

Sustainable Banking Disclosures, Credit Risk, and Profitability in Sub-Saharan Africa: A Sequential Explanatory SUR-ARDL Approach

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ABSTRACT

This study examines the impact of sustainable banking disclosure compliance on credit default risk and financial performance in Sub-Saharan Africa, focusing on Ghana's commercial banking sector (Q1 2018–Q4 2025). Utilizing a Seemingly Unrelated Regressions Autoregressive Distributed Lag (SUR-ARDL) model controlling for the 2023 Domestic Debt Exchange Programme (D_{DDEP}) structural break, results show that higher ESG compliance significantly reduces Non-Performing Loans ($\beta = -0.058, p < 0.05$) over the long run. Multinational subsidiaries achieve risk reduction faster than domestic banks. Furthermore, a non-linear, U-shaped relationship exists between ESG disclosures and Return on Equity (ROE), revealing a critical strategic turning point at **63.3% compliance**. Below this threshold, compliance overhead acts as an operational cost drag; beyond it, structured Environmental and Social Risk Management integration yields net financial returns. Sequential qualitative evidence ($N = 12$) highlights operational friction points and industry readiness for mandatory IFRS S1 and S2 disclosures by 2027.

Keywords: Sustainable Banking, ESG Disclosures, Credit Risk, Non-Performing Loans, Return on Equity, SUR-ARDL, Domestic Debt Exchange Programme, IFRS S1/S2, Sub-Saharan Africa.

INTRODUCTION, PROBLEM STATEMENT, AND STUDY CONTEXT

Context and Background

Over the past decade, sustainable finance has shifted from a voluntary corporate social responsibility (CSR) exercise to a core pillar of global financial regulation and risk management. In Sub-Saharan Africa (SSA), commercial banks occupy a pivotal position in this transition. Unlike developed financial markets where capital markets drive corporate behavior, SSA economies remain predominantly bank-led; commercial banks mediate over 80% of total financial flows across key economic sectors, including agriculture, mining, infrastructure, and commerce (World Bank, 2022). Consequently, the banking sector acts as both a primary transmission channel for climate and environmental risks and the chief mechanism for funding sustainable development.

In Ghana, this dual dynamic is especially pronounced. The Ghanaian banking sector operates at the intersection of acute physical climate vulnerabilities—such as rainfall shifts impacting agrarian loan performance—and rapid regulatory transformation. In 2019, the Bank of Ghana (BoG), in partnership with the Environmental Protection Agency (EPA) and the Ghana Association of Banks (GAB), formally launched the **Sustainable Banking Principles (SBPs)**. These principles mandate commercial banks to integrate Environmental and Social Risk Management (ESRM) directly into credit risk assessments, corporate governance, and financial disclosures. This framework was further bolstered by the Ghana Stock Exchange (GSE) ESG Disclosure Guidance Manual and the Institute of Chartered Accountants, Ghana (ICAG) roadmap mandating International Sustainability Standards Board (ISSB) standards (**IFRS S1 and S2**) for Specified Public Interest Entities starting in 2027.

However, this regulatory push coincided with macroeconomic turbulence. The 2023 **Domestic Debt Exchange Programme (DDEP)** forced commercial banks to restructure sovereign holdings, leading to immediate capital impairments, liquidity shocks, and elevated loan loss provisions across the industry. Understanding how

sustainable disclosure practices interact with bank risk and profitability in an emerging market undergoing severe macroeconomic shocks remains a critical empirical and practical question.

Problem Statement

Despite the rapid adoption of sustainable finance frameworks across developing nations, empirical literature exhibits two critical gaps that this study explicitly addresses:

1. **The "Cost-Drag vs. Value-Creation" Ambiguity in Emerging Markets:** Traditional corporate finance literature presents conflicting predictions regarding sustainability investments. Agency theory and cost-tradeoff perspectives (Friedman, 1970) argue that ESG compliance diverts capital toward non-productive administrative overhead, creating an operational cost drag that depresses Return on Equity (ROE). Conversely, stakeholder and resource-based views (Freeman, 1984; Porter & van der Linde, 1995) contend that ESG integration mitigates default risk and lowers capital costs. While recent studies suggest a non-linear relationship in developed markets, empirical evidence identifying explicit inflection points (ESG^*) within SSA commercial banking remains scarce.
2. **Methodological Vulnerabilities in Existing Small-Panel Studies:** Prior empirical research on African banking disclosures frequently relies on standard panel estimators (such as pooled OLS or fixed/random effects) or incorrectly applies System GMM to panels with small cross-sectional dimensions (N). In settings where N is small (e.g., comparing key anchor banking typologies) and T is moderate-to-large ($T = 32$ quarters), standard GMM suffers from severe instrument proliferation and small-sample bias, while OLS ignores contemporaneous cross-sectional error correlation across competing financial institutions. Furthermore, studies often fail to isolate sovereign debt shocks, risking omitted variable bias where macroeconomic impairments are misattributed to sustainability compliance costs.

Research Questions

To resolve these theoretical and methodological gaps, this study addresses three central research questions:

- **RQ1:** How does compliance with sustainable banking disclosures impact commercial bank credit default risk (measured by Non-Performing Loans, NPLs) over both short-run and long-run horizons in Ghana?
- **RQ2:** What is the structural functional form—linear or non-linear—of the relationship between ESG disclosures and bank profitability (ROE), and at what specific disclosure threshold does compliance transition from an operational cost drag to a net value-creator?
- **RQ3:** How do institutional ownership structures (indigenous domestic vs. multinational subsidiary models) and systemic macroeconomic shocks (specifically the 2023 DDEP structural break) alter the transmission of ESG risk management into balance-sheet resilience?

Research Objectives

In alignment with the research questions, the specific objectives of this study are to:

1. Econometrically estimate the long-run and short-run dynamics between ESG disclosure compliance and credit risk (NPL ratios) across major commercial bank typologies in Ghana using a Seemingly Unrelated Regressions Autoregressive Distributed Lag (SUR-ARDL) framework.
2. Determine the non-linear inflection point (ESG^*) in the relationship between sustainable disclosures and bank profitability (ROE) to operationalize the cost-benefit trade-off for commercial bank boards.
3. Quantify the isolated impact of the 2023 Domestic Debt Exchange Programme (D_{DDEP}) structural break on bank risk and return metrics.

4. Integrate primary qualitative data from executive interviews ($N = 12$) to explain operational lags, ESRM infrastructure asymmetries, and industry readiness for mandatory IFRS S1 and S2 reporting.

1.5 Significance and Justification of the Study

Domain	Key Contribution
Methodological Innovation	Demonstrates SUR-ARDL with structural break controls as a robust alternative to GMM for small- N , large- T African banking panels.
Theoretical Advancement	Validates a U-shaped profitability curve (63.3% inflection point), reconciling Cost-Drag vs. Porter hypotheses in emerging markets.
Supervisory & Executive Impact	Provides central banks and boardrooms with empirical targets for ESRM implementation, green capital risk weights, and IFRS S1/S2 transition planning.

LITERATURE REVIEW AND THEORETICAL HYPOTHESES DEVELOPMENT

Theoretical Framework

The relationship between sustainable banking disclosures, financial risk, and corporate performance in emerging economies cannot be fully captured by a single theoretical perspective. Consequently, this study synthesizes **Legitimacy Theory**, **Institutional Theory**, and **Stakeholder Theory** to establish an explanatory framework for commercial bank behavior in Sub-Saharan Africa.

1. Legitimacy Theory

Legitimacy Theory asserts that organizations continuously seek to ensure that their operations operate within the bounds and norms of their respective societies (Pfeffer & Salancik, 1978; Suchman, 1995). In banking, legitimacy is a vital strategic asset; financial institutions rely on societal trust to mobilize retail deposits and maintain capital market access. Applying this theory, disclosures aligned with the Bank of Ghana Sustainable Banking Principles (BoG SBPs) and the Ghana Stock Exchange (GSE) ESG Manual act as a primary mechanism to preserve a bank's "social contract" or license to operate. However, pure legitimacy-seeking behavior can result in *greenwashing*—disclosing superficial policies to project compliance while failing to integrate environmental risk screening into core credit underwriting.

2. Institutional Theory

Institutional Theory explains how organizational structures and reporting practices homogenize across an industry through institutional pressures (DiMaggio & Powell, 1983). These pressures operate along two primary dimensions in the Ghanaian banking market:

- **Coercive Isomorphism:** Driven by explicit regulatory mandates, such as the BoG SBPs directives and the Institute of Chartered Accountants, Ghana (ICAG) adoption roadmap for IFRS S1 and S2. Banks comply because non-compliance risks regulatory sanctions, fines, or heightened supervisory scrutiny.
- **Mimetic Isomorphism:** Occurs when domestic banking institutions emulate the practices of multinational banking subsidiaries (e.g., Ecobank Ghana PLC) that possess established environmental and social risk management (ESRM) systems inherited from global parent entities.

3. Stakeholder Theory & The Risk-Transmission Channel

Extending Freeman's (1984) stakeholder paradigm, modern risk management posits that integrating non-financial stakeholder interests directly improves financial stability. For commercial banks, environmental and social risks faced by borrowers (e.g., climate disruptions in agriculture, environmental fines in mining) directly convert into credit risk on the bank's balance sheet (Weber, 2017). Implementing robust ESRM screening enables credit officers to identify vulnerable loan applications prior to approval, reducing default risks and Non-Performing Loans (NPLs).

2.2 Literature Review and Hypotheses Development

1. Sustainable Disclosures and Credit Default Risk (NPLs)

Empirical literature examining the link between ESG disclosures and credit risk yields mixed insights, though modern findings lean heavily toward risk mitigation. Studies in developed financial markets establish that firms with higher ESG ratings exhibit lower default probabilities, narrower credit default swap (CDS) spreads, and lower costs of debt (Höck et al., 2020; Sharfman & Fernando, 2008).

In emerging banking markets, the primary transmission mechanism functions through credit risk evaluation. When commercial banks evaluate borrowers' climate resilience, environmental compliance, and labor standards, they screen out capital-heavy, high-risk assets that are vulnerable to asset stranding or regulatory litigation (Weber et al., 2010). In Ghana, where bank loan portfolios are exposed to environmentally sensitive sectors like agriculture, forestry, construction, and mining, rigorous SBP implementation acts as a secondary risk filter alongside traditional financial ratio checks.

However, the speed at which this risk reduction materializes depends on institutional infrastructure. Foreign-owned subsidiaries leverage global group software and automated workflows, whereas domestic institutions must build capacity manually across fragmented SME portfolios. Despite these operational lags, higher ESG compliance is expected to systematically suppress credit default risk over time.

- **Hypothesis 1 (H_1):** Higher sustainable banking disclosure compliance significantly decreases commercial bank credit default risk (NPL ratios) in Ghana.
- **Hypothesis 1a (H_{1a}):** Multinational banking subsidiaries capture ESG-driven credit risk reductions faster than domestic/indigenous financial institutions.

2. The Non-Linear Relationship Between ESG Disclosures and Bank Profitability (ROE)

The financial impact of sustainability integration remains widely debated in corporate finance literature, dividing scholars into two camps:

Theoretical View	Core Premise	Expected Relationship
Trade-Off / Cost Drag View	ESG activities consume capital, increase administrative overhead, and divert managerial focus away from core revenue generation (Friedman, 1970).	Negative Linear ($\beta < 0$)
Value Creation / Porter View	ESG integration optimizes operational efficiency, attracts low-cost green capital, and builds customer loyalty (Porter & van der Linde, 1995).	Positive Linear ($\beta > 0$)

To reconcile these opposing views, recent banking literature proposes a **non-linear, U-shaped relationship** (Barnett & Salomon, 2012; Nollet et al., 2016). In the initial phase of ESG compliance, banks incur substantial upfront fixed costs: procuring ESG analytics platforms, training credit personnel, conducting portfolio carbon audits, and setting up reporting mechanisms for IFRS S1/S2 standards. During this setup phase, compliance costs outpace financial returns, creating an operational cost drag that depresses short-term Return on Equity (ROE).

Once a critical threshold of ESG integration is crossed, the marginal cost of compliance decreases while the strategic benefits begin to compound. These benefits include lower loan-loss provisioning due to reduced NPLs, lower capital costs from green investors, and specialized advisory fees from green finance products.

- **Hypothesis 2 (H_2):** *There is a non-linear, U-shaped relationship between sustainable banking disclosures and commercial bank profitability (ROE) in Ghana.*

3. The Exogenous Shock of Sovereign Debt Restructuring (DDEP)

Recent empirical studies in African banking stress that non-financial risk models must account for macroeconomic stability shocks (Aboagye et al., 2024). In early 2023, the Government of Ghana executed the Domestic Debt Exchange Programme (DDEP), forcing commercial banks to swap high-yielding domestic government bonds for new instruments featuring reduced coupons and extended maturities.

This sovereign restructuring inflicted severe direct impairments on commercial bank balance sheets, causing sharp drops in capital adequacy ratios (CAR), restricting liquidity, and spiking credit loss allowances under IFRS 9. Failing to isolate this sovereign shock in empirical modeling creates an omitted variable bias, which risks incorrectly attributing balance-sheet deterioration to ESG compliance investments.

- **Hypothesis 3 (H_3):** The 2023 Domestic Debt Exchange Programme (D_{DDEP}) structural break significantly increased credit risk (NPLs) and decreased bank profitability (ROE), independent of ESG compliance activities.

3. Methodology and Econometric Framework

3.1 Research Philosophy and Mixed-Methods Design

This study employs a **sequential explanatory mixed-methods design** (QUAN → qual) under a pragmatic philosophical worldview (Creswell & Creswell, 2018). Pragmatism provides the epistemic latitude to evaluate empirical asset-pricing and credit risk models alongside qualitative organizational narratives.

SEQUENTIAL EXPLANATORY DESIGN
[Phase 1: Quantitative]
Panel quarterly financial & ESG disclosures (Q1 2018 – Q4 2025; T = 32)
--> Estimated via SUR-ARDL with DDEP Structural Break Control
[Phase 2: Qualitative]
Semi-structured executive interviews (N = 12)
--> Explains empirical parameters, operational lags, & IFRS S1/S2 readiness

The quantitative phase models panel data spanning 32 consecutive quarters (Q1 2018 to Q4 2025) across two institutional typologies: GCB Bank PLC (domestic/indigenous model) and Ecobank Ghana PLC (multinational subsidiary model). The subsequent qualitative phase uses primary interview data ($N = 12$) to contextualize structural parameter estimates, operational compliance lags, and institutional responses to regulatory enforcement.

Data Construction and Variables

The quarterly panel dataset merges audited financial statements, Bank of Ghana (BoG) prudent regulatory returns, Ghana Stock Exchange (GSE) filings, and annual corporate sustainability reports.

ESG Compliance Score ($ESG_{i,t}$) and Index Justification

The ESG compliance index is constructed using an unweighted binary framework across **35 sector-specific disclosure indicators**. Following established sustainability accounting literature (Cooke, 1992; Haniffa & Cooke, 2005; Weber, 2017), an unweighted index is utilized to eliminate subjective weighting bias, which assumes certain disclosures are universally more valuable across all bank operating models.

The composite index is defined as:

$$ESG_{i,t} = \sum_{k=1}^{35} \frac{d_{k,i,t}}{35} \times 100$$

where $d_{k,i,t} = 1$ if bank i discloses/fulfills indicator k in quarter t , and 0 otherwise.

The 35 indicators are directly mapped to three regulatory frameworks: the Bank of Ghana Sustainable Banking Principles (BoG SBPs 1–7), the Ghana Stock Exchange (GSE) ESG Guidance Manual, and the ICAG baseline roadmap for IFRS S1 and S2 disclosures.

Breakdown of the 35 ESG Disclosure Indicators

Category	#	Indicator Description	Primary Alignment
Environmental (E)	E01	Formal E&S policy in credit underwriting	BoG SBP 1 / GSE E1
	E02	Categorization of loan portfolio by climate/E&S risk level	BoG SBP 1 / IFRS S2
	E03	Exclusion list screening for high-risk sector loans	BoG SBP 1
	E04	Disclosure of Scope 1 operational greenhouse gas emissions	GSE E2 / IFRS S2
	E05	Disclosure of Scope 2 electricity/energy consumption emissions	GSE E2 / IFRS S2
	E06	Tracking of Scope 3 financed emissions in commercial lending	IFRS S2
	E07	Energy efficiency projects financed (GWh or GHS volume)	GSE E3
	E08	Renewable energy project exposure (% of gross loan book)	GSE E3
	E09	Internal paper, water, and waste recycling/reduction targets	GSE E4
	E10	Climate physical risk vulnerability assessments on collateral	BoG SBP 1 / IFRS S2
	E11	Environmental compliance audits required for corporate borrowers	BoG SBP 1
	E12	Green Bond or Sustainable Finance framework adoption	GSE E5
Social (S)	S01	Gender diversity disclosures across workforce (% female)	BoG SBP 5 / GSE S1
	S02	Board-level gender balance disclosures (% female directors)	GSE S1
	S03	Occupational health and safety (OHS) incident rate disclosures	GSE S2
	S04	Financial inclusion programs (SME & agricultural financing volume)	BoG SBP 2
	S05	Total employee training hours on ESRM and sustainability	BoG SBP 6
	S06	Employee turnover rate disclosures	GSE S3
	S07	Fair labor practice and human rights clauses in supplier contracts	BoG SBP 3 / GSE S4
	S08	Customer privacy and data security breaches reported	GSE S5
	S09	Community investment / CSR spending (% of profit after tax)	BoG SBP 4 / GSE S6
	S10	Grievance redress mechanisms operational for external stakeholders	BoG SBP 4
	S11	Financial literacy outreach initiatives in rural sectors	BoG SBP 2
Governance (G)	G01	Board-level sustainability/ESG subcommittee established	BoG SBP 7 / GSE G1
	G02	Executive compensation linked to ESG performance metrics	GSE G2
	G03	Anti-bribery and corruption policy disclosure & enforcement	BoG SBP 7 / GSE G3

	G04	Whistleblower protection policy and independent reporting line	GSE G4
	G05	Code of Conduct signed by all employees and executive management	GSE G5
	G06	Audit committee independence (% independent non-executive directors)	GSE G6
	G07	Risk committee oversight explicitly includes E&S financial risks	BoG SBP 7
	G08	Tax transparency and total tax contribution reporting	GSE G7
	G09	Third-party verification/assurance of sustainability disclosures	GSE G8
	G10	Supply chain ESG risk management policy	BoG SBP 3
	G11	Stakeholder engagement policy and annual report section	BoG SBP 4
	G12	Integration of IFRS S1 & S2 transition timeline into governance	ICAG Roadmap

Dependent and Control Variables

- **Credit Default Risk ($NPL_{i,t}$):** Measured as the ratio of Non-Performing Loans (gross loans past due > 90days under BoG BSD directives) to Total Gross Loans and Advances.
- **Profitability ($ROE_{i,t}$):** Calculated as annualized Net Income after tax divided by Total Average Shareholders' Equity.
- **Sovereign Shock Control ($D_{DDEP,t}$):** A structural break dummy capturing the systemic impact of Ghana's Domestic Debt Exchange Programme:

$$D_{DDEP,t} = \begin{cases} 0, & t < Q1\ 2023 \\ 1, & t \geq Q1\ 2023 \end{cases}$$

- **Bank-Level Control Variables:** Include **Bank Size** ($SIZE_{i,t} = \ln(\text{Total Assets})$), **Capital Adequacy** ($CAR_{i,t} = \text{Regulatory Capital}/\text{Risk-Weighted Assets}$), and **Liquidity** ($LIQ_{i,t} = \text{Liquid Assets}/\text{Total Assets}$).

Econometric Specification and Justification: SUR-ARDL Model

In a small- N , large- T panel setting ($N = 2, T = 32$), standard Generalized Method of Moments (GMM) estimators (Arellano & Bond, 1991; Blundell & Bond, 1998) are invalid. Under System GMM, internal instruments generated scale quadratically with T , rapidly exceeding $N(W > N)$. This results in severe instrument proliferation, over-identification failure, and downward-biased standard errors (Roodman, 2009). Furthermore, standard panel fixed/random effects ignore contemporaneous error cross-correlations across institutions operating in the same national market.

To resolve these econometric vulnerabilities, we specify a **Seemingly Unrelated Regressions (SUR)** framework within an **Autoregressive Distributed Lag (ARDL)** structure (Zellner, 1962; Pesaran et al., 2001). SUR captures efficiency gains by incorporating the contemporaneous cross-equation error covariance matrix ($\text{Cov}(\varepsilon_{GCB,t}, \varepsilon_{ECO,t}) \neq 0$), while the ARDL specification handles mixed integration orders [$I(0)$ and $I(1)$] and dynamic lag effects.

Equation 1: Credit Risk Dynamics (NPL Model)

$$\Delta NPL_{i,t} = \alpha_{1,i} + \sum_{j=1}^p \gamma_{1,i,j} \Delta NPL_{i,t-j} + \sum_{j=0}^q \beta_{1,i,j} \Delta ESG_{i,t-j} + \delta_{1,i} D_{DDEP,t} + \theta'_{1,i} X_{i,t} + \varepsilon_{1,i,t}$$

Equation 2: Profitability & Non-Linear ESG Dynamics (ROE Model)

$$\Delta ROE_{i,t} = \alpha_{2,i} + \sum_{j=1}^p \gamma_{2,i,j} \Delta ROE_{i,t-j} + \sum_{j=0}^q \beta_{2,i,j} \Delta ESG_{i,t-j} + \sum_{j=0}^q \beta_{3,i,j} \Delta ESG_{i,t-j}^2 + \delta_{2,i} \mathbf{D}_{DDEP,t} + \boldsymbol{\theta}'_{2,i} \mathbf{X}_{i,t} + \varepsilon_{2,i,t}$$

where $\mathbf{X}_{i,t}$ represents the vector of bank-level control variables ($SIZE_{i,t}$, $CAR_{i,t}$, $LIQ_{i,t}$), ESG^2 captures non-linear quadratic effects, and the error vector $\boldsymbol{\varepsilon}_t = [\varepsilon_{1,GCB,t}, \varepsilon_{1,ECO,t}]'$ exhibits a non-diagonal variance-covariance matrix:

$$\boldsymbol{\Omega} = \mathbb{E}[\boldsymbol{\varepsilon}_t \boldsymbol{\varepsilon}_t'] = \begin{bmatrix} \sigma_{GCB}^2 & \sigma_{GCB, ECO} \\ \sigma_{ECO, GCB} & \sigma_{ECO}^2 \end{bmatrix} \otimes \mathbf{I}_T$$

Derivation of the Non-Linear Inflection Turning Point (ESG*)

To calculate the strategic turning point where ESG disclosure compliance transitions from an operational cost drag to a net value-creator, we take the partial derivative of long-run ROE with respect to ESG compliance and set the initial condition to zero:

$$\frac{\partial ROE}{\partial ESG} = \beta_2 + 2\beta_3(ESG^*) = 0 \Rightarrow ESG^* = -\frac{\beta_2}{2\beta_3}$$

Qualitative Phase Methodology & Participant Selection

To contextualize the empirical parameters, 12 semi-structured interviews were conducted across GCB Bank PLC ($n = 5$), Ecobank Ghana PLC ($n = 5$), and banking regulators (Bank of Ghana and SEC Ghana, $n = 2$).

Participants were selected via **purposive expert sampling** based on three inclusion criteria: (1) minimum of 5 years of senior management experience in risk, credit, or ESG compliance; (2) direct leadership in BoG SBP or IFRS implementation; and (3) executive oversight of corporate loan underwriting.

QUALITATIVE SAMPLING FRAMEWORK (N = 12)

Institution / Category	Key Participants	Sample Size (n)
GCB Bank PLC (Domestic Anchor)	Chief Risk Officer; Head of Sustainability; 2 Senior Credit Analysts; Financial Controller	5
Ecobank Ghana PLC (Foreign Subsidiary Anchor)	Head of ESG/Sustainability; Senior Credit Officer; Group Risk Director; Head of Regulatory Compliance; Financial Controller	5
Regulators (Policy Oversight)	Bank of Ghana Sustainable Finance Lead; SEC ESG Policy Officer	2
Total		12

Interviews (45–60 minutes) were recorded, transcribed verbatim, and systematically coded using **Braun and Clarke's (2006) six-stage thematic analysis procedure** in NVivo 14. Codes were organized under thematic nodes focusing on ESRM operational costs, loan screening lags, post-DDEP capital preservation, and Scope 3 financed emissions data gaps under IFRS S1/S2.

Empirical Results and Econometric Testing

Unit Root and Stationarity Diagnostics

To avoid spurious regressions and confirm model eligibility for ARDL bounds testing, unit root properties were evaluated using ADF, PP, and **Zivot-Andrews structural break unit root tests**.

Variable	ADF (Level)	ADF (1st Diff)	Zivot-Andrews Break	Order of Integration
NPL Ratio (NPL)	-1.842	-5.412***	Q1 2023***	I(1)
Profitability (ROE)	-2.105	-6.189***	Q1 2023***	I(1)
ESG Compliance Score (ESG)	-3.814***	--	Q4 2021**	I(0)
Bank Size (SIZE)	-1.402	-4.908***	Q2 2022	I(1)
Capital Adequacy Ratio (CAR)	-2.311	-5.874***	Q1 2023***	I(1)
Liquidity Ratio (LIQ)	-3.951***	--	Q3 2020	I(0)

Standard errors in parentheses. $p < 0.05$, *** $p < 0.01$.

The results confirm a mixed integration structure [$I(0)$ and $I(1)$] with no $I(2)$ processes. The endogenous break dates identified by Zivot-Andrews tests cluster at **Q1 2023**, validating the econometric inclusion of the D_{DDEP} structural break dummy.

ARDL Bounds Test for Co-Integration

Estimated System Model	Calculated F - Statistic	Critical Value $I(0)(5\%)$	Critical Value $I(1)(5\%)$	Outcome
Model 1: $NPL = f(ESG, \text{Controls})$	6.84***	2.86	4.01	Co-Integration Established
Model 2: $ROE = f(ESG, ESG^2, \text{Cont.})$	8.12***	2.56	3.49	Co-Integration Established

*** $p < 0.01$. * The calculated F -statistics exceed upper-bound critical values, confirming long-run structural co-integration across equations.

System SUR-ARDL Regression Results

Independent Variables	Dependent Variable: NPL Ratio	Dependent Variable: ROE
ESG Compliance (ESG)	-0.042** (0.018)	-0.184** (0.071)
ESG Compliance Squared (ESG^2)	--	+0.001453** (0.0006)
DDEP Control (D_{DDEP})	+0.087*** (0.012)	-0.142*** (0.029)
Bank Size (SIZE)	-0.011 (0.009)	+0.045* (0.021)
Capital Adequacy (CAR)	-0.115** (0.043)	+0.210*** (0.058)
Liquidity Ratio (LIQ)	+0.022 (0.019)	-0.088 (0.062)
Constant	+0.104** (0.041)	+0.125** (0.052)
Long-Run Error Correction (ECM_{t-1})	-0.412*** (0.095)	-0.584*** (0.112)
System R-Squared	0.782	0.814
Breusch-Pagan LM Test (p)	0.002 (Rejected H_0)	0.001 (Rejected H_0)
Calculated Turning Point (ESG^*)	--	63.32%

Standard errors in parentheses. * $p < 0.10$, $p < 0.05$, *** $p < 0.01$.

Detailed Empirical Findings:

- Credit Risk Reduction (H_1 Supported):** ESG compliance exhibits a negative relationship with NPL ratios, reducing credit default risk by 0.042% in the short run and 0.058% in the long run ($p < 0.05$).

Cross-equation output shows Ecobank Ghana captures this reduction faster (lag = 1 quarter) than GCB Bank PLC (lag = 3 quarters), supporting H_{1a} .

2. **U-Shaped Profitability Curve (H_2 Supported):** The linear term is negative ($\hat{\beta}_2 = -0.184, p < 0.05$) while the quadratic term is positive ($\hat{\beta}_3 = +0.001453, p < 0.05$). Evaluating the partial derivative yields the explicit inflection point:

$$ESG^* = -\frac{-0.184}{2(0.001453)} = 63.32\%$$

3. **Exogenous Sovereign Shock (H_3 Supported):** The D_{DDEP} coefficient shows that the debt exchange shock increased systemic NPLs by 8.7percentage points and depressed ROE by 14.2percentage points ($p < 0.01$), confirming the necessity of controlling for sovereign debt shocks.

Robustness and Diagnostic Checks

To verify model stability, several diagnostic tests were conducted:

- **Alternative Estimators:** Re-estimating the models using **Driscoll-Kraay Standard Errors** to account for cross-sectional dependence and autocorrelation yielded consistent results ($\beta_{NPL} = -0.051, p < 0.05$; $ESG^* = 62.8\%$).
- **Materiality-Weighted ESG Index:** Re-running the SUR-ARDL specification using a materiality-weighted ESG score (emphasizing corporate loan screening) yielded a turning point of $ESG^* = 64.1\%$, confirming that the U-shaped relationship is robust to index construction choices.
- **System Diagnostics:** Jarque-Bera tests confirmed error normality ($p > 0.30$), Breusch-Godfrey tests confirmed the absence of serial correlation ($p > 0.25$), and CUSUM/CUSUMSQ plots remained within the 5% critical bounds.

5. Qualitative Discussion and Policy Recommendations

5.1 Discussion of Qualitative Findings

The qualitative data contextualizes the empirical parameters and transmission mechanisms:

Quantitative Result	Operational Mechanism (Qualitative Evidence)
NPL Reduction Lag (Ecobank: Q1 vs. GCB: Q3)	Ecobank leverages parent-level (ETI) automated ESRM screening toolkits, whereas GCB performs manual site appraisals across broad SME portfolios.
U-Shaped ROE Curve (Turning Point: 63.3%)	Upfront capital investments in ESG software, carbon auditing, and staff training create a short-term cost drag before risk-mitigation benefits accrue.
DDEP Sovereign Shock	Balance-sheet impairments forced banks to temporarily freeze discretionary capital allocations for green loan subsidies to preserve Tier-1 capital.
IFRS S1/S2 Readiness	Scope 1 and 2 emissions tracking is largely complete, but Scope 3 financed emissions remain constrained by client-level data deficits across SMEs.

As noted by Ecobank's Head of ESG:

"Our risk management architecture automatically screens corporate loan applications against IFC Performance Standards. The Bank of Ghana SBP reporting is largely an automated extraction from our core banking systems. The heavy lifting on systems investment was completed years ago at the group level."

Conversely, a Senior Credit Officer at GCB Bank PLC observed:

"Evaluating an agricultural co-operative or a local construction firm in regional markets for environmental compliance requires manual site visits and subjective assessments. Early on, this added processing delay and overhead cost without providing immediate yield enhancements."

Policy Recommendations

Stakeholder	Recommended Strategic Policy Actions
Bank of Ghana (BoG)	• Introduce simplified, tiered ESRM guidelines for domestic SMEs. • Implement Basel-aligned capital risk-weight reductions for accredited green loans. • Establish a national ESG data repository in partnership with EPA Ghana.
SEC Ghana & GSE	• Harmonize the 2022 GSE ESG Disclosure Guidance Manual directly with IFRS S1 and S2 ahead of the 2027 mandatory ICAG deadline.
Bank Executives & Boards	• Direct capital toward pushing ESG compliance past the 63.3% inflection point. • Embed automated ESRM checks directly into credit origination software.

CONCLUSION, MANAGERIAL IMPLICATIONS, LIMITATIONS, AND FUTURE RESEARCH

Conclusion

This study provides empirical and qualitative evidence on the relationship between sustainable banking disclosures, credit default risk, and financial performance within Sub-Saharan Africa. Utilizing a SUR-ARDL model controlling for the 2023 DDEP sovereign debt shock, the study demonstrates that sustainable banking disclosures reduce long-run credit risk while exhibiting a non-linear, U-shaped relationship with bank profitability. The identification of a **63.3% ESG compliance inflection point** provides boardrooms with a clear target for transitioning from compliance cost drag into net value creation.

Managerial and Practical Implications

- **For Executive Leadership:** Partial or superficial ESG compliance acts as a net financial drag. Management must accelerate compliance beyond the 63.3% threshold to capture lower provisioning costs and cheaper green capital.
- **For Chief Risk Officers:** Integrating ESRM into front-end credit origination—rather than conducting post-approval reviews—accelerates NPL suppression and improves loan portfolio quality under IFRS 9.

Study Limitations

While GCB Bank PLC and Ecobank Ghana PLC represent primary anchor typologies in Ghana, analyzing two major institutions over 32 quarters limits direct generalizability to non-bank financial institutions or microfinance sectors. Additionally, while the ARDL lag structure captures directional dynamics, empirical panel analyses reflect dynamic associations rather than fully experimental causal relationships. Direct measurement of Scope 3 financed emissions also remains constrained by client-level data gaps across African enterprises.

Directions for Future Research

1. **Cross-Country Comparative Panels:** Replicating this SUR-ARDL framework across WAEMU, EAC, and SADC banking regions to compare regional inflection thresholds.

2. **Post-2027 IFRS S1/S2 Impact Evaluations:** Assessing market valuation shifts following the mandatory implementation of audited ISSB standards across Sub-Saharan Africa.

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