direct and moderating hypothetical relationships, as shown in Figure 1. The next sections examine the relationships among the study's constructs.

Thus, by identifying economic, environmental, and social sustainability as factors influencing green banking operations and green ICT adoption and integrating green policies as a contextual mechanism influencing these relationships, this study expands on the conventional application of the Triple Bottom Line (TBL) paradigm. This integrated viewpoint clarifies how operational and technological changes in banking are influenced by sustainability principles. The integration is pertinent to the Global South, where institutional restrictions, changing legal systems, and developing financial systems all contribute to sustainable transitions.

Social Sustainability and Green Banking Operations

Social sustainability means that an organisation may prioritise social welfare, employee well-being, and ethical behaviour (Gazi et al., 2024). In the banking industry, this is evident in the development of responsible financial products and the extension of loans to local communities (Shih, Silalahi, Baljir, & Jargalsaikhan, 2024). It prompts banks to incorporate social and ethical values into their core strategies, for example, by adopting green practices.

Previous studies have also indicated that social factors promote green banking. For example, Sharma and Choubey (2022) reported that social factors promote green banking. Likewise, Kumar, Rani, Rani, and Rani (2024) demonstrated that social practices have a strong effect on green finance and on banks' sustainability performance. These findings suggest that the social dimension remains crucial for transforming banking operations towards sustainability. In addition, these findings further suggest that social sustainability is an increasingly important driver of green banking transformation (Bansal, Shukla, Tripathi, & Dubey, 2024). Therefore,

H₁: Social sustainability has a positive influence on green banking operations.

Environmental Sustainability and Green Banking Operations

Environmental sustainability emphasises preserving natural ecosystems, reducing carbon emissions, conserving resources, and preventing pollution. This aspect is represented in banking through internal procedures such as reducing paper use, installing energy-efficient branches, and offering eco-friendly products, such as green loans or financing for environmental projects (Muchiri, Erdei-Gally, & Fekete-Farkas, 2025). In recent years, banks have increasingly incorporated the SDGs and environmental, social, and governance (ESG) principles into their operations (Rahman, Moral, Akther, Hossain, & Islam, 2025). In order to promote green banking activities, they are also urged to participate in the expanding global climate change governance (Elsner & Neumann, 2023).

In their study, which seeks to investigate the role of Environmental Sustainability in Determining Bankers' Green Banking Usage Behaviour, Hasan, Al Amin, Moon, and Afrin (2022) argue that environmental

sustainability positively and significantly reshapes bankers' attitudes and green banking usage behaviour. In the same vein, daily operations and employee-related environmental practices have a major impact on banks' green operations (Gazi et al., 2024). Conversely, perceived value, environmental issues, and perceived consumer effectiveness are higher-level factors that impact the behavioural intention of customers to adopt green banking (Jain, Behera, & Kochhar, 2025). The consistency across studies suggests a robust and growing integration of environmental sustainability principles into green banking operations. Thus, it is postulated that:

H₂: Environmental sustainability has a positive influence on green banking operations.

Green Banking Operations and Economic Sustainability

Economic sustainability refers to long-term value creation, financial resilience, cost efficiency, and the capacity of institutions to remain profitable while aligning with sustainability goals (Aslam & Jawaid, 2023). Banks that prioritise economic sustainability often seek to attract customers and investors through value-driven, cost-efficient services. The evidence suggests a robust, multi-dimensional relationship between economic sustainability and green banking, with consistent findings across different geographical contexts. Based on Ahmad, Zayed, and Harun (2013) economic factors are among six major influencers of green banking decisions, accounting for a substantial 65.25% of the variance in banking strategies. Rahman et al. (2025) argue that green banking supports economic sustainability while balancing future and current business needs. Shameem and Haleem (2021) demonstrate that economic variables shape green banking practices besides environmental considerations. Although previous studies offer strong conceptual evidence, further quantitative research is necessary to validate the specific economic mechanisms underlying the transformation of green banking. Hence, the hypothesis:

H₃: Economic sustainability has a positive effect on green banking operations.

Green Banking Operations and ICT Adoption

Green banking operations refer to environmentally responsible banking practices, including reduced paper usage, energy-efficient infrastructure, eco-friendly lending portfolios, and conformity with Environmental, Social, and Governance (ESG) principles (Chen, Siddik, Zheng, Masukujaman, & Bekhzod, 2022; Rahman et al., 2025). Examples include green financing, digital service delivery, reduced reliance on paper, energy-efficient equipment, and adherence to ESG standards (Chen et al., 2022). These initiatives create an operational climate that promotes environmentally friendly ICT solutions. The literature shows that ICT adoption and green operations are mutually related. Compared with conventional brick-and-mortar operations, digital banking infrastructure, such as automated service channels, online banking platforms, and mobile banking, is more environmentally friendly (Cuevas-Vargas et al., 2022). To improve efficiency and reduce environmental impact, banks employing green operational practices are moving toward wider adoption of green ICT. Examples include cloud computing, virtualization, low-carbon IT infrastructure, energy-efficient data centres, and system optimization technologies (Mandari, 2025). Technologies that reduce resource consumption, facilitate sustainability reporting, and improve the delivery of environmentally friendly services are necessary for green banking operations. As a result, implementing eco-friendly ICT solutions becomes both necessary and driven by green operations. Furthermore, banks committed to sustainable operations consider green information and communication technology (ICT) essential for enhancing environmental performance, reducing costs, and ensuring regulatory compliance (Rahman et al., 2025). Ultimately, the transition to climate-conscious digital transformation is expedited when green practices align with ICT modernization.

H₄: Green banking operations positively influence green ICT adoption.

Green Policies and ESG

Green policies are defined as institutional and legal frameworks that direct ecologically responsible operations and shape organisational behaviour (Aslam & Jawaid, 2023; Roy, 2024). To regulate and encourage environmentally friendly operations and services, banks implement green banking policies (Gazi et al., 2024). To lessen the environmental impact of banking, green banking policies incorporate partnerships, green lending standards, energy-saving branch and office practices, environmental risk assessments in investment decisions, and community involvement. These policies, which compel the banking sector to incorporate sustainability into its operational and technical plans, often comprise sectoral guidelines, national environmental regulations, climate risk disclosure requirements, and green reporting systems.

Green policies significantly influence Green ICT adoption through multiple institutional pressures and policy mechanisms. The evidence suggests that green policies affect Green ICT adoption through several key channels: government legislation, political and social pressures, normative institutional expectations, and coercive regulatory frameworks (Islam, Muthaiyah, & Fie, 2020). Ara (2018) demonstrated that perceptions of green innovation policy significantly moderate technology adoption behaviour. In connection with this, Thabit, Aissa, and Jasim (2021) noted that developing countries adopt green ICT because of government legislation and political conditions.

The objectives of social sustainability are inclusive development and improved community well-being. Banks wishing to attain social sustainability generally distribute funds to social community welfare initiatives, set up local jobs and provide financial products that are appropriate for the community (Shih et al., 2024). However, even with supportive green policies in place, social sustainability does not always translate into green banking practices. Regulations such as those mandating ESG reporting and the disclosure of climate-related information enhance a bank's sense of responsibility by promoting green operations and fulfilling its social obligations (Chen et al., 2022; Roy, 2024). Studies involving more than 1,000 employees at banks in Pakistan and India (Chen et al., 2022; Gulzar, Bhat, Mir, Athari, & Al-Adwan, 2024; Singh & Sharma, 2023) consistently revealed that environmentally friendly banking, such as operational procedures, investments, and policy systems, greatly improves environmental performance.

Notably, Gulzar et al. (2024) stated that the operational elements of green banking have the most direct and significant influence on environmental sustainability. When established environmental standards are imposed, green policies make banks more accountable for their environmental performance and assist their transition to green operations. In regulatory settings with strong green policies, banks are more likely to adopt eco-conscious practices, thus strengthening their impact on environmental sustainability. Various studies have demonstrated that green banking policies positively affect economic sustainability (Aslam et al., 2025; Iqbal, Akram, & Rao, 2026).

Economic incentives encourage banks to invest in eco-friendly technologies, including those that support green operations. However, where there is a lack of strong policy, banks may prioritise short-term profitability over their long-term environmental responsibilities (Du et al., 2022).

H₅: Green policies have a significant positive influence on green banking operations.

H₆: Green policies have a significant positive influence on green ICT adoption.

H_{6a}: Green policies positively moderate the relationship between social sustainability and green banking operations.

H_{6b}: Green policies positively moderate the relationship between environmental sustainability and green banking operations.

H_{6c}: Green policies positively moderate the relationship between economic sustainability and green banking operations.

The suggested theoretical framework for this investigation is shown in Figure 1, which is based on the discussion above.

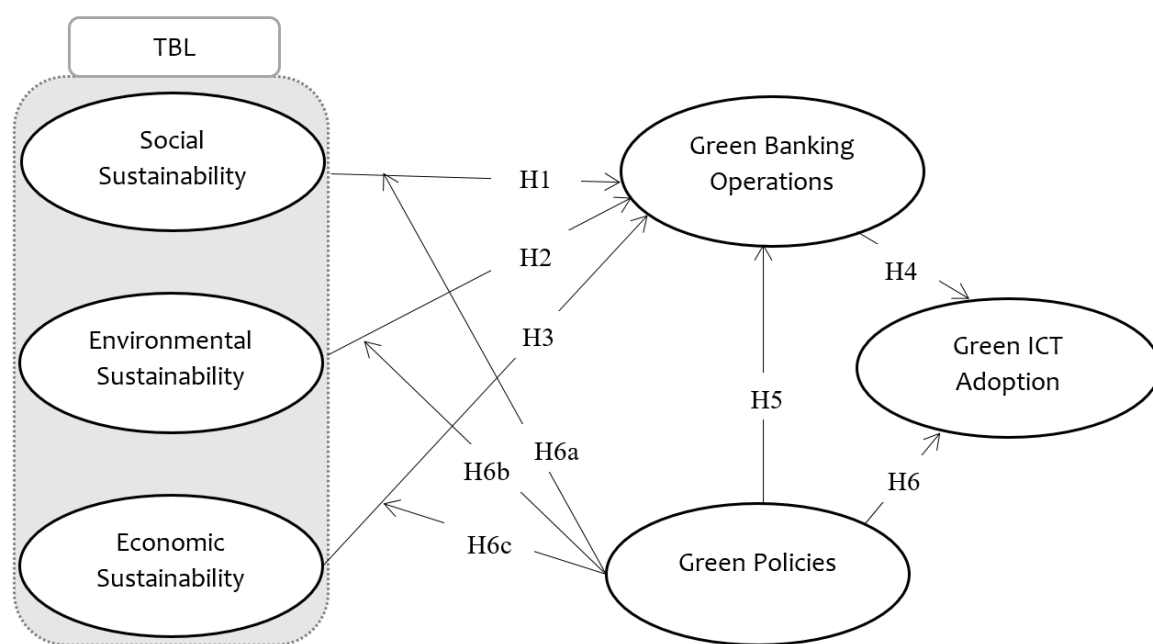


Figure 1: Proposed Theoretical Framework

METHODS

Research Design

Our study employed a quantitative research strategy. This strategy aligns with its stated objectives and uses a closed-ended questionnaire for data collection.

Participants and Sampling Procedures

The study targeted employees of commercial banks with at least 1 year of banking experience. This cohort of respondents has experience with the evolving banking operations, particularly the Environmental, Social, and Governance (ESG) requirements and reporting. The NBAA requires all financial institutions to report their ESG compliance, effective January 2024. The selection of this respondent cohort corresponds with the ESG reporting compliance period. The study followed a method described by Roy (2024) and Uprichard (2013). It involved using screening questions and a structured process to select people from the general population who met the criteria. Respondents were first asked about their experience in the banking industry to make sure only those with the right background continued to the consent form. The number of participants required to determine the sample size for meaningful results was calculated with G*power 3.1 software. The calculation showed that 300 respondents were required for the study.

Data Collection Instrument, Procedures, and Ethical Considerations

The questionnaire had three sections. The first section introduced the study, included a screening question, and provided a consent form for participants. Respondents were told that their data would only be used for research and that their anonymity and confidentiality would be protected. The second section asked about the respondents' general characteristics. The third section measured how respondents viewed the main variables in the study.

The questionnaire was pre-tested to enhance its structure and readability. Pre-testing involved 30 respondents, as recommended by Perneger, Courvoisier, Hudelson, and Gayet-Ageron (2015) with characteristics similar to those of the study's target respondents.

The questions used to measure respondents' perceptions were adopted from previous studies, as indicated in Appendix 1. All scale items were measured on a five-point Likert scale ranging from one to five, where one (1) denotes strong disagreement and five (5) denotes strong agreement. The questionnaires were disseminated using online platforms. Reminders were sent to respondents every seven (7) days. The entire data collection exercise took three (3) months, from February to May 2026, and yielded a response rate of 87%. The collected data fall within the estimated sample size range necessary to produce a meaningful effect size, as indicated in the previous section. Before proceeding to data analysis, we tested for missing data to determine whether any were present and, if so, whether they were missing completely at random (MCAR). We conducted this assessment using the MCAR test (Graham, 2009). We found no identifiable pattern in the missing values in our sample ($\chi^2 = 567$, $df = 311.5$; $p < 2.21$). We therefore replaced the missing values using the expectation-maximisation (EM) method.

DATA ANALYSIS AND RESULTS

Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed for data analysis. PLS-SEM is particularly appropriate for examining complex structural links and predictive modelling (Hair et al., 2021; Mwemezi & Nzaga, 2025). The assessment of the structural and measurement models was conducted in two distinct phases.

Measurement Model Analysis

The evaluation of the measurement model demonstrated sufficient validity and reliability. Reliability analysis indicated that all Cronbach's alpha values exceeded the recommended threshold of 0.70. According to Hair, Sarstedt, and Ringle (2019) the assessment items in Table 1 therefore exhibited strong internal consistency. Additionally, all constructs reported composite reliability values above 0.70, confirming adequate construct reliability. Convergent validity was established as all Average Variance Extracted (AVE) values surpassed the recommended minimum of 0.50 (Ringle, Sarstedt, Mitchell, & Gudergan, 2020), demonstrating that the indicators accounted for sufficient variance within their respective constructs.

Table 1: Measurement model assessment

Construct	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
ECS	0.823	0.826	0.895	0.739
ENS	0.899	0.900	0.937	0.832
GB	0.883	0.886	0.914	0.681
GP	0.819	0.820	0.917	0.846
GTA	0.889	0.908	0.930	0.816
SS	0.917	0.917	0.947	0.857

Note: ECS: Economic Sustainability, ENS: Environmental Sustainability, GP: Green Policies. SS: Social Sustainability, GB: Green Banking Operations, GTA: Green ICT Adoption.

Table 2 presents the evaluation of discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) criterion. According to Henseler, Ringle, and Sarstedt (2015) all values were below the recommended threshold of 0.90; therefore, they support discriminant validity.

Table 2: Heterotrait-Monotrait Results

Construct	ECS	ENS	GB	GP	GTA	SS
ECS						
ENS	0.625					
GB	0.714	0.766				
GP	0.673	0.745	0.877			
GTA	0.599	0.684	0.727	0.709		
SS	0.690	0.891	0.761	0.729	0.651	

Note: ECS: Economic Sustainability, ENS: Environmental Sustainability, GP: Green Policies, SS: Social Sustainability, GB: Green Banking Operations, GTA: Green ICT Adoption.

HYPOTHESES TESTING

The results of the structural model provide several significant conclusions, as presented in Table 3.

H3 was supported by the significant and beneficial influence of economic sustainability on green banking operations ($\beta = 0.562$, $p = 0.000$). This suggests that financially viable banking institutions promote environmentally responsible business activities. H2 is supported by the strong impact of environmental sustainability on green banking operations ($\beta = 0.105$, $p = 0.009$). According to this research, banks that prioritise environmental preservation are more likely to use green operating systems.

H4 is supported by the strong relationship between green banking operations and green ICT adoption ($\beta = 0.438$, $p < 0.001$). This illustrates how environmentally responsible financial practices support long-term technological advancement. Green policies supported H5 and H6 by having a substantial impact on green banking operations ($\beta = 0.302$, $p = 0.000$) and green ICT adoption ($\beta = 0.295$, $p < 0.001$). However, there was no direct significant impact of social sustainability on green banking operations ($\beta = 0.067$, $p = 0.149$). H1 was therefore not supported. The explanatory factors accounted for 86.3% of the variance in green banking operations, as indicated by the R^2 value of 0.863. Green banking operations and green policies accounted for 47.0% of the variance in green ICT adoption, as indicated by an R^2 of 0.470. Results of the hypothesis testing are shown in Table 3 and Figure 2.

Table 3. Hypothesis Testing Results for Direct Effects

Hypothesis	β	SE (Standard Error)	t-values	P values	Bias-corrected CI	
					2.5%	97.5%
H1: SS $\rightarrow$ GB	0.067	0.047	1.442	0.149	-0.027	0.154
H2: ENS $\rightarrow$ GB	0.105	0.040	2.624	0.009	0.023	0.179
H3: ECS $\rightarrow$ GB	0.562	0.038	14.822	0.000	0.484	0.633
H4: GB $\rightarrow$ GTA	0.438	0.059	7.418	0.000	0.325	0.557
H5: GP $\rightarrow$ GB	0.302	0.033	9.218	0.000	0.237	0.366
H6: GP $\rightarrow$ GTA	0.295	0.068	4.335	0.001	0.149	0.421

Note: ECS: Economic Sustainability, ENS: Environmental Sustainability, GP: Green Policies, SS: Social Sustainability, GB: Green Banking Operations, GTA: Green ICT Adoption.

Regarding moderation effects, green policies supported H6a by significantly moderating the connection between social sustainability and green banking operations ($\beta = 0.159$, $p = 0.001$). In contrast to H6b, green policies had a negative effect on the link between environmental sustainability and green banking operations ($\beta = -0.165$, $p = 0.000$). H6c was rejected because the moderating effect of green banking operations on economic sustainability was not statistically significant ($\beta = -0.031$, $p = 0.238$). The structural model demonstrated strong explanatory power. The results of the moderation analysis are shown in Table 4 and in Figure 3 and 4.

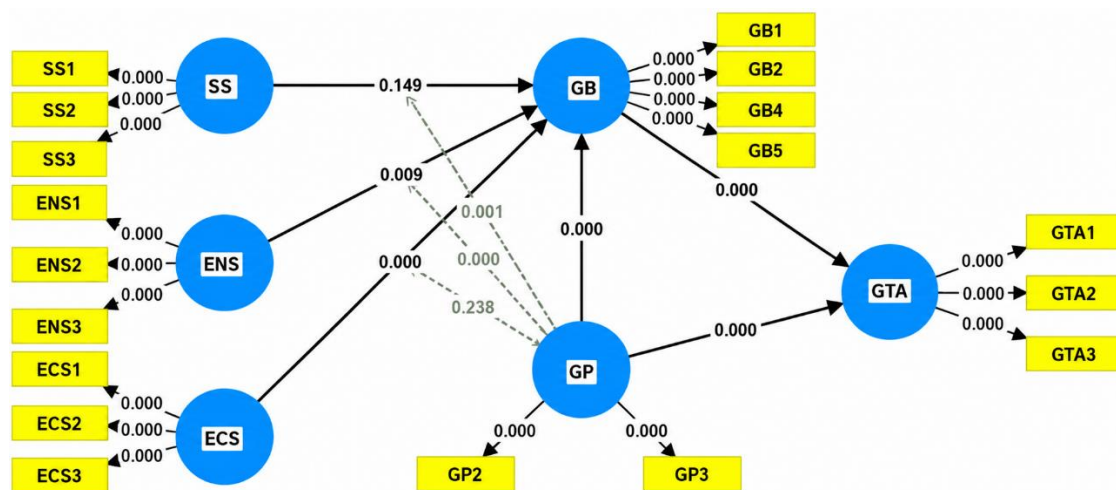


Figure 2: The structural model results

Table 4: Hypothesis Testing Results for Moderating Effects

Hypothesis	β	SE (Standard Error)	t-values	P values	Bias-corrected CI	
					2.5%	2.5%
H6a: GP x SS $\rightarrow$ GB	0.159	0.046	3.474	0.001	0.063	0.242
H6b: GP x ENS $\rightarrow$ GB	-0.165	0.037	4.523	0.000	-0.236	-0.095
H6c: GP x ECS $\rightarrow$ GB	-0.031	0.026	1.180	0.238	-0.087	0.015

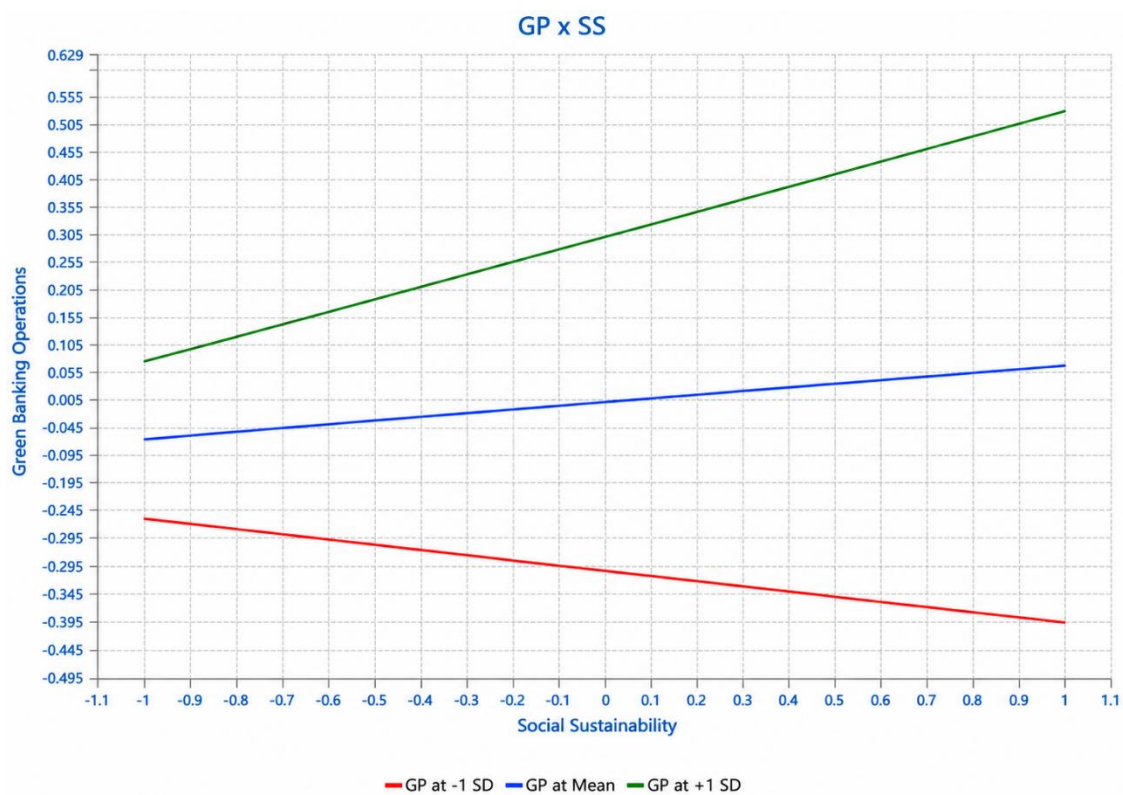


Figure 3: Graphical moderation analysis: Green policies and social sustainability

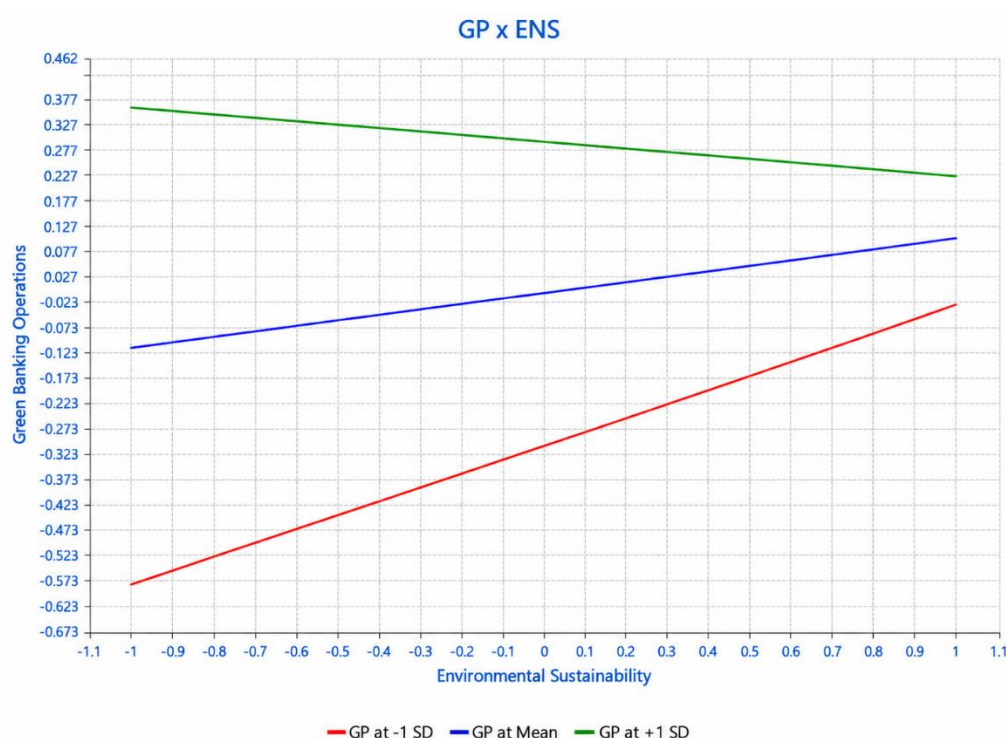


Figure 4: Graphical moderation analysis: Green policies and environmental sustainability

DISCUSSION OF THE RESULTS

This study has investigated how social, environmental, and economic sustainability factors affect green banking operations, and how these operations influence the adoption of green ICT in Tanzania's banking sector. The study has also examined the moderating effects of green policies on sustainability and green banking operations. The structural model showed R^2 values of 0.863 for green banking operations and 0.470 for green ICT adoption. According to Hair, Ringle, and Sarstedt (2011) these results show that the model is reliable and relevant for Tanzanian banks. Because its R^2 explains about 86.3% of the variation in green banking operations and 47.0% of the variation in green ICT adoption.

Moreover, the results indicate that social sustainability (SS) does not directly affect green banking operations; therefore, H1 is not supported. This finding differs from recent studies that argue social sustainability is important for green banking transformation (Bansal et al., 2024; Gazi et al., 2024). One possible reason for the lack of significance of social sustainability in green banking operations is that green banking is still new in Tanzania; therefore, banks are more likely to respond to financial incentives and regulations than to social sustainability as a principal driver of operational change. In connection with this finding, it should be noted that Banks may have initially focused on the environmental and governance aspects of ESG due to the NBAA's statutory ESG reporting requirement, which took effect in January 2024, leaving the social dimension relatively underdeveloped as an operational imperative. Hence, this result suggests that the legal and policy landscape dictates the impact of social sustainability on green banking operations rather than existing independently. Nonetheless, it is crucial to emphasise that the moderated relationship for social sustainability ($GP \times SS \rightarrow GB$) is statistically significant, a finding examined in relation to H6a.

The discovery that environmental sustainability had a statistically significant positive impact on green banking operations supports H2. The results show that environmental issues are becoming increasingly significant strategic forces driving the transition to green banking in Tanzania's banking industry. Green operational practices, like reduced paper use, energy-efficient infrastructure, digital banking platforms, environmentally conscious lending, and green financing initiatives, are more likely to be adopted by banks that

prioritise ecological preservation, carbon reduction, and environmentally responsible service delivery. This outcome is consistent with Rahman et al. (2025) who found that environmental concerns are important institutional drivers of green banking operations, and with Hasan et al. (2022) who found that environmental sustainability positively affects bankers' green banking usage behaviour. In the same vein, Gazi et al. (2024) found that environmentally responsible operational procedures significantly improve green banking performance and sustainability outcomes. The comparatively low coefficient may reflect Tanzania's developing green banking maturity, where awareness of environmental sustainability is rising, but operational implementation remains slow and institutionally limited.

H3 has strong support, as economic sustainability was identified as the most important and powerful predictor of green banking operations. Research indicates that Tanzanian banks regard green banking as a strategically important and economically beneficial initiative that improves long-term competitiveness, operational capability, investor attractiveness, and institutional reputation. Sustainable banking practices, such as paperless transactions, digital banking systems, energy-efficient infrastructure, and ESG-compliant operations, reduce costs while increasing client confidence and economic soundness.

These results correspond with the findings of Shameem and Haleem (2021) who identified economic elements as substantially influencing green banking practices. Rahman et al. (2025) demonstrated that economically sustainable operational systems substantially support green banking transformation in emerging economies, while Aslam and Jawaid (2023) reported that green banking practices improve both operational and monetary performance. The relatively high coefficient suggests that the primary driver of operational transformation in green banking within the Tanzanian banking industry is the business case for sustainability.

The findings deliver strong support for H4, indicating that green banking operations have a substantial and positive effect on the use of green information and communication technology (ICT). This demonstrates that environmentally sustainable operational transformation promotes the implementation of eco-friendly technology systems in the banking sector. Banks are more likely to invest in cloud computing systems, virtual servers, energy-efficient ICT infrastructure, digital documentation systems, and online banking applications when adopting green operational practices, such as reduced paper usage, energy-efficient infrastructure, ESG-compliant lending, and environmentally responsible service delivery. This evidence supports the assertion by Cuevas-Vargas et al. (2022) that ICT adoption strengthens operational effectiveness and advances environmental protection objectives. Similarly, Mandari (2025) found that an organisation's sustainability orientation substantially affects the acceptance of green ICT. Rahman et al. (2025) also observed that, to improve ESG reporting, operational capability, and carbon footprint reduction, green bank initiatives require institutional environments that facilitate eco-friendly ICT systems. The relatively high coefficient indicates that sustainable operational foundations are the main drivers of green digital transformation in Tanzania's banking industry.

Support for H5 was demonstrated by the finding that green policies have a statistically significant positive impact on the use of green ICT. This result highlights the critical role of institutional and regulatory systems in accelerating long-term technological change within the banking industry. Banks are compelled to update their operational relevance and technological systems in accordance with environmental regulations due to institutional pressures, such as ESG reporting standards, climate-related financial disclosure frameworks, and sustainability compliance requirements.

Initiatives such as the NBAA sustainability reporting standards and the Bank of Tanzania Strategic Plan 2025/2026–2029/2030 appear to provide substantial regulatory support for green ICT investments in Tanzania. This result is consistent with the findings of Islam et al. (2020) who found that institutional pressures have a big impact on the use of green ICT, and Ara (2018) who found that policy-driven pressure is a significant antecedent of the utilization of green technology in emerging economies. In a similar vein, Thabit et al. (2021) noted that political and governmental restrictions strongly influence organisational use of green technologies. The findings also show that green policies support wider operational transformation in green banking and directly promote the deployment of green ICT.

The relationship between social sustainability and green banking operations was considerably and favourably mediated by green policies, supporting H6a. According to this research, social sustainability programs become more operationally successful when strong legal and policy systems support them.

Banks are more likely to translate social responsibility pledges into practical green banking initiatives, such as ESG-compliant service delivery, sustainable operational systems, and environmentally responsible practices, in heavily regulated sustainability environments. The results support the claim made by that ESG disclosure regulations improve the incorporation of social responsibility into banking operations. In a similar vein, Roy (2024) noted that in emerging economies, sustainability-driven institutional transformation is amplified by sustainability-oriented financial laws. On the other hand, H6b was rejected because green policies negatively and statistically significantly moderated the linkage between environmental sustainability and green banking operations. Strong policy contexts may reduce the independent impact of environmental sustainability on green banking operations, according to this paradoxical study. Excessive regulatory pressure may lead to compliance-driven conduct, in which banks adopt green practices primarily to meet policy requirements rather than out of an innate dedication to the environment. In such circumstances, internal reasons for environmental sustainability may be replaced by policy frameworks rather than strengthened. This result is consistent with Elsner and Neumann (2023) observation that strong institutional green frameworks may lessen the distinctiveness of domestically motivated environmental commitments and supports the regulatory substitution perspective (Du et al., 2022).

The study found that H6c was not a significant moderator of the relationship between economic sustainability and green banking operations. This finding emphasises that economic sustainability principally drives green banking operations regardless of how strict the regulation is. It further suggests that, rather than relying on regulation, banks may adopt green practices to boost profits, attract investors, and gain a competitive advantage.

THEORETICAL IMPLICATIONS

This research adds to the existing literature on digital transformation, green banking, and sustainable finance in various ways.

First, by integrating sustainability, green banking practices, green policies, and green ICT adoption into a single conceptual model, the study advances and contextualises the Triple Bottom Line (TBL) framework within the banking industry of a rising African economy. The results show that the three sustainability dimensions have asymmetric impacts on green banking operations, with social sustainability having no discernible direct influence, environmental sustainability having a smaller but significant impact, and economic sustainability emerging as the strongest predictor. This challenges the notion that sustainability factors contribute equally to organisational transformation and expands TBL theory. Second, to explain the moderating influence of green policies, the study combines the TBL framework with green policies, green banking operations, and green ICT adoption. The results show that while green regulations have no discernible moderating influence on economic sustainability, they strengthen the association between social sustainability and green banking operations and diminish the relationship between environmental and social sustainability. The results show that policy affects the various levels of the model differently, suggesting that it benefits some factors but not all factors involved in overall sustainability. However, owing to the sequential relationships among sustainability dimensions, green banking operations, and green ICT adoption, the current study sheds additional light on the existing literature on green ICT adoption. One notable direct effect identified in our analysis is that the use of green ICT is further supported by green banking initiatives and regulations. This additional support goes beyond that provided by the organisational and technological dimensions included in the green ICT model. Finally, the study also provides insight into the concept of regulatory substitution through the negative moderating effect of green policy on environmental sustainability.

POLICY IMPLICATIONS

The conclusions of the study have important practical and regulatory implications for legislators, banking regulators, and institutional leaders who wish to speed up lasting change in Tanzania's banking sector. In particular, the findings confirm the key role of regulatory systems in promoting sustainable banking practices, since the significant positive effect of green regulations is seen in both green banking activities and the use of green information and communication technology (ICT).

The Bank of Tanzania, together with other regulatory bodies, could improve its sustainability policies by incorporating ESG reporting standards for climate risk disclosure. Adopting green policies would help link social sustainability to green banking and demonstrate the value of regulatory support in translating social objectives into concrete projects. Furthermore, banking regulations should include measures such as inclusive finance, community investment statements, and social impact reporting. On the other hand, unduly strict regulation might cause banks to concentrate merely on compliance rather than on environmental values. As a strategy for encouraging commitment, regulators could combine mandatory regulations with incentives such as green banking awards, sustainability certifications, and tax reductions.

The economic sustainability of green banking is crucial since it contributes to long-term competitiveness, helps to attract investors, increases efficiency and leads to higher profits. In order to make green banking more appealing, policymakers could provide incentives such as priority refinancing, support for green loans, and opportunities for sustainability-linked investments.

Moreover, investments in sustainable operational systems are important for promoting green digital transformation in the banking sector, since there is a strong correlation between green banking operations and the adoption of green information and communication technology.

LIMITATIONS AND FUTURE RECOMMENDATIONS

Even though this study offers useful findings on the use of green ICT in the banking industry, several limitations should be noted. First, reliance on quantitative data overlooks the qualitative aspects of environmental, social, and economic sustainability impacts. Future research should therefore use a mixed-methods approach to address these limitations. Second, although the moderating effects of green policies and programmes have been identified, their potential mediating effects have not been investigated. Future research should examine how green policies mediate decisions to adopt green ICT to better assist policymakers and decision-makers in understanding their influence on the adoption process. Third, because the study only examined bank employees, it limits our understanding of green ICT adoption. To gain a better understanding, future research should also include other external stakeholders, such as customers.

CONCLUSION

This study investigates the influence of social, environmental, and economic sustainability on green banking operations and green information and communication technology (ICT) adoption, and assesses the moderating role of green policy within Tanzania's banking sector. The results indicate that green banking policies encourage the use of green ICT, while economic and environmental sustainability are the main factors behind green banking operations. The findings also show that green policies strengthen the link between social sustainability and green banking operations yet weaken the connection with environmental sustainability.

This research reveals the relationship between sustainability, green policies, sustainable banking operations, and green ICT adoption. These findings empower stakeholders in the banking sector with insights on how sustainability features and regulatory systems could support sustainability efforts in the Global South. This study uses the Triple Bottom Line framework to examine not only the different aspects of sustainability, but also how they affect banking operations and the adoption of green ICT for sustainable banking.

FUNDING: This study received no specific financial support.

INSTITUTIONAL REVIEW BOARD STATEMENT: The study involved minimal risk and followed ethical guidelines for social science fieldwork. Formal approval from an Institutional Review Board was not required under the policies of Institute for Research Ethics Committee of the Institute of Finance Management (IFM), Tanzania. All participants gave informed consent, and their data were anonymized to protect their privacy.

TRANSPARENCY: The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

COMPETING INTERESTS: The authors declare that they have no competing interests.

AUTHORS' CONTRIBUTIONS: Both authors contributed equally to the conception and design of the study. Both authors have read and agreed to the published version of the manuscript.

DISCLOSURE OF AI USE: Grammarly Business Version was used to refine wording and structure of the sentences through out the paper.

REFERENCES

- Ahmad, F., Zayed, N. M., & Harun, M. A. (2013). Factors behind the adoption of green banking by Bangladeshi commercial banks. *ASA University Review*, 7(2), 241–255.
- Ara, F. (2018). Barriers to implement green ICT in Bangladesh: A study on organizations. *International Journal of Computer Applications*, 179(34), 43–47. <https://doi.org/10.5120/ijca2018916775>
- Aslam, S., Khan, N., Chen, T. B., & Rahman, H. M. M. (2025). Enhancing sustainability through green banking: Assessing its impact on environmental performance. *Journal of Infrastructure, Policy and Development*, 9(1), 10884. <https://doi.org/10.24294/jipd10884>
- Aslam, W., & Jawaid, S. T. (2023). Green banking adoption practices: Improving environmental, financial, and operational performance. *International Journal of Ethics and Systems*, 39(4), 820–840. <https://doi.org/10.1108/IJOES-06-2022-0125>
- Bank of Tanzania. (2025a). *Guidelines on climate-related financial risks management and disclosures*, 2025. Tanzania: Bank of Tanzania.
- Bank of Tanzania. (2025b). *Bank of Tanzania strategic plan 2025/2026–2029/2030*. Tanzania: Bank of Tanzania.
- Bansal, J., Shukla, P., Tripathi, P. K., & Dubey, S. (2024). Green banking and SDGs: Drivers, facilitators, and accelerators. In M. Irfan, M. Elmogy, S. Gupta, F. Khalifa, & R. Dias (Eds.), *AI-driven decentralized finance and the future of finance* (pp. 185–204). Hershey, PA: IGI Global Scientific Publishing.
- Chen, J., Siddik, A. B., Zheng, G.-W., Masukujjaman, M., & Bekhzod, S. (2022). The effect of green banking practices on banks' environmental performance and green financing: An empirical study. *Energies*, 15(4), 1292. <https://doi.org/10.3390/en15041292>
- Cuevas-Vargas, H., Parga-Montoya, N., & Fernández-Escobedo, R. (2022). The adoption of ICT as an enabler of frugal innovation to achieve customer satisfaction. The mediating effect of frugal innovation. *Procedia Computer Science*, 199, 198–206. <https://doi.org/10.1016/j.procs.2022.01.025>
- Du, M., Zhang, R., Chai, S., Li, Q., Sun, R., & Chu, W. (2022). Can green finance policies stimulate technological innovation and financial performance? Evidence from Chinese listed green enterprises. *Sustainability*, 14(15), 9287. <https://doi.org/10.3390/su14159287>
- Elsner, C., & Neumann, M. (2023). Caught between path-dependence and green opportunities—Assessing the impetus for green banking in South Africa. *Earth System Governance*, 18, 100194. <https://doi.org/10.1016/j.esg.2023.100194>
- Gazi, M. A. I., Al Masud, A., bin Kabir, S., Chaity, N. S., Senathirajah, A. R. B. S., & Rahman, M. K. H. (2024). Impact of green banking practices on green CSR and sustainability in private commercial banks: The mediating role of green financing activities. *Journal of Sustainability Research*, 6(4), e240072. <https://doi.org/10.20900/jsr20240072>
- Graham, J. W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology*, 60, 549–576. <https://doi.org/10.1146/annurev.psych.58.110405.085530>
- Gulzar, R., Bhat, A. A., Mir, A. A., Athari, S. A., & Al-Adwan, A. S. (2024). Green banking practices and environmental performance: Navigating sustainability in banks. *Environmental Science and Pollution Research*, 31(15), 23211–23226. <https://doi.org/10.1007/s11356-024-32418-7>
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice*, 19(2), 139–152. <https://doi.org/10.2753/MTP1069-6679190202>
- Hair, J. F., Sarstedt, M., & Ringle, C. M. (2019). Rethinking some of the rethinking of partial least squares. *European Journal of Marketing*, 53(4), 566–584. <https://doi.org/10.1108/EJM-10-2018-0665>
- Hair, J. F. J., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial least squares structural equation modeling (PLS-SEM) using R: A workbook*. Cham, Switzerland: Springer Nature.
- Hasan, M. M., Al Amin, M., Moon, Z. K., & Afrin, F. (2022). Role of environmental sustainability, psychological and managerial supports for determining bankers' green banking usage behavior: An integrated framework. *Psychology Research and Behavior Management*, 15, 3751–3773. <https://doi.org/10.2147/PRBM.S377682>
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. <https://doi.org/10.1007/s11747-014-0403-8>

- Hu, G., Chohan, S. R., & Liu, J. (2022). Does IoT service orchestration in public services enrich the citizens' perceived value of digital society? *Asian Journal of Technology Innovation*, 30(1), 217-243. <https://doi.org/10.1080/19761597.2020.1865824>
- Iqbal, Z., Akram, M., & Rao, Z. U. R. (2026). Unlocking green potential: A mediation-moderation analysis of bank policies-related practices and green financing sustainability in Pakistan. *International Journal of Ethics and Systems*, 42(2), 479-507. <https://doi.org/10.1108/IJOES-02-2024-0057>
- Islam, K. S., Muthaiyah, S., & Fie, D. Y. G. (2020). Isomorphic drivers of institutional pressure and importance of environmental management system implementation towards the adoption propensity of green ICT. *International Journal of Energy Economics and Policy*, 10(6), 624-634. <https://doi.org/10.32479/ijeep.10618>
- Jain, A., Behera, B., & Kochhar, K. (2025). Factors affecting customers' adoption of green banking: An interpretive structural modeling approach. *Qualitative Research in Financial Markets*. <https://doi.org/10.1108/QRFM-07-2024-0206>
- Kumar, J., Rani, G., Rani, M., & Rani, V. (2024). Do green banking practices improve the sustainability performance of banking institutions? The mediating role of green finance. *Social Responsibility Journal*, 20(10), 1990-2007. <https://doi.org/10.1108/SRJ-02-2024-0096>
- Lee, D. H. (2022). Linkages among extended service quality, distinct perceived value and satisfaction in the exhibition trust-building process. *Asia Pacific Journal of Marketing and Logistics*, 34(4), 817-842. <https://doi.org/10.1108/APJML-01-2021-0014>
- Liao, Z. (2023). Assessing sustainable impacts of green energy projects for the development of renewable energy technologies: A triple bottom line approach. *Processes*, 11(8), 2228. <https://doi.org/10.3390/pr11082228>
- Mandari, H. (2025). Green ICT adoption for sustainable development: The moderating role of firm size. *Human Behavior and Emerging Technologies*, 2025(1), 5515194. <https://doi.org/10.1155/hbe2/5515194>
- Miroshnychenko, I., Barontini, R., & Testa, F. (2017). Green practices and financial performance: A global outlook. *Journal of Cleaner Production*, 147, 340-351. <https://doi.org/10.1016/j.jclepro.2017.01.058>
- Muchiri, M. K., Erdei-Gally, S., & Fekete-Farkas, M. (2025). Nexus between green financing and carbon emissions: Does increased environmental expenditure enhance the effectiveness of green finance in reducing carbon emissions? *Journal of Risk and Financial Management*, 18(2), 90. <https://doi.org/10.3390/jrfm18020090>
- Mwemezi, J. G., & Nzaga, A. A. (2025). Unmasking the path to sustainable fraud mitigation through cybersecurity investments: Insights from commercial banks in Tanzania. *African Development Finance Journal*, 8(9), 276-299.
- National Board of Accountants and Auditors (NBAA). (2024). IFRS sustainability reporting standards (April). Dar es Salaam, Tanzania: National Board of Accountants and Auditors.
- Nica, I., Chiriță, N., & Georgescu, I. (2025). Triple bottom line in sustainable development: A comprehensive bibliometric analysis. *Sustainability*, 17(5), 1932. <https://doi.org/10.3390/su17051932>
- Perneger, T. V., Courvoisier, D. S., Hudelson, P. M., & Gayet-Ageron, A. (2015). Sample size for pre-tests of questionnaires. *Quality of Life Research*, 24(1), 147-151. <https://doi.org/10.1007/s11136-014-0752-2>
- Rahman, M. S., Moral, I. H., Akther, S., Hossain, G. M. S., & Islam, W. (2025). What drives green banking operations in Bangladesh? Findings from PLS-SEM and BSEM. *Asian Journal of Economics and Banking*, 9(1), 83-104. <https://doi.org/10.1108/AJEB-09-2023-0088>
- Ringle, C. M., Sarstedt, M., Mitchell, R., & Gudergan, S. P. (2020). Partial least squares structural equation modeling in HRM research. *The International Journal of Human Resource Management*, 31(12), 1617-1643. <https://doi.org/10.1080/09585192.2017.1416655>
- Roy, A. (2024). Green monetary policy to combat climate change: Theory and evidence of selective credit control. *Journal of Climate Finance*, 6, 100035. <https://doi.org/10.1016/j.jclimf.2024.100035>
- Shameem, A. L. M. A., & Haleem, A. (2021). A study on green banking practices in banking industry: Sri Lankan context. *The Journal of Contemporary Issues in Business and Government*, 27(1), 490-505.
- Sharma, M., & Choubey, A. (2022). Green banking initiatives: A qualitative study on Indian banking sector. *Environment, Development and Sustainability*, 24(1), 293-319. <https://doi.org/10.1007/s10668-021-01426-9>
- Shih, I.-T., Silalahi, A. D. K., Baljir, K., & Jargalsaikhan, S. (2024). Exploring the impact of perceived sustainability on customer satisfaction and the mediating role of perceived value. *Cogent Business & Management*, 11(1), 2431647. <https://doi.org/10.1080/23311975.2024.2431647>
- Singh, A., & Sharma, M. (2023). Development of a 'green IT brand image sustainability model for competitive advantage'. *Environment, Development and Sustainability*, 25(1), 40-60. <https://doi.org/10.1007/s10668-021-02039-y>
- Svensson, G., Høgevold, N., Ferro, C., Varela, J. C. S., Padin, C., & Wagner, B. (2016). A triple bottom line dominant logic for business sustainability: Framework and empirical findings. *Journal of Business-to-Business Marketing*, 23(2), 153-188. <https://doi.org/10.1080/1051712X.2016.1169119>
- Tariq, G., Sun, H., Ali, I., Pasha, A. A., Khan, M. S., Rahman, M. M., . . . Shah, Q. (2022). Influence of green technology, green energy consumption, energy efficiency, trade, economic development and FDI on climate change in South Asia. *Scientific Reports*, 12(1), 16376. <https://doi.org/10.1038/s41598-022-20432-z>
- Thabit, T., Aissa, S. A. H., & Jasim, Y. (2021). The impact of green ICT adoption in organizations of developing countries. *Al-Riyada for Business Economics Journal*, 7, 1-10.
- Uprichard, E. (2013). Sampling: Bridging probability and non-probability designs. *International Journal of Social Research Methodology*, 16(1), 1-11. <https://doi.org/10.1080/13645579.2011.633391>

Appendix 1: Measurement items and sources

Construct/Items	Sources
Social Sustainability	
I believe a sustainable banking product or service makes social contributions.	Shih et al. (2024)
I believe that sustainable banking services offer social benefits to local communities.	
I believe a sustainable banking product or service prioritises hiring local personnel.	
Environmental Sustainability	Shih et al. (2024)
My bank believes it is essential that a banking product utilises green technology to be considered truly sustainable.	
My bank believes that a banking product or service must support environmental preservation to be considered truly sustainable.	
My bank believes it is essential that a banking product or service provides eco-friendly goods or services to be considered truly sustainable.	
Economic Sustainability	
Based on my observation, sustainable banking products and services attract customers and investors.	Shih et al. (2024)
In my opinion, sustainable banking products and services provide excellent value for money.	
I believe that the economic benefits of using sustainable products outweigh the associated costs for customers.	
Green Banking Operations	
My bank has reduced paper usage.	Chen et al. (2022)
My bank utilises energy-efficient equipment, including ATMs and online banking.	and Rahman et al. (2025)
My bank implements eco-friendly banking services.	
My bank issues loans for eco-friendly projects.	
My bank complies with Environmental, Social, and Governance (ESG) practices.	
Green Policies	
My bank complies with environmental (green) policy.	Chen et al. (2022)
My bank has environmental-related agreements with relevant parties/stakeholders (suppliers, customers, etc.).	and Rahman et al. (2025)
My bank promotes an environmentally friendly policy at the corporate level.	
Green ICT Adoption	Mandari (2025)
My bank aims to adopt green ICT practices.	
My bank will strive to adopt green ICT practices.	
My bank has often practised green ICT adoption.	