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Cloud Accounting and ESG Reporting: How Real-Time Data Improves Sustainability Disclosures in Nigerian Listed Firms

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ABSTRACT
Environmental, Social, and Governance (ESG) reporting has transitioned from peripheral corporate social responsibility communication to a core component of financial decision-making and regulatory compliance. The adoption of the International Sustainability Standards Board IFRS S1 and S2 standards by the Financial Reporting Council of Nigeria in January 2024, coupled with the Nigerian Exchange Group Sustainability Disclosure Guidelines of 2022, has created unprecedented demand for timely, complete, verifiable, and decision-useful sustainability information from listed entities. Yet, the technological infrastructure underpinning ESG reporting in Nigeria remains underdeveloped. An estimated 64% of listed firms continue to rely on manual spreadsheet-based processes for ESG data aggregation, leading to delays, inconsistencies, and elevated assurance risk (PwC Nigeria, 2023). This study investigates whether cloud accounting adoption can resolve these challenges by providing integrated, automated, and real-time data capabilities. Drawing on the Information Systems Success Model (DeLone & McLean, 2003), Technology-Organization-Environment framework (Tornatzky & Fleischer, 1990), and Stakeholder Theory (Freeman, 1984), we examine 124 non-financial firms listed on the Nigerian Exchange Group over the period 2020 to 2024. Using a mixed-methods explanatory design, we combine panel data from NGX ESG scores and annual reports with primary survey data from 186 accountants and sustainability officers. Fixed-effects panel regression results indicate that cloud accounting adoption increases ESG reporting quality by 18.94 points on a 100-point scale, significant at the 1% level. Mechanism analysis shows that cloud adopters disclose 32% more ESG indicators, publish sustainability reports 2.8 months earlier, achieve 27% higher external assurance rates, and experience 11% fewer restatements. Four cloud features emerge as critical drivers: API integration with utility and operational systems, automated GHG emissions calculation, real-time ESG dashboards, and immutable audit trail functionality. Qualitative interviews reveal that while data migration and staff training pose initial barriers, 82% of adopters report positive return on investment within 18 months. The study concludes that cloud accounting is a strategic enabler for ISSB-aligned ESG reporting in emerging economies. We recommend that the FRCN and NGX mandate API integration between certified cloud platforms and the NGX ESG portal, that professional bodies integrate cloud-ESG competencies into continuing professional development, and that software vendors localize ESG modules to Nigerian regulatory requirements. These findings contribute to the literature on digital transformation and sustainability reporting in developing markets.

Keywords: Cloud Accounting; ESG Reporting; Sustainability Disclosure; Real-Time Accounting; Digital Transformation

1. INTRODUCTION

1.1 Background and Context

The 21st century capital market is being reshaped by the integration of financial and non-financial information. Investors no longer evaluate firms solely on profitability and balance sheet strength. They demand insight into climate risk exposure, labor practices, supply chain resilience, board diversity, and data governance. This shift is codified in the work of the International Sustainability Standards Board, which in June 2023 issued IFRS S1 General Requirements and IFRS S2 Climate-related Disclosures. These standards establish a global baseline for sustainability-related financial disclosures and are designed to be used alongside IFRS Accounting Standards (ISSB, 2023).

Nigeria has responded decisively. The Financial Reporting Council of Nigeria announced in 2023 that IFRS S1 and S2 would be mandatory for all public interest entities effective January 1, 2024 (FRCN, 2024). The Nigerian Exchange Group reinforced this through its 2022 Sustainability Disclosure Guidelines, which require listed companies to report on 43 specific ESG indicators across environmental, social, and governance themes. The NGX also publishes an annual ESG scorecard as part of its FactBook.

Despite this regulatory momentum, implementation capacity lags. PwC Nigeria's 2023 Sustainability Reporting Survey found that 64% of NGX-listed firms compile ESG data manually using Microsoft Excel. KPMG's 2022 report on ESG in Africa noted that most ERP systems in Nigeria were configured for financial accounting and lack fields for carbon intensity, water withdrawal, or gender pay gap. The consequence is predictable: reporting lag, data fragmentation across departments, and difficulty obtaining external assurance. EY's 2023 global survey ranked "data availability and quality" as the number one barrier to ESG reporting.

1.2 Cloud Accounting as a Technological Solution

Cloud accounting represents a paradigm shift from on-premise, license-based software to internet-hosted, subscription-based Software-as-a-Service. Defined as accounting applications delivered over the internet and accessed via browsers or mobile apps, cloud platforms offer three features directly relevant to ESG: real-time processing, integration, and embedded analytics (Dimitriu & Matei, 2014). Unlike desktop systems, cloud platforms provide automatic updates, multi-user collaboration, scalability, and API integration with banks, tax authorities, utility providers, and HR systems (Marand & Marand, 2016).

Leading vendors have moved beyond bookkeeping. Oracle NetSuite, SAP S/4HANA Cloud, Microsoft Dynamics 365, Xero, and Sage Intacct now offer ESG modules. These modules can ingest electricity bills via API, calculate Scope 1, 2, and 3 emissions using emission factors, track HR metrics for social reporting, and generate dashboard visualizations for board oversight. Deloitte's 2023 report on ESG technology argues that cloud platforms reduce the marginal cost of disclosure and create audit trails that satisfy assurance providers.

The adoption curve in Nigeria is accelerating. The National Information Technology Development Agency reported that cloud accounting adoption among Nigerian businesses rose from 18% in 2020 to 46% in 2024 (NITDA, 2024). This growth is driven by improved broadband, mobile penetration, and regulatory digitization initiatives such as the FIRS e-invoicing platform.

1.3 Problem Statement Embedded

This divergence between regulatory demand and technological capacity creates a critical challenge. While 71% of listed firms report that they lack integrated systems for ESG data as of 2024 (FRCN, 2024), they are now legally required to produce ISSB-aligned disclosures within 4 months of year-end. Manual processes cannot meet this timeline without significant error. Therefore, understanding whether cloud accounting can bridge this gap is both timely and necessary.

1.4 Research Objectives

This study addresses the intersection of these two trends. Specifically, it pursues three objectives:

1. To examine the effect of cloud accounting adoption on the overall quality of ESG reporting among Nigerian listed firms.

2. To assess the impact of specific cloud accounting features on the timeliness, completeness, and reliability dimensions of ESG disclosures.
3. To develop a framework for leveraging cloud accounting to achieve compliance with ISSB S1 and S2 and NGX disclosure requirements in Nigeria.

1.5 Significance of the Study

This research contributes in three ways. First, it provides the first large-sample empirical evidence from an African market on the link between cloud accounting and ESG outcomes. Second, it offers practical guidance to regulators, firms, and software vendors navigating ISSB implementation. Third, it extends IS theory by applying the DeLone and McLean model to sustainability information systems. For practice, the findings help CFOs and sustainability officers justify cloud investment and help regulators design technology-enabled compliance pathways.

1.6 Structure of Paper

The paper proceeds as follows. Section 2 reviews conceptual foundations, theoretical frameworks, and empirical evidence. Section 3 describes methodology. Section 4 presents results. Section 5 discusses findings. Section 6 concludes with implications, recommendations, and limitations.

2. Literature Review and Theoretical Framework

2.1 Conceptual Review

Cloud Accounting: Cloud accounting refers to accounting software hosted on remote servers and accessed via the internet under a SaaS model (Dimitriu & Matei, 2014). Key features include real-time data processing, automatic software updates, multi-user access, mobile accessibility, data security, and API integration (Marand & Marand, 2016). For ESG, the most relevant extensions are embedded sustainability modules, IoT data ingestion, and analytics dashboards.

ESG Reporting: ESG reporting is the disclosure of environmental, social, and governance performance to stakeholders. The ISSB (2023) defines it as information on sustainability-related risks and opportunities that could reasonably be expected to affect enterprise value. The NGX Sustainability Disclosure Guidelines (2022) operationalize this through 43 indicators covering emissions, energy, water, waste, labor practices, human rights, community impact, board composition, ethics, and risk management.

ESG Reporting Quality: Following Cho et al. (2015) and Hahn and Kühnen (2013), we conceptualize ESG quality along four dimensions. Relevance refers to coverage of material topics. Faithful representation means accuracy and neutrality. Timeliness is publication within a decision-useful window. Verifiability is the ability to be audited and assured. This study focuses on timeliness, completeness, and reliability as measurable proxies.

2.2 Theoretical Framework

Technology-Organization-Environment Framework: Tornatzky and Fleischer (1990) posit that technology adoption is influenced by three contexts. Technological context includes perceived benefits and compatibility. Organizational context includes firm size, resources, and readiness. Environmental context includes regulatory pressure and competitive environment (Omaliko, 2026). In Nigeria, the FRCN mandate and NGX guidelines create strong environmental pressure, while NITDA's broadband initiatives improve technological context.

Information Systems Success Model: DeLone and McLean (2003) argue that system quality leads to information quality, which leads to use and net benefits. We apply this to ESG: cloud accounting's system quality attributes - integration, real-time processing, accessibility - should improve ESG information quality. This provides the direct mechanism for our hypothesis.

Stakeholder Theory: Freeman (1984) suggests firms disclose ESG to meet diverse stakeholder demands. Verrecchia (2001) adds that disclosure costs influence supply. By automating data collection, cloud accounting lowers marginal disclosure cost, leading to more comprehensive reporting. This explains why we expect completeness to improve.

Diffusion of Innovation Theory: Rogers (2003) argues that relative advantage drives adoption. For ESG, cloud's relative advantage lies in automated Scope 3 calculation and real-time dashboards, which are impossible with spreadsheets. This accelerates diffusion among sustainability-focused firms.

2.3 Empirical Review

Global Evidence: Eccles and Krzus (2018) found that firms using integrated cloud ERP systems scored 29% higher on Bloomberg ESG disclosure scores. In the EU, Mittelbach et al. (2021) reported that cloud-based sustainability modules reduced ESG reporting time from 90 to 22 days. Alsaifi et al. (2020) showed that real-time data from cloud systems improved carbon disclosure accuracy by 34% in UK firms. Seele and Gatti (2017) argued that digital technologies reduce greenwashing by creating immutable audit trails.

Emerging Market Evidence: Truant et al. (2017) demonstrated that cloud accounting improves financial reporting timeliness by 41% in Italian SMEs. Chouaibi et al. (2022) found no significant relationship in Tunisian firms, citing poor internet infrastructure. This suggests context matters.

Nigerian Evidence: Research on cloud accounting in Nigeria has focused on SMEs and audit (Okoye & Ezejiofor, 2020; Okafor et al., 2021). Studies on ESG reporting examined determinants like board size and profitability (Adegbie & Fakile, 2019), but not technology. Umukoro et al. (2022) noted that 78% of Nigerian firms use spreadsheets for ESG data, causing inconsistencies. No study has linked cloud accounting to ESG outcomes in Nigeria using ISSB metrics.

3. METHODOLOGY

3.1 Research Design

This study adopted an explanatory mixed-methods design. The quantitative strand tests the relationship between cloud adoption and ESG quality using panel regression. The qualitative strand explains the mechanisms through semi-structured interviews.

3.2 Population and Sample

The population comprised all 156 non-financial firms listed on NGX as of December 2024. Financial firms were excluded due to different ESG metrics. Using Taro Yamane formula at 5% margin of error, a sample of 124 firms was selected via stratified random sampling by 11 GICS sectors to ensure representation.

3.3 Data Collection

Primary data were collected using a structured questionnaire administered to finance directors and sustainability officers. 186 responses were obtained, 1.5 per firm on average. The instrument measured cloud accounting adoption, system features, and perceived ESG reporting quality on a 5-point Likert scale. Cronbach's alpha was 0.87, indicating reliability.

Secondary data included ESG scores from NGX FactBook, annual reports, and sustainability reports from 2020-2024. Cloud adoption was measured as a dummy: 1 if firm uses SaaS accounting with ESG module, 0 otherwise.

3.4 Variable Measurement

Dependent Variable: ESGQit = Composite score 0-100 based on: 1) Number of indicators disclosed out of 43, 2) Timeliness: 1 if published within 3 months of year-end, 0 otherwise, 3) Assurance: 1 if externally assured, 0 otherwise, 4) ISSB alignment score. Total score normalized to 100.

Independent Variable: Cloudit = 1 if firm uses SaaS accounting with ESG module, 0 otherwise.

Control Variables: Size = ln total assets; ROA; Leverage = debt-to-equity; Board Ind = % independent directors.

Mechanism Variables: API Integration, Automated Emissions Calculator, Real-time ESG Dashboard, Audit Trail Functionality - all measured on 5-point Likert.

3.5 Model Specification

To test the effect of cloud accounting on ESG quality, the following fixed-effects model was estimated:

\text{ESGQ}{it} = \beta0 + \beta1 \text{Cloud}{it} + \beta2 \text{Size}{it} + \beta3 \text{ROA}{it} + \beta4 \text{Leverage}{it} + \beta5 \text{BoardInd}{it} + \mui + \lambdat + \epsilon{it}

Where $\mui$ and $\lambdat$ are firm and year fixed effects. Hausman test confirmed fixed effects over random effects. Analysis was conducted in Stata 18. Qualitative data were analyzed thematically in NVivo 14.

4. RESULTS

4.1 Descriptive Statistics

Table 1 shows the descriptive statistics. Mean ESG Quality Score is 52.4 out of 100, indicating moderate quality with room for improvement. Cloud Accounting Adoption has a mean of 0.46, meaning 46% of firm-years use cloud. Mean reporting lag is 4.9 months.

Table 1: Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
ESG Quality Score	52.4	21.6	12	94
Cloud Accounting Adoption	0.46	0.50	0	1
Firm Size (Log Assets)	10.82	1.74	7.21	14.91
ROA (%)	6.3	8.1	-12.4	31.2
Leverage	1.24	0.91	0.11	4.62
Board Independence (%)	58.2	14.3	25	85
Reporting Lag (months)	4.9	2.1	1	11

4.2 Group Comparison

Table 2 compares cloud adopters and non-adopters. Cloud adopters outperform on all metrics. ESG scores are 22.8 points higher, they disclose 7.6 more indicators, and report 2.8 months earlier. The 27 percentage point gap in external assurance suggests cloud data is more auditable.

Table 2: Comparison of ESG Metrics by Cloud Adoption Status

Metric	Cloud Adopters	Non-Adopters	Difference	t-stat
ESG Quality Score	64.7	41.9	+22.8	7.42
Number of ESG Indicators Disclosed	31.2	23.6	+7.6	5.89
Reporting Lag [months]	3.4	6.2	−2.8	−8.11
External Assurance [% of firms]	51	24	+27	4.33
Restatements [% of firms]	8	19	−11	−2.51

Note: $p < 0.01$, $p < 0.05$.

4.3 Regression Results

Table 3 presents regression results. The fixed-effects coefficient for Cloud Accounting is 18.94. This implies that adopting cloud accounting increases ESG score by 18.94 points, holding other factors constant. The effect remains significant after controlling for firm size and governance. R-squared is 0.61.

Table 3: Regression Results – Effect of Cloud Accounting On ESG Quality

Variable	OLS	Fixed Effects	Random Effects
Cloud Accounting	23.61	18.94	20.12
Firm Size	4.12	3.87	3.95
ROA	0.54	0.41	0.48
Leverage	−2.31	−1.98	−2.11
Board Independence	0.29	0.22	0.25
Constant	5.11	8.43	6.92
R-squared	**0.52**	**0.61**	**0.58**
N	**620**	**620**	**620**
Hausman Test	—	—	18.42

Note: $p < 0.01$, $p < 0.05$, $p < 0.10$.

4.4 Mechanism Analysis

Table 4 shows which cloud features drive which quality dimension. Real-time ESG Dashboard most strongly predicts timeliness (0.61). Automated Emissions Calculator drives completeness (0.56). Audit Trail Functionality strongly predicts reliability (0.62).

Table 4: Mechanisms – Cloud Features and ESG Quality Components

Cloud Feature	Timeliness	Completeness	Reliability
API Integration with Utilities	0.52	0.48	0.31
Automated Emissions Calculator	0.44	0.56	0.39
Real-time ESG Dashboard	0.61	0.33	0.28
Audit Trail Functionality	0.19	0.21	0.62

Note: $p < 0.01$, $p < 0.05$, $p < 0.10$.

4.5 Qualitative Findings

Three themes emerged. First, automation reduces error. One sustainability officer stated: "Before cloud, we spent 3 months chasing utility bills. Now it syncs automatically." Second, integration eliminates silos. "HR, Operations and Finance now see the same ESG dashboard." Third, challenges include data migration cited by 71%, staff training 64%, and internet reliability 58%. However, 82% said benefits outweighed costs within 18 months.

4.6 DISCUSSION

The findings confirm that cloud accounting significantly enhances ESG reporting quality in Nigeria. The 18.94 points increase and 2.8 month reduction are economically meaningful given FRCN's 4-month deadline for ISSB reports. Non-adopters average 6.2 months, risking non-compliance.

Mechanistically, automation reduces the 14% manual error rate to 3% as reported by respondents. Integration solves the silo problem identified by KPMG (2022). Real-time processing enables continuous disclosure, consistent with stakeholder theory that lower cost increases supply.

Results align with Eccles and Krzus (2018) and Mittelbach et al. (2021) but extend them to Nigeria. They contrast with Chouaibi et al. (2022), suggesting infrastructure improvements in Nigeria since 2020 matter. The dominance of technology over governance variables like board independence suggests that in the digital era, systems may supersede structures, challenging Adegbie and Fakile (2019).

For regulators, the findings support technology mandates as compliance tools. For firms, cloud-ESG integration should be treated as strategic. For investors, cloud adoption can serve as a signal of reporting quality.

5. CONCLUSION, IMPLICATIONS, AND RECOMMENDATIONS

5.1 Conclusion

Cloud accounting significantly improves ESG reporting quality among Nigerian listed firms. It enhances timeliness by 2.8 months, increases completeness by 32%, and improves reliability through automated audit trails and external assurance. The fixed-effects model confirms a causal relationship: cloud adoption raises ESG scores by 18.94 points. These improvements help firms meet ISSB S1/S2 requirements and NGX deadlines. The study validates the Technology-Organization-Environment framework and Information Systems Success Model in the sustainability context.

5.2 Implications

Theoretical: Extends IS Success Model to non-financial reporting.

Practical: Provides ROI justification for cloud investment.

Policy: Shows technology can accelerate regulatory compliance.

5.3 Recommendations

1. For Regulators: FRCN and NGX should mandate API integration between approved cloud accounting systems and the NGX ESG reporting portal to enable real-time filing. Update NGX Guidelines to recognize cloud audit trails as sufficient evidence for assurance.
2. For Firms: Listed companies should prioritize cloud accounting with embedded ESG modules. Conduct cost-benefit analysis: average cloud cost is N4.2M annually vs N21M saved from reduced reporting time and restatements.
3. For Professional Bodies: ICAN and ANAN should integrate cloud-ESG reporting into MCPD programs. Develop a "Certified Cloud Sustainability Accountant" designation covering ISSB standards in NetSuite, Xero, and Sage Intacct.
4. For Software Vendors: Localize ESG templates to NGX 43 indicators and ISSB S2 climate requirements. Partner with NITDA to offer subsidized cloud for SMEs preparing to list.
5. For Researchers: Future studies should examine blockchain-cloud integration for immutable ESG data and AI-driven materiality assessment within cloud platforms.

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