CLIMATE RISK AND THE COST OF CREDIT IN AFRICA: A SYSTEMATIC REVIEW OF EVIDENCE FROM 2010 TO 2026

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DOI: https://doi.org/10.57233/gujaf.v7i5.15

Abstract
Africa contributes little to global greenhouse gas emissions yet is highly exposed to climate change and must mobilize an estimated USD 2.5–3 trillion for climate action by 2030. This systematic review asks whether, and through which channels, climate and environmental risk is priced into the cost of credit for African borrowers. Following PRISMA 2020, we searched academic databases and the repositories of the IMF, the World Bank, and the African Development Bank for studies published from January 2010 to June 2026. Two coders independently screened, coded, and quality-rated all studies (96.5% agreement), and the 86 included studies were synthesized narratively by credit-market segment. Evidence of a climate premium is most consistent for sovereign debt: climate-vulnerable sovereigns pay up to 117 basis points more (Kling et al., 2018), although no estimate isolates African sovereigns. Corporate spread increases of 8–91 basis points are driven almost entirely by United States samples (Correa et al., 2020; Seltzer, 2022). Certified, but not self-labelled, African ESG bonds carry lower spreads (Mutarindwa et al., 2024). In agriculture, climate risk works mainly through credit rationing rather than higher rates, and banking evidence, largely from short panels and simulations, points to weaker balance sheets. The findings are consistent with a climate-debt trap, in which vulnerability raises the cost, or reduces the availability, of the credit needed to reduce it. Priorities are observable investments in adaptive capacity and the pairing of agricultural credit with index insurance.

Keywords: Africa, agricultural finance, bank lending, climate risk, climate vulnerability, cost of credit, ESG, green bonds, sovereign bond spreads, transition risk.
JEL Classification: G12; G21; G28; Q54; O16; H63; F34

1.0 Introduction

Background and Motivation

Africa produces under 4% of global greenhouse gas emissions (Trisos et al., 2022) yet bears a disproportionate share of the damage: climate change already costs it 5–15% of per capita GDP growth (African Development Bank, 2022). It must raise an estimated USD 2.5-3 trillion by 2030 for adaptation and mitigation (Belianska et al., 2022), but tracked climate finance is about USD 30 billion a year, roughly 11% of the USD 277 billion needed annually (Meattle et al., 2022). Hence, our central question: do lenders charge African borrowers a climate-vulnerability surcharge that erodes the very investment needed to reduce vulnerability?

Markets have begun to price climate and environmental risks (Kling et al., 2018; Cevik & Jalles, 2020a, 2020b; Namwanja, 2023). Given Africa's high exposure, limited adaptive capacity and shallow financial markets, three concerns arise: a "climate-sovereign debt doom loop" in which rising debt service crowds out adaptation spending (Zenios, 2024); credit rationing that starves corporate and agricultural climate-resilient activity (Mohamed et al., 2026); and uncertainty over whether the financing discounts reported for green bonds and ESG instruments reach African issuers (Mutarindwa et al., 2024; Mustapha, 2025).

Research Questions, Approach, and Structure

We address four research questions. RQ1: Is climate and environmental risk associated with higher borrowing costs, or reduced credit access, for African sovereign, corporate, agricultural and bank

borrowers, and by how much? RQ2: Through which channels (physical risk, transition risk, signalling, institutional quality) does it operate? RQ3: How does the relationship vary by income, sector and institutional context? RQ4: Do certified green and ESG instruments lower borrowing costs for African issuers?

Following PRISMA 2020 (Page et al., 2021), two coders independently screened, extracted and quality-rated studies (2010-2026) empirically linking environmental risk to credit cost or access in Africa, or offering comparator evidence where African evidence is thin. Because the 86 included studies use incompatible outcomes, we synthesize them narratively by credit-market segment under the Synthesis Without Meta-analysis (SWiM) guideline (Campbell et al., 2020), reporting how far each finding rests on African data.

The review makes three contributions: it is, to our knowledge, the first to focus on the Africa-climate-credit nexus; it distinguishes physical from transition risk and their channels; and it compares five segments (sovereign debt, corporate credit, green and ESG bonds, agricultural finance, banking), separating African from global or non-African evidence.

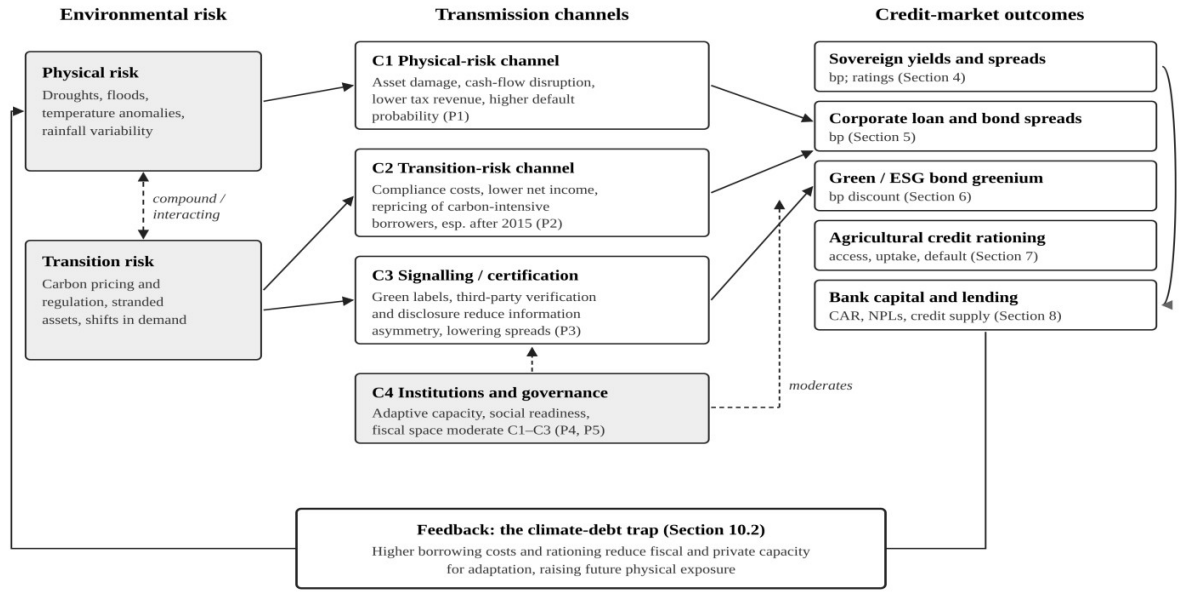
Section 2 sets out the theoretical channels and five predictions; Section 3 the methodology; Section 4 the findings by segment (4.1-4.5), each with a critical appraisal, and heterogeneity (4.6); and Section 5 the summary and conclusions: synthesis and policy implications (5.1), limitations and a research agenda (5.2), and the conclusion (5.3).

2.0 Literature Review

Following Buhr et al. (2018) and Cevik and Jalles (2020a, 2020b), environmental risk raises credit costs through four channels: physical risk, transition risk, signalling and certification, and institutions and governance (Figure 1). Physical hazards such as droughts and floods damage assets, disrupt cash flows and raise operating costs (Mohamed et al., 2026; Boehm, 2021). Sovereigns lose tax revenue, spend more and grow more slowly, raising default risk (Cevik & Jalles, 2020b); firms lose capital and face supply-chain disruption and higher insurance costs (Javadi & Al-Masum, 2020; Correa et al., 2020); and farmers' yields fall while default risk rises (Dlamini, 2011).

Under transition risk, decarbonization threatens carbon-intensive sectors with stranded assets (Bruno & Lombini, 2023a, 2023b); high emitters face rising compliance costs and lower distributable income, and lenders have increasingly reassessed them since the 2015 Paris Agreement (Bruno & Lombini, 2023a). Under signalling, green bonds and ESG labels reduce borrower–lender information asymmetry: credible ESG signals are associated with lower emerging-market sovereign spreads, and third-party certification curbs greenwashing in African markets (Mutarindwa et al., 2024; Immel et al., 2021; Avila-Yiptong et al., 2025). Under the institutional channel, better-governed states with greater adaptive capacity face lower costs and poorly governed states higher ones (Kling et al., 2018; Mohamed et al., 2026; Mdaghri et al., 2026).

Figure 1. Conceptual Framework: Channels from Environmental Risk to the Cost of Credit



Note. P1–P5 refer to the empirical predictions in Section 2.2. Dashed lines denote moderating or interacting effects; the grey arc denotes the sovereign–bank nexus.

Interactions Between Channels and Alternative Perspectives

The channels interact. A drought-hit sovereign loses fiscal space just as decarbonisation threatens its carbon-intensive export revenue (Zenios, 2022; Rahaman & Majid, 2026); institutional quality moderates both channels (Kling et al., 2018; Cevik & Jalles, 2020a); and through the sovereign–bank nexus, wider sovereign spreads impose losses on bank bond holdings and cut private lending (Mdaghri et al., 2026; Mohammed & Oladipo, 2025). Sections 4.1–4.5 should therefore be read as connected markets.

This asset-pricing framework, in which lenders price expected losses, is qualified by two alternative views. A political-economy view holds that prices also reflect how risk is assessed: ratings incorporate climate risk unevenly (Angelova et al., 2021; Klusak et al., 2023), and debt distress and the international financial architecture shape market access (Gallagher et al., 2024; Volz, 2025), so part of any "climate premium" may be perceived rather than actuarial. A behavioural view stresses salience: lenders raise loan rates in years of highly publicised climate reports even when fundamentals are unchanged (Correa et al., 2020), so pricing can lag risk and then jump. Both imply that observed premiums are imperfect measures of exposure (Section 5.1).

Empirical Predictions

The channels yield five predictions: P1 (physical risk), greater vulnerability raises sovereign, corporate and agricultural borrowing costs or reduces credit access (Sections 4.1, 4.2, 4.4); P2 (transition risk), carbon-intensive borrowers pay more, especially after the 2015 Paris Agreement (Section 4.2); P3 (signalling), certified green and ESG instruments carry a negative "greenium" (Section 4.3); P4 (heterogeneity), effects are larger in low-income, fragile and exposed settings (Section 4.6); and P5 (institutions), strong governance and adaptive capacity attenuate premiums (Sections 4.1, 4.6). Table 8 (Section 5.1.1) gives the verdicts.

3.0 Methodology

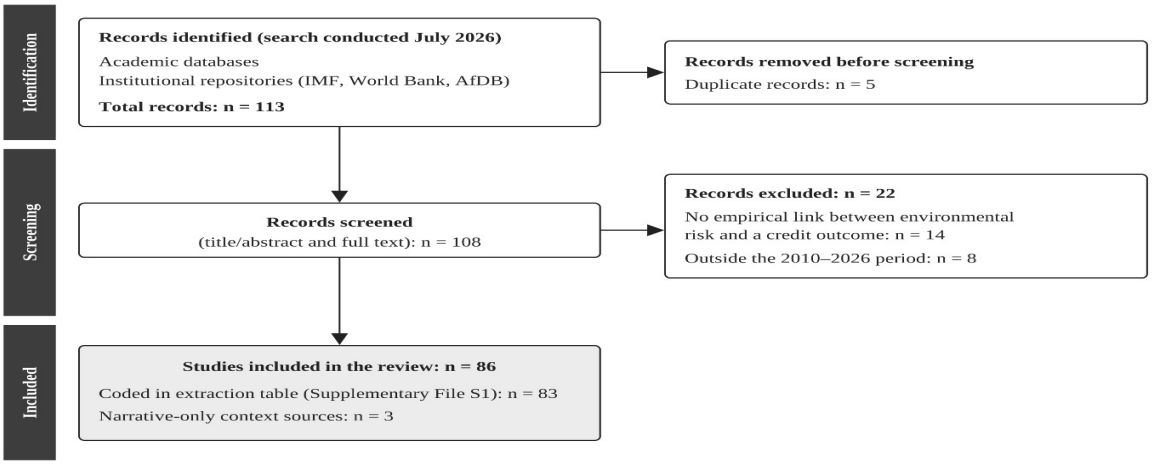
Literature Search and Selection

We searched five academic databases (Google Scholar, PubMed, Web of Science, Scopus and EconLit) and the IMF, World Bank and African Development Bank repositories for January 2010 to June 2026. The primary search string, adapted to each database, was: ("climate risk" OR "climate vulnerability" OR "environmental risk" OR "carbon emissions" OR "ESG" OR "green bond" OR "physical risk" OR "transition risk") AND ("cost of credit" OR "loan spread" OR "bond spread" OR "borrowing cost" OR "interest rate" OR "sovereign yield" OR "credit risk" OR "capital adequacy") AND ("Africa" OR "Sub-Saharan Africa" OR "Nigeria" OR "South Africa" OR "Kenya" OR "Ghana" OR "Ethiopia" OR "Mozambique" OR "Uganda" OR "Mali" OR "SADC" OR "ECOWAS").

Eligible studies (i) were journal articles, working papers, institutional reports, book chapters or theses; (ii) presented empirical analysis, reviews of empirical evidence, or evidence-based policy analysis linking environmental or climate risk to credit cost or access; (iii) were published in 2010–2026; and (iv) covered African countries or, where African evidence was absent or thin, provided comparator evidence on the mechanism. Excluding studies lacking a credit measure (14), outside the time scope (8) and duplicates (5) left 86 studies. Of the 83 coded studies, 37 use African samples only, 17 multi-country samples explicitly including Africa, and 29 global or non-African comparator samples (Appendix A.2); Sections 4.1–4.5 keep these groups distinct.

Two coders, the author (Coder 1) and a second coder (Coder 2; see Acknowledgements), independently screened, assessed, extracted and rated every record using the same criteria, form and rubric. They agreed on 83 of the 86 included sources (96.5%; Krippendorff's alpha ≈ 0.94) across inclusion, coding and quality tiers; the three disagreements were resolved by discussion, and consensus values are reported. Figure 2 gives record counts and exclusion reasons at each stage.

Figure 2. Study Identification, Screening and Inclusion



Note. Adapted from the PRISMA 2020 flow diagram (Page et al., 2021).

Data Extraction and Coding

The standardized extraction form (Appendix A.3) recorded authorship, outlet, sample period, coverage, design, environmental risk measure (e.g., ND-GAIN or another vulnerability index,

hazard indicators, emissions, ESG scores), credit measure (sovereign yields or spreads, bond or loan spreads, interest rates, credit access, bank capital), effect direction, size and unit, significance, segment and quality tier. The review used a fully controlled model with robust standard errors, where reported, and coded direction only, without imputing magnitude when size was unavailable. Eighty-three studies were coded (Appendix A.2); the other three (Avila-Yiptong et al., 2025; Gemayel et al., 2025; Rusike & Alagidede, 2021) provide market context for the narrative synthesis.

Synthesis Approach

A meta-analysis would be misleading for four reasons. Outcomes are on incompatible scales (basis points of yield or spread, default probability, capital adequacy, non-performing loans, probability of obtaining credit); only 14 of the 83 coded studies report a numerical effect size, and very few report the standard errors needed for inverse-variance weighting; several estimates share author teams and overlapping samples (e.g., Cevik & Jalles, 2020a, 2020b; Beirne et al., 2020, 2021; Bruno & Lombini, 2023a, 2023b); and Africa-specific price estimates are too few to pool, with none for corporate spreads and only two for sovereign or green bond spreads (Mustapha, 2025; Mutarindwa et al., 2024). Following SWiM (Campbell et al., 2020), we group studies by segment, vote-count effect directions, report magnitudes in original units, and state whether each finding rests on African, multi-country or comparator samples. Units are basis points (bp) unless labelled otherwise (e.g., percentage points, pp); point estimates are as published, with confidence intervals only where provided.

Quality Assessment

Both coders rated each study on a rubric adapted from Cochrane and Campbell Collaboration guidance, covering internal validity (identification, confounders, endogeneity, robustness), external validity (sample size, relevance to African credit markets) and reporting quality, assigning a high, medium or low tier (Table 1). Tiers reflect design, not publication status, so a well-identified working paper can receive a high rating; the outlet is assessed in Section 3.5, and disagreements were resolved as in Section 3.1.

Table 1:

Distribution of Coded Studies by Quality Tier (n = 83)

Quality Tier	Number of Studies	Criteria Met
High	44	Credible identification strategy; controls for confounders; robustness checks; adequate sample.
Medium	34	Standard panel or regression design with limited robustness checks, or a transparent review or policy analysis.
Low	5	Small samples; limited controls; case-study or descriptive design; or an unverified or non-specialist outlet.

Note. *Tiers are the consensus ratings of the two coders for the 83 coded studies, after resolution of the three disagreements; the three narrative-only context sources were not coded.*

Source: Authors' Computation, 2026.

Source Quality and Sensitivity Analysis

As the literature is young, grey literature is substantial: of the 83 coded studies, 51 are journal articles, 24 are working papers or preprints, 3 are institutional reports, 3 are books or chapters, and 2 are theses. IMF, central bank, and research-institute working papers (e.g., Kling et al., 2018;

Cevik & Jalles, 2020a, 2020b) were retained as among the most rigorous estimates, though they may change before publication. Three sources from outlets outside specialist finance and economics indexing (Mustapha, 2025; Bila, 2025; Mohammed & Oladipo, 2025) are treated as preliminary, flagged wherever cited, and never the sole basis for a headline conclusion.

In a sensitivity test, 58 of the 64 coded studies with an assessable direction (91%) report effects consistent with climate-risk pricing; the share is similar for specialist peer-reviewed journals only (38 of 41; 93%) and excluding low-quality studies (55 of 61; 90%). The direction of evidence thus does not hinge on grey or low-quality sources, though magnitudes are more fragile (Sections 4.1–4.5).

4.0 Findings

Sovereign Debt Markets: Climate Vulnerability and Borrowing Costs

Sovereign debt shows the strongest evidence of climate-risk pricing: more vulnerable countries pay 10 to 117 bp more, depending on measure and sample (Kling et al., 2018; Cevik & Jalles, 2020a, 2020b; Beirne et al., 2020).

Using ND-GAIN for 40 emerging economies (15 African) over 1995–2016, Kling et al. (2018) find that V20 Climate Vulnerable Forum members pay 117.4 bp more on sovereign debt, over USD 62 billion in extra interest in 2007–2017; social readiness (education, health, infrastructure) offsets about 57% of this premium.

Across 98 countries (1995–2017), sovereign yields and spreads rise with climate vulnerability, especially in developing economies (Cevik & Jalles, 2020b); in 54 emerging markets, positive temperature deviations worsen bond performance and ratings, more so in hotter, less seasonal countries and less so where institutions are strong (Cevik & Jalles, 2020a). Default probability in the most vulnerable countries rises 2–3 pp per 1°C of warming (Boehm, 2021), and vulnerable developing countries pay an extra USD 1 per USD 10 of sovereign interest (about 10%), a burden set at least to double without more adaptation investment (Buhr et al., 2018).

Sparse evidence from Africa follows the global pattern. Green financing and lower ESG risk reduced Kenyan Eurobond spreads (Mustapha, 2025), a preliminary single-country finding, but consistent with evidence that emerging-market and African Eurobond spreads price country-specific risk (Avila-Yiptong et al., 2025; Rusike & Alagidede, 2021). Climate risk reduces private credit in fragile, climate-stressed Sub-Saharan states (Mohamed et al., 2026), and climate and carbon risk affect long-run banking stability in SADC countries (Mufandaedza, 2025).

Three mechanisms drive the premium: physical shocks weaken fiscal balances (Cevik & Jalles, 2020b; Boehm, 2021); projected damage lowers ratings (Klusak et al., 2023; Cevik & Jalles, 2020a); and vulnerable sovereigns face rollover stress and possible loss of market access (Kling et al., 2018). Indirectly, the sovereign bank nexus limits private lending (Mdaghri et al., 2026; Mohammed & Oladipo, 2025).

Critical appraisal. Direction is consistent: 15 of 16 sovereign studies with an assessable direction find that vulnerability raises borrowing costs or worsens creditworthiness. African magnitude is uncertain: no price estimate isolates African sovereigns; the 117.4 bp figure is a V20 effect from a sample where African countries are a minority; the 10–117 bp range spans very different measures (Beirne et al., 2020); key estimates are working papers by overlapping teams; and the only Africa-specific yield estimate (Mustapha, 2025) is preliminary. ND-GAIN and similar indices

also correlate with income, governance, and debt, so part of the premium may reflect development rather than climate risk. The safest reading is that climate vulnerability is priced in emerging-market sovereign debt; African sovereigns, among the most vulnerable, are likely affected, and an African premium has yet to be estimated directly.

Table 2:
Summary of Extracted Studies - Sovereign Debt Markets

Study	Country / Region	Method	Effect Size	Significant
Li et al. (2022)	174 countries (global, includes Africa)	Panel regression (FE, GMM)	N/A	Yes
Kling et al. (2018)	40 emerging markets (incl. 15 African)	Panel OLS + PCA; ND-GAIN indices	**+117.4 bp (1.174 pp) for V20 countries**	Yes
Buhr et al. (2018)	Developing countries (including Africa)	Policy report / synthesis	**~$1 extra per $10 interest paid (~10%)**	Yes
Cevik & Jalles (2020b)	98 countries (global incl. Africa)	Panel regression (FE, RE, GMM)	Significant; larger in developing countries	Yes
Cevik & Jalles (2020a)	54 emerging markets (incl. Africa)	Monthly panel regression	Significant; larger for hotter, less seasonal countries	Yes
Beirne et al. (2020)	Global (incl. Africa)	Panel regression	**10-117 bp range across sample**	Yes
Boehm (2021)	Emerging economies (incl. Africa)	Panel regression	**+2-3 pp default probability per 1°C increase**	Yes
Beirne et al. (2021)	Southeast Asia	Panel regression	Significant; larger in low-institution countries	Yes
Volz (2025)	Global (developing country focus)	Policy/analytical review	N/A	N/A
Klusak et al. (2023)	Global (all rated sovereigns incl. Africa)	Rating agency methodology + climate projections	**Multiple notch downgrades by 2100**	Yes
Zenios (2024)	Global (theoretical review)	Literature review / analytical framework	N/A (framework)	N/A
Rahaman & Majid (2026)	Emerging markets and developing economies	Fiscal reaction function; panel data	N/A	Yes
Angelova et al. (2021)	Global (rating methodology review)	Comparative methodology analysis	N/A	N/A
Zenios (2022)	Global (incl. Africa)	Risk analysis / scenario analysis	N/A	N/A

Anyfantaki et al. (2025)	Global	Cross-country empirical analysis	Not reported in abstract	N/A
Cappiello et al. (2025)	Global	Rating-methodology analysis	Not reported in abstract	N/A
Capriotti & Muzzioli (2026)	Euro Area	Empirical analysis	Not reported in abstract	N/A
Collender et al. (2023)	Global	Panel analysis	Not reported in abstract	N/A
Gallagher et al. (2024)	Sub-Saharan Africa	Policy/empirical analysis	Not reported in abstract	N/A
Leykun (2024)	Sub-Saharan Africa	Panel analysis	Not reported in abstract	N/A
Porenta & Rant (2025)	Global (development banks)	Empirical analysis	Not reported in abstract	N/A
Şeker & İşgüven (2025)	62 countries (global)	Panel regression	Asymmetric by rating tier	Yes
Wollenweber et al. (2026)	Global (Africa/Asia focus)	Cross-country modeling	Not reported in abstract	N/A

Note. Applies to Tables 2–6. Effect sizes in bold are statistically significant numerical estimates in the primary study. Units are basis points (bp) of yield or spread unless otherwise stated; pp = percentage points. "Not reported in abstract" indicates that no effect size could be extracted; no values were imputed.

Source: Authors' Computation, 2026.

Corporate Credit Markets: Transition Risk and Carbon Pricing

Corporate credit markets increasingly price transition risk, and carbon-intensive firms have paid wider spreads since the Paris Agreement (Bruno & Lombini, 2023a; Seltzer, 2022).

In U.S. corporate bonds (2009–2017), each 1-point cut in environmental score reduced spreads by 0.9–1.4 bp, while carbon intensity added 16.2 bp; post-Paris, spreads rose by 38 bp for carbon-intensive firms and 91.1 bp for poorly rated, highly regulated ones (Seltzer, 2022). Transition risk raises syndicated-loan pricing most for the most exposed borrowers (Bruno & Lombini, 2023b), and drought exposure widened U.S. corporate spreads, mainly via costlier long-term loans to low-rated borrowers (Javadi & Al-Masum, 2020). Banks charge indirectly affected borrowers 8 bp more after disasters and 17 bp after major climate reports, costing U.S. borrowers over USD 250 million a year (Correa et al., 2020).

Evidence on African corporate governance is limited but indicative. South African banks' short-term lending carries more carbon risk than long-term lending, concentrated in Energy and Materials, suggesting lenders recognize transition risk but cannot price long-term exposures (Bimha, 2015). Ghanaian banks' indirect environmental risk stems mainly from mining, and non-agricultural environmental risk substantially affects non-performing loans (Antwi et al., 2020). South African banks increasingly attend to environmental credit risk but have yet to fully implement sustainable practices (Dlamini, 2011).

Sectoral differences are sharp: transition (and some physical) risk hits energy, materials and heavy manufacturing hardest, with little effect on financial services and technology (Bimha, 2015; Bruno & Lombini, 2023a, 2023b), while agriculture faces mainly physical risk (Section 4.4).

Critical appraisal. Sixteen of 18 corporate studies support the hypothesized direction, but 15 use global or non-African samples and every spread estimate above is from U.S. data. The 8–91 bp range is thus a benchmark for a deep, disclosure-rich market, not an African estimate. Transferability cuts both ways: thin bond markets and reliance on bank credit may mute observable spread effects, while weak disclosure may prompt blunt sector premiums or rationing. African evidence (Bimha, 2015; Antwi et al., 2020; Bell & van Vuuren, 2022) is descriptive or simulation-based, showing awareness of carbon risk without pricing it, making corporate credit the segment with the widest gap between global and African evidence.

Table 3:
Summary of Extracted Studies - Corporate Credit Markets

Study	Country / Region	Method	Effect Size	Significant
Bimha (2015)	South Africa	Sectoral analysis; public disclosures	N/A (qualitative concentration)	Descriptive
Bruno & Lombini (2023b)	Global (including Africa)	Panel regression; IV estimation	Significant; concentrated in highly vulnerable borrowers	Yes
Javadi & Al-Masum (2020)	United States	Panel regression	Significantly higher spreads for drought-exposed firms	Yes
Ge et al. (2024)	International (multi-country)	Panel regression	Significant; amplified by disclosure quality	Yes
Fard et al. (2019)	International (multi-country)	Panel regression	Significant spread divergence	Yes
Correa et al. (2020)	United States	Panel regression; difference-in-differences	**+8 bp (indirect borrowers' post-disaster); +17 bp (year of major climate report)**	Yes
Bruno & Lombini (2023a)	Global (syndicated loans)	Panel regression; IV	Non-linear; concentrated in high-exposure borrowers	Yes
Seltzer (2022)	United States	Panel regression	**+16.2 bp per ton/$1K revenue; +38 bp post-Paris (top emitters); up to +91.1 bp**	Yes
Henisz & McGlinch (2019)	Global (multi-sector firms)	Event study; regression	Significant	Yes
Gianfrate (2020)	Global corporate	Market-based analysis (distance-to-default)	N/A	Yes

Bell & van Vuuren (2022)	South Africa (corporate)	Geometric Brownian Motion simulation	N/A (scaling factors estimated)	Yes
Becker et al. (2025)	Global	Panel regression (bank loan-level)	Not reported in abstract	Yes
Chen et al. (2025)	Europe	Empirical study (rating agencies)	Not reported in abstract	N/A
Dimitras et al. (2024)	United States	Panel regression	Not reported in abstract	Yes
Hale et al. (2024)	Global / US banks	Loan-portfolio analysis	Not reported in abstract	N/A
Ho & Wong (2023)	Emerging economies	Panel regression	Not reported in abstract	Yes
Kempa (2026)	Not specified	Panel regression	Not reported in abstract	Yes
Salachas et al. (2026)	Not specified	Panel regression	Not reported in abstract	Yes

Source: Authors' Computation, 2026.

Green Bonds and ESG Premiums in African Markets

Green bonds and ESG instruments can lower borrowing costs through positive signalling, with a larger "greenium" in emerging markets (Ando et al., 2024; Immel et al., 2021).

The sovereign greenium averages 4 bp in advanced and 11 bp in emerging economies (Ando et al., 2024). Across 107 African ESG bonds (2010–2023), certified bonds show lower spreads and volatility but self-labelled bonds do not, underlining the need for credible verification (Mutarindwa et al., 2024). Kenyan Eurobonds show a similar pattern (Mustapha, 2025), though this is unreplicated and preliminary; credible ESG signalling also lowers emerging-market sovereign spreads (Avila-Yiptong et al., 2025), and African green bond markets are growing (Gemayel et al., 2025).

The global corporate green bond premium is −8 to −14 bp, with governance mattering more than the environmental pillar of ESG scores (Immel et al., 2021). Across 1,206 green bonds (2012–2022), financial and low-emission issuers improve their credit risk while high-emission issuers may not (Ballester & González-Urteaga, 2023).

Unlike some developed markets, where self-labelled bonds also earn modest premiums, Africa rewards only certified bonds, implying greater information asymmetry (Mutarindwa et al., 2024); with environmental risk poorly understood by many African banks, third-party certification is critical (Lindlein, 2012; Köhn, 2012). Markets remain underdeveloped, constrained in Mozambique by weak investor interest, inadequate regulation, currency risk and a thin project pipeline (Bila, 2025), and across Sub-Saharan Africa by political risk, currency volatility and scarce institutional investors (Michoud & Hafner, 2021).

Critical appraisal. The 4–14 bp greenium estimates are global (Ando et al., 2024; Immel et al., 2021). The key African study (Mutarindwa et al., 2024) is rigorous and confirms the direction for certified bonds but offers no comparable magnitude. Seven of 12 green-finance studies document

barriers rather than prices, and one (Emara et al., 2025) measures poverty rather than credit costs. The certification result is the segment's most policy-relevant finding, but its size, and whether it holds in local-currency markets, remain open; successful issuances such as Kenya's show feasibility, not a measured price benefit.

Table 4:
Summary of Extracted Studies - Green Bonds and ESG Instruments

Study	Country / Region	Method	Effect Size	Significant
Mutarindwa et al. (2024)	Africa (pan-continental)	Panel regressions; spread/volatility analysis	Significant negative; non-certified = no benefit	Yes
Mustapha (2025)	Kenya	Time-series regression; event study	Significant negative	Yes
Ando et al. (2024)	Global sovereign green bonds	Comprehensive greenium estimation	**-4 bp (advanced economies); -11 bp (emerging markets)**	Yes
Ballester & González-Urteaga (2023)	Global (multi-country)	Event study; CDS/spread analysis	Varies by issuer type and sector	Yes
Immel et al. (2021)	Global corporate bonds	Cross-sectional regression	**-8 to -14 bp (green label); -6 to -13 bp per ESG point**	Yes
Bila (2025)	Mozambique	Case study	N/A	N/A (qualitative)
Michoud & Hafner (2021)	Sub-Saharan Africa	Policy/market analysis	N/A	N/A
Belianska et al. (2022)	Sub-Saharan Africa	IMF policy analysis	USD 2.5-3 trillion needed by 2030	N/A
Cheteni et al. (2024)	South Africa	Market/policy analysis	N/A (qualitative)	N/A
Dave & Akongwale (2024)	South Africa	Investor survey/analysis	N/A (qualitative)	N/A
Emara et al. (2025)	MENA and SSA (73 countries)	Panel regression	**1% issuance -> -0.13% poverty headcount**	Yes
Lwesya (2025)	Africa (continental)	Literature review	N/A	N/A

Source: Authors' Computation, 2026.

Agricultural Finance: Weather Shocks and Credit Rationing

Agricultural credit is most directly exposed to climate risk, given rain-fed production, thin insurance, and scarce collateral. All 13 agricultural studies use African samples, making this

Africa's best-evidenced segment, though they focus more on access than on price. Climate risk operates through lender rationing, borrower withdrawal, and lost adaptation investment (Namwanja, 2023; Abay et al., 2021; Ojo & Baiyegunhi, 2020).

Supply-Side Rationing

When poor information and small loans prevent lenders from pricing weather risk, theory predicts quantity rationing rather than higher rates (Stiglitz & Weiss, 1981), as African evidence confirms. Excess harvest rainfall raises microfinance default in Madagascar (Pelka et al., 2015); Ugandan creditors tighten lending and exclude affected debtors after shocks, especially alongside crises such as COVID-19 (Namwanja, 2023); rationed Kenyan households turn to informal lenders (Nasr, 2017); and about 96% of northern Nigerian farmers seeking adaptation credit could not obtain it (Abraham & Fonta, 2018).

Demand-Side Risk Rationing

Farmers also withdraw when a bad season could cost them their collateral: Ethiopian households in the most rainfall-variable arid and semi-arid areas take up the least credit (Abay et al., 2021), and in Mali moderate weather risk raises precautionary borrowing while extreme rainfall reduces it (Meißner et al., 2024).

Consequences for Adaptation

Rationing matters because credit finances adaptation. Constrained rice farmers in South-West Nigeria adopt fewer adaptation strategies (Ojo & Baiyegunhi, 2020), unconstrained farmers there use about 1.6 times as many (Olutumise, 2023), and constrained farmers in Kenya, Nigeria and Tanzania suffer larger unmet fertilizer needs and crop losses (Coffie et al., 2026); conversely, Fadama II participants facing greater rainfall risk invested more in irrigation pumps (Takeshima & Yamauchi, 2010). Partial remedies include informal credit, linked to greater perceived resilience in northern Ghana (Batung et al., 2022), credit assessment that values climate-resilient assets (Jonas et al., 2025), and earth-observation-based drought financing to underpin weather-indexed credit (Fava & Vrieling, 2024).

Critical Appraisal

Eleven of 12 agricultural studies with an assessable direction find that climate risk restricts credit or that restricted credit impairs adaptation. The weakness is design: most are single-region cross-sectional surveys, nine of 13 are medium quality, and few separate supply- from demand-side rationing. Since the dominant response is rationing, not repricing, interest rates alone would understate the cost to African farmers, making agriculture the clearest case for counting lost access as part of the cost of credit.

Table 5:

Summary of Extracted Studies - Agricultural Finance

Study	Country / Region	Method	Effect Size	Significant
Nasr (2017)	Kenya	Simultaneous 3SLS	N/A (access measure)	Yes
Namwanja (2023)	Uganda	Case analysis / panel	N/A (qualitative)	Yes
Takeshima & Yamauchi (2010)	Nigeria	Panel data regression (matched program data)	N/A	Yes

Batung et al. (2022)	Ghana (Upper West Region)	Cross-sectional survey; ordered logistic regression	N/A	Yes
Abay et al. (2021)	Ethiopia	Household-level econometric analysis	Significant reduction in uptake	Yes
Pelka et al. (2015)	Madagascar	LPM + sequential logit (MFI loan data)	Significant increase in default probability	Yes
Meißner et al. (2024)	Mali	3SLS; admin loan data + weather	N/A (loan amount measure)	Yes
Fava & Vrieling (2024)	Sub-Saharan Africa (pastoral)	Review of EO-based drought financing	N/A	N/A
Abraham & Fonta (2018)	Nigeria (northern)	Survey-based analysis	~96% seeking credit unable to access it	N/A
Coffie et al. (2026)	Kenya, Nigeria, Tanzania	Cross-country econometric analysis	Not reported in abstract	Yes
Jonas et al. (2025)	South Africa	Survey-based analysis	Not reported in abstract	Yes
Ojo & Baiyegunhi (2020)	Nigeria (South-West)	Cross-sectional survey; regression	Not reported in abstract	Yes
Olutumise (2023)	Nigeria (Southwest)	Endogenous treatment Poisson regression	**~1.6x more adaptation strategies**	Yes

Source: Authors' Computation, 2026.

Banking Sector Responses and Risk Management

African banks must manage climate risk in their existing portfolios while financing adaptation and mitigation, and their responses are emerging but uneven. Climate risk amplifies the adverse effect of credit risk on African banks' liquidity creation, particularly in low- and lower-middle-income countries, among small banks, and in the pre-COVID-19 period (Mdaghri et al., 2026). In a stress test, capital adequacy falls from 11.58% to 7.97% under a moderate shock and 4.83% under a severe one, with flood risk more damaging than transition risk (7.40% under a severe flood) (Mohammed & Oladipo, 2025). In SADC, a 1% rise in non-performing loans cuts financial stability by 2.03–2.09%, and green credit, a proposed mitigant, is insignificant (Mufandaedza, 2025).

Beyond the sectoral exposures in Section 4.2, domestic and foreign Ghanaian banks differ in their environmental risk (Antwi et al., 2020). Outside South Africa, where banks are beginning to address it (Dlamini, 2011), understanding of environmental credit risk in African banking is poor (Lindlein, 2012; Köhn, 2012). A puzzling inverse short-run link between biodiversity loss and non-performing loans in Sub-Saharan Africa suggests macroeconomic factors currently dominate (Okoyeuzu & Ukpere, 2022).

Across 174 countries, climate risk shifts credit from the private to the public sector, more so in high-income countries (Li et al., 2022); in fragile Sub-Saharan economies, climate hazards likewise cut private credit once risk becomes evident (Mohamed et al., 2026).

Explaining The Mixed Evidence

Banking results diverge most in terms of which income groups are most affected (Li et al., 2022; Mdaghri et al., 2026), the sign of the biodiversity link (Okoyeuzu & Ukpere, 2022), and the role of green credit (Mufandaedza, 2025). Four study features explain most of this. Outcomes differ: credit supply, liquidity creation, non-performing loans, stability indices, and capital ratios respond over different horizons. Risk measures differ: emissions and biodiversity loss track economic activity as much as hazard, which can yield inverse associations, whereas hazard and temperature measures produce the expected rise in non-performing loans (Damette et al., 2026; Ntsaila & Hloele, 2026). Horizons differ: ARDL models separate short- and long-run effects, and Okoyeuzu and Ukpere (2022) find a positive long-run link. Samples differ in income and bank size (Mdaghri et al., 2026).

Critical Appraisal

Twelve of 13 banking studies with an assessable direction find that climate risk weakens balance sheets or lending, mostly on African data. The largest magnitudes, however, come from one simulated stress test in a non-specialist outlet (Mohammed & Oladipo, 2025), with capital adequacy falling 3.6 pp (moderate shock) and 6.8 pp (severe). These reflect assumed scenarios, not observed losses, and are illustrative until replicated with supervisory data. Several South African studies are unreviewed central bank working papers (Bongini et al., 2025; Chiappini et al., 2025).

Table 6:
Summary of Extracted Studies - Banking Sector

Study	Country / Region	Method	Effect Size	Significant
Mohamed et al. (2026)	Sub-Saharan Africa (Fragile States)	Panel regression	N/A (directional)	Yes
Mufandaedza (2025)	SADC (Southern Africa)	Panel regression (DOLS, FMOLS)	**1% increase in NPL -> -2.09% to -2.03% financial stability**	Yes
Dlamini (2011)	South Africa	Qualitative case study / survey	N/A	Descriptive
Mdaghri et al. (2026)	Africa (panel)	Panel regression (GMM)	N/A	Yes
Antwi et al. (2020)	Ghana	Survey; OLS regression	N/A	Yes (all sectors except agriculture)
Okoyeuzu & Ukpere (2022)	Sub-Saharan Africa	Panel regression (ARDL, PMG)	N/A	Partial

Mohammed & Oladipo (2025)	Africa (panel)	Climate stress testing	**CAR: 11.58% -> 7.97% (moderate); 4.83% (severe); 7.40% (extreme flood)**	Yes (simulated)
Lindlein (2012)	Developing countries (including Africa)	Literature review / policy analysis	N/A	N/A
Köhn (2012)	Developing countries	Edited volume / literature review	N/A	N/A
de Bandt et al. (2024)	Global (literature review)	Systematic literature review	Most empirical estimates <50 bp	Majority significant
Bongini et al. (2025)	South Africa	Text-based indicator + panel regression	Not reported in abstract	Yes
Chiappini et al. (2025)	South Africa	SARB working paper analysis	Not reported in abstract	N/A
Damette et al. (2026)	51 countries incl. SSA	Panel regression	Not reported in abstract	Yes
Mbotho & Zhou (2025)	South Africa	Time-series analysis	Not reported in abstract	Yes
Ntsaila & Hloele (2026)	Lesotho, Eswatini, Namibia	Panel/time-series analysis	Not reported in abstract	Yes
Takawira et al. (2026)	SADC (Southern Africa)	Panel regression	Not reported in abstract	Yes
Jin et al. (2025)	Global (cross-country)	Panel regression	Not reported in abstract	Yes

Source: Authors' Computation, 2026.

Heterogeneity Analysis: Income, Geography, and Institutions

Effects vary with income: premiums are larger in developing than advanced economies (Kling et al., 2018; Cevik & Jalles, 2020b), largest for V20 members (117.4 bp), and the climate-amplified credit risk–liquidity nexus is strongest in low- and lower-middle-income African countries (Mdaghri et al., 2026; Rahaman & Majid, 2026). The exception, stronger credit-supply effects in high-income countries (Li et al., 2022), may reflect more visible adjustment in deeper markets (Section 4.5). Within Africa, effects peak in arid and semi-arid areas (Abay et al., 2021; Batung et al., 2022) and the most fragile states (Mohamed et al., 2026). Institutions are the main moderator: social readiness cuts the sovereign premium by 57% (Kling et al., 2018), stronger institutions dampen bond responses to climate shocks (Cevik & Jalles, 2020a; Beirne et al., 2021), and governance modestly mitigates climate effects on African banks (Mdaghri et al., 2026).

Effects also vary by sector and time. Transition risk concentrates in energy, materials, mining, construction, and oil and gas (Bimha, 2015; Antwi et al., 2020), while agriculture faces physical risk; transition-risk pricing strengthened after Paris 2015 (Seltzer, 2022; Bruno & Lombini, 2023a),

and some African banking effects were stronger before COVID-19 displaced other risk factors (Mdaghri et al., 2026).

Effects are thus strongest in low-income, fragile, dry, and carbon-intensive settings, and are moderated chiefly by institutional quality and adaptive capacity (Rahaman & Majid, 2026).

5.0 Summary and Conclusions

Tables 7 and 8 summarise the segments and test the predictions in Section 2.3. Three patterns stand out. First, direction is highly consistent: 58 of 64 coded studies with an assessable direction (91%) support climate-risk pricing. Second, the evidence is least African where it is most precise about price: basis-point estimates come mainly from global, emerging-market or U.S. samples, while the largely African agricultural and banking evidence measures access, defaults and stability. Third, the penalty's form differs: sovereigns and large firms in priced markets face premiums, smallholders and small firms in thin-information, relationship-based markets face rationing, and banks transmit both via the sovereign–bank nexus. The African cost of credit thus combines price and quantity effects, and spread-only estimates likely understate it.

Table 7:
Cross-Segment Summary of the Evidence

Segment	Studies coded (Africa-only / incl. Africa / comparator)	Direction consistent / assessable	Main outcome and unit	Reported magnitude (source)	Confidence in African evidence
Sovereign debt	23 (2 / 12 / 9)	15 / 16	Yield or spread (bp); default probability (pp); rating notches	+117.4 bp for V20 members (Kling et al., 2018); 10–117 bp range (Beirne et al., 2020); +2–3 pp default probability per 1°C (Boehm, 2021)	Moderate for direction; low for magnitude
Corporate credit	18 (2 / 1 / 15)	16 / 18	Loan or bond spread (bp)	+8 to +17 bp (Correa et al., 2020); +38 bp post-Paris, up to +91.1 bp (Seltzer, 2022); all United States samples	Very low: no African price estimate
Green and ESG bonds	12 (8 / 1 / 3)	4 / 5	Spread discount (bp)	−4 bp advanced, −11 bp emerging markets (Ando et al., 2024); −8 to −14 bp (Immel et al., 2021); lower spreads for certified African bonds only (Mutarindwa et al., 2024)	Low
Agricultural finance	13 (13 / 0 / 0)	11 / 12	Credit uptake, access and default (probabilities)	About 96% of adaptation-credit seekers unable to borrow (Abraham & Fonta, 2018); higher default after excess rain (Pelka et al., 2015)	Moderate for rationing; no price evidence
Banking	17 (12 / 3 / 2)	12 / 13	Capital adequacy (pp); NPLs;	CAR −3.6 pp (moderate) to −6.8 pp (severe), simulated (Mohammed & Oladipo,	Low

Segment	Studies coded (Africa-only / incl. Africa / comparator)	Direction consistent / assessable	Main outcome and unit	Reported magnitude (source)	Confidence in African evidence
			credit supply	2025); 1% NPL rise → 2.03–2.09% lower stability (Mufandaedza, 2025)	
All segments	83 (37 / 17 / 29)	58 / 64			

Note. Africa-only = sample of African countries only; incl. Africa = multi-country sample explicitly including African countries; comparator = global or non-African sample without stated African coverage. Direction = studies whose effect is consistent with the hypothesized pricing of climate risk (or, for green bonds, a discount), out of studies with an assessable direction. Confidence is the author's judgment based on the number of African-sample studies, design, and quality tier. Segment assignment follows Tables 2–6; Jin et al. (2025) is assigned to the banking segment. bp = basis points; pp = percentage points; CAR = capital adequacy ratio; NPL = non-performing loan.

Source: Authors' Computation, 2026.

Table 8:
Assessment of the Empirical Predictions

Prediction	Verdict	Main evidence
P1 Physical risk raises borrowing costs or restricts credit	Supported in direction; African magnitude not established	Sections 4.1 and 4.4; Kling et al. (2018); Abay et al. (2021); Pelka et al. (2015)
P2 Carbon-intensive borrowers pay more, especially after 2015	Supported in comparator markets; untested in Africa	Section 4.2; Seltzer (2022); Bruno & Lombini (2023a)
P3 Certified green instruments carry a greenium	Supported for certified instruments only	Section 4.3; Ando et al. (2024); Mutarindwa et al. (2024)
P4 Effects are larger in low-income, fragile and exposed settings	Largely supported; one contrary finding	Section 4.6; Kling et al. (2018); Mdaghri et al. (2026); contra Li et al. (2022)
P5 Strong institutions attenuate premiums	Supported	Sections 4.1 and 4.6; Kling et al. (2018); Cevik & Jalles (2020a)

Source: Authors' Computation, 2026.

The Climate-Debt Trap

These findings describe a climate-debt trap: vulnerability raises borrowing costs and narrows fiscal and private capacity for adaptation, and under-adaptation raises future damage, credit risk, and borrowing costs (Zenios, 2022, 2024). It is most acute for sovereigns: V20 countries paid over USD 62 billion in excess interest in a decade (Kling et al., 2018), funds that could have financed adaptation. Because it operates through both rationing and price, the trap can bind even when spreads look modest.

Policy Implications

We rank responses by strength of evidence and directness against the trap: Priority 1 rests on consistent evidence and acts directly; Priority 2 rests on evidence consistent in direction but thin for Africa; Priority 3 is plausible but needs evaluation before scaling.

Priority 1: invest in adaptive capacity and make it visible to markets (finance ministries and development partners). Social readiness offsets about 57% of the sovereign premium (Kling et al., 2018), and strong institutions dampen bond responses to shocks (Cevik & Jalles, 2020a). Debt strategies and investor presentations should report adaptation spending and resilience indicators so that rating agencies and investors can price them (Klusak et al., 2023).

Priority 1: pair agricultural credit with risk transfer (central banks, development finance institutions and insurers). Since farmers are mainly rationed, lenders' exposure to covariate weather shocks should be reduced by bundling loans with weather-index insurance triggered by earth-observation data (Fava & Vrieling, 2024) and recognizing climate-resilient assets in credit assessment (Jonas et al., 2025); rural savings and credit cooperatives can fill gaps when formal lenders withdraw (Batung et al., 2022; Namwanja, 2023).

Priority 2: require third-party certification for green and ESG instruments (securities regulators and exchanges). Only certified African ESG bonds achieve lower spreads (Mutarindwa et al., 2024), and global greeniums of 4–14 bp indicate potential gains (Ando et al., 2024; Immel et al., 2021). Regulators should make external verification a condition of green labeling and help build pipelines of eligible projects (Michoud & Hafner, 2021; Bila, 2025).

Priority 2: build bank-level climate risk supervision (central banks and banking supervisors). Evidence that climate shocks raise non-performing loans and weaken liquidity creation (Mdaghri et al., 2026; Damette et al., 2026) justifies supervisory stress tests on actual loan books, which would also replace current simulated estimates (Mohammed & Oladipo, 2025); environmental portfolio screening is a low-cost first step (Dlamini, 2011; Lindlein, 2012).

Priority 3: lower the cost of capital for vulnerable sovereigns through international action (multilateral development banks, rating agencies and the G20). Concessional climate finance (Belianska et al., 2022) and more transparent climate treatment in rating methodologies (Angelova et al., 2021; Klusak et al., 2023) could cut premiums, though their effect on African borrowing costs is unevaluated.

Priority 3: improve corporate climate disclosure (regulators and stock exchanges). Disclosure lowers loan spreads internationally (Ge et al., 2024), but its African benefit is unknown, so disclosure rules should come with the data collection needed to evaluate them.

Theoretical and Methodological Contributions

Theoretically, the review shows that climate risk reaches African borrowers through rationing as well as price, so the cost of credit includes lost access; treats institutional quality as a first-order moderator rather than a control (Kling et al., 2018; Rahaman & Majid, 2026); and identifies certification as the condition for signalling to work under high information asymmetry (Mutarindwa et al., 2024). Methodologically, it shows the value of separating African from comparator evidence in a literature dominated by global samples.

Limitations and Future Research Directions

Limitations of the Review

Beyond the segment appraisals in Sections 4.1-4.5, cross-cutting limitations remain. Twenty-nine of 83 coded studies use non-African samples, and African studies concentrate on South Africa, Kenya, Nigeria and Ghana, leaving the Sahel, Central Africa and fragile states thinly covered. Fixed-effects panels may not resolve endogeneity, quasi-experimental designs are rare, horizons are mostly one to five years (Boehm, 2021; Zenios, 2024), and direct mechanism tests are scarce. Only 14 coded studies report a numerical effect size, and 26 are marked "not reported in abstract". Three non-specialist sources remain preliminary (Section 3.5).

Future Research Priorities

Four priorities stand out: Africa-specific quantitative work (country-level sovereign yield decompositions, sectoral corporate spreads, bank-level stress tests on African data); causal designs exploiting disasters as exogenous shocks, policy changes as treatments, or regression-discontinuity and instrumental variables; mediation analysis through fiscal, growth and institutional channels; and longer-horizon (10-30-year), distributional research, including differing responses of formal and informal credit. This needs better African corporate bond databases, weather-linked agricultural loan data, bank-level climate exposure data, harmonized vulnerability indices and standardized green bond and ESG certification data.

Conclusion

Drawing on 86 independently double-coded studies, this review finds consistent evidence that environmental risk is priced into African credit: vulnerable sovereigns pay more, carbon-intensive firms face higher spreads, certified green instruments earn modest discounts, weather-exposed farmers are rationed out, and bank balance sheets weaken under climate stress. The evidence is uneven, however: precise price estimates come from global or non-African samples, while African evidence speaks mainly to access and stability, so an African climate premium remains to be measured directly.

The findings are consistent with a climate-debt trap in which vulnerability raises the cost, or reduces the availability, of the finance needed to reduce it. Priorities are market-visible investment in adaptive capacity and the pairing of agricultural credit with risk transfer, followed by the certification of green instruments and bank-level climate supervision (Section 5.1.3).

Closing the evidence gap requires African-sample spread estimates, weather-linked agricultural loan data, supervisory stress tests and quasi-experimental designs. Africa's climate-finance challenge is real but tractable: the markets that penalize vulnerability also reward credible climate action.

Acknowledgements

The author thanks Dr. Terfa Swem, Postdoctoral Fellow, Department of Educational Foundations, College of Education, University of South Africa, for serving as the independent second coder for this review.

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