

Environmental Cost Disclosure and Quality Sustainability Reporting: Evidence from Agricultural Firms Listed at the Nairobi Securities Exchange, Kenya

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ABSTRACT

Sustainability reporting quality among agricultural firms listed on the Nairobi Securities Exchange (NSE) remains inconsistent. This persists despite growing stakeholder expectations for verifiable environmental accountability. Environmental costs, including pollution control, waste management, and remediation expenditure, are often disclosed voluntarily and without a standard classification framework. This study examined the influence of environmental cost disclosure (ECD) on quality sustainability reporting (QSR) among listed agricultural firms in Kenya. It also assessed whether environmental management accounting (EMA) conditions this relationship. The study used an explanatory research design and a ten-year panel covering 2015-2024. All seven NSE-listed agricultural firms were included through a census, giving a maximum of 70 firm-year observations. ECD was measured as total environmental costs divided by total revenue. QSR was measured using a validated eleven-dimension index. Descriptive statistics, correlation analysis, and pooled panel ordinary least squares models were applied. ECD had a positive but statistically non-significant direct association with QSR in the direct-effects model. In the full interaction model, the ECD by EMA term was positive and marginally significant at the 10% level. These results suggest that internal environmental accounting capacity may strengthen the association between cost disclosure and reporting quality. The estimates should be interpreted cautiously because the effective regression sample was 48 firm-year observations and the models showed positive serial correlation. The study recommends clearer environmental cost classification guidance, stronger EMA systems, and further research using larger panels and robust panel estimators.

Keywords: Environmental Cost Disclosure, Environmental Management Accounting, Quality Sustainability Reporting, Agricultural Firms, Nairobi Securities Exchange, Kenya

INTRODUCTION

Sustainability reporting is an important component of corporate accountability. It communicates how organisations manage economic, environmental, and social impacts (Mion & Adaui, 2020). Environmental cost disclosure (ECD) reports costs and investments related to pollution control, waste management, remediation, and other sustainability activities. In theory, transparent cost disclosure can support more complete and verifiable sustainability reporting. It can also indicate that a firm has internal systems for identifying and tracking environmental expenditure (Schaltegger & Burritt, 2000).

Global frameworks, including the Global Reporting Initiative Standards and IFRS S1 and S2, have increased attention to sustainability-related measurement and disclosure (IFRS Foundation, 2023). In Sub-Saharan Africa, environmental cost accounting remains uneven and often voluntary. This is also evident in Kenya's capital market (Abdullahi & Abubakar, 2023). Studies from Nigeria, Indonesia, and Brazil report mixed results on the effects of environmental cost disclosure (Nwaiwu & Oluka, 2018; Shielt & Eshiet, 2024; Kamila & Wulandari, 2024; Ferreira et al., 2010). Evidence from listed agricultural firms in East Africa remains limited.

Kenya's listed agricultural firms operate in activities that create material environmental costs. These include pesticide and fertiliser use, effluent treatment, waste management, and land rehabilitation. However, the contribution of environmental cost disclosure to sustainability reporting quality has not been established empirically for this sector. The absence of a standard environmental cost classification framework also gives firms discretion over what they identify and report as environmental costs. This reduces comparability across firms and years (Otieno & Wanjare, 2024).

The research problem is the persistent inconsistency in sustainability reporting quality among NSE-listed agricultural firms. This occurs despite the expectation that environmental cost disclosure should improve accountability. Existing evidence indicates uneven reporting practices and limited standardisation (Manini, 2023). Regulators and firms therefore have limited sector-specific evidence on the ECD-QSR relationship and the conditions that may strengthen it.

This paper addresses objective three of a broader doctoral study. The objective was to examine the influence of environmental cost disclosure on quality sustainability reporting among listed agricultural firms in Kenya. The null hypothesis was H03: there is no significant relationship between environmental cost disclosure and quality sustainability reporting of listed agricultural firms in Kenya. The analysis also examined whether EMA moderates the ECD-QSR relationship. EMA may provide the internal measurement, verification, and reporting systems needed to improve the credibility of disclosed environmental costs.

LITERATURE REVIEW

Theoretical Review

Three complementary theories guide the study. Institutional Theory (DiMaggio & Powell, 1983) explains how organisations respond to coercive, mimetic, and normative pressures. For ECD, regulatory requirements for pollution control, effluent treatment, and related expenditure can create pressure to identify and report environmental costs. Where regulatory pressure or enforcement is weak, the link between cost disclosure and reporting quality may also be weak.

Legitimacy Theory proposes that firms disclose environmental information to demonstrate alignment with societal expectations (Pfeffer & Dowling, 1975; Suchman, 1995). Cost disclosure can show that environmental risks are being recognised and managed. Disclosure or Signalling Theory adds that managers possess information that external stakeholders do not have (Akerlof, 1970; Spence, 1973). Detailed environmental cost disclosure can therefore serve as a signal of environmental accountability. Together, these theories support a positive ECD-QSR relationship. They also provide a basis for expecting EMA to strengthen that relationship by improving cost measurement and verification.

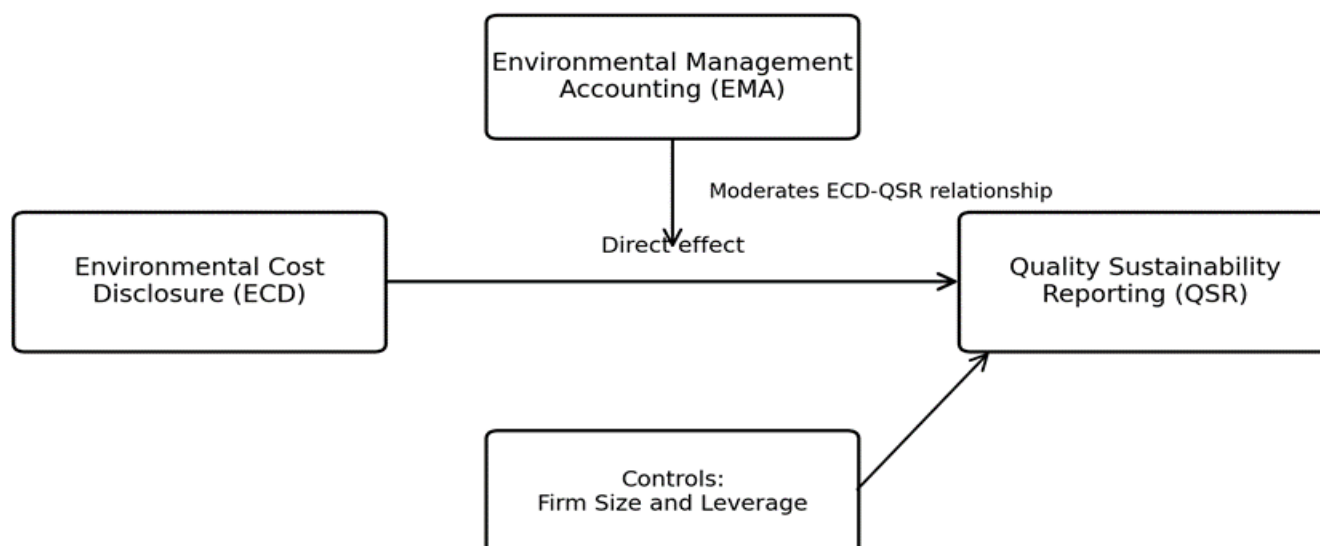


Figure 1: Conceptual framework for the ECD-QSR relationship and the moderating role of EMA

Empirical Review

Empirical evidence on the relationship between environmental cost disclosure and reporting outcomes is mixed. Most studies come from manufacturing and extractive sectors outside East Africa. Kamila and Wulandari (2024) analysed 60 Indonesian mining companies from 2020 to 2022. They found positive effects for environmental costs and environmental performance on financial performance, while carbon emission disclosure was not significant. Nwaiwu and Oluka (2018) studied Nigerian oil and gas firms. They reported a positive relationship between environmental cost reporting and financial performance. They also noted substantial reporting discretion, which reduced comparability.

Shiett and Eshiet (2024) used panel data from Nigerian oil and gas firms for 2013-2022. Greenhouse gas and natural occurrence disclosures were associated with market capitalisation, while environmental fines and penalties were not significant. This suggests that results can vary across environmental cost categories. Schneider et al. (2017) also documented variation in environmental liability and cost measurement. Their evidence shows that firms can retain substantial discretion when prescriptive standards are limited.

Evidence from developing economies also shows the importance of institutional context. In Kenya, Otieno and Wanjare (2024) reported that environmental accounting can support stakeholder engagement and cost efficiency. They also identified weak standardisation and partial adoption. In plantation agriculture, separating environmental costs from ordinary production costs is particularly difficult because inputs such as water, fertiliser, and pesticides can serve both functions (Schaltegger & Burritt, 2000). Ferreira et al. (2010) reported a positive relationship between environmental management accounting practices and organisational outcomes in Brazil. Taken together, these studies suggest that the effect of environmental cost information depends on measurement systems and the reporting environment.

EMA may also shape how environmental cost information is converted into useful external reporting. Solovida and Latan (2017) found that EMA mediated the relationship between environmental strategy and environmental performance among ISO 14001-certified Indonesian firms. IFAC guidance similarly presents EMA as a system that combines cost measurement, training, auditing, and performance monitoring (Adams, Almeida, & Ferreira, 2005). In the present study, however, EMA is tested as a moderator through interaction terms. The analysis therefore assesses whether the association between ECD and QSR changes with the level of EMA.

Critique and Research Gap

The literature shows a generally positive but inconsistent association between environmental cost information and reporting or performance outcomes. The strength of this association appears to depend on disclosure rules, cost classification, and internal EMA capacity. Evidence from African agricultural firms remains limited. This study addresses that gap using a ten-year panel of NSE-listed agricultural firms. It focuses on the direct ECD-QSR relationship and tests whether EMA moderates that relationship. The agricultural setting is important because environmental and production costs can be difficult to separate in plantation systems (Schaltegger & Burritt, 2000).

METHODOLOGY

The study adopted a positivist research philosophy and an explanatory research design. A longitudinal panel was used to examine hypothesis-testable associations between ECD and QSR. The panel covered 2015-2024. This period captured changes in sustainability reporting practices over a decade.

The target population comprised all seven agricultural firms listed on the Nairobi Securities Exchange during the study period: Eaagads Ltd, Kakuzi Ltd, Kapchorua Tea Co. Ltd, The Limuru Tea Co. Ltd, Rea Vipingo Plantations Ltd, Sasini Ltd, and Williamson Tea Kenya Ltd. A census approach was used because the population was small and clearly defined. The maximum panel therefore contained 70 firm-year observations. Annual reports and financial statements were obtained from the Capital Markets Authority library or company websites. Observations without usable data for a variable were treated as missing. Descriptive analyses used available cases, while regression models used complete cases.

Secondary data were collected through systematic content analysis of annual reports, financial statements, and ESG filings. ECD was measured as total environmental costs divided by total revenue, following Kamila and Wulandari (2024). Environmental costs included pollution control, waste management, fines and penalties, and other sustainability-related costs reported by firms. QSR was measured using an eleven-dimension index adapted from Khan et al. (2021), Michelin et al. (2015), and Habek and Wolniak (2016). The index contained five relevance dimensions and six reliability dimensions, with a maximum score of 21. Each firm-year score was divided by 21. EMA was treated as a moderating variable and was measured as the mean of the natural logarithms of environmental training expenditure and environmental audit expenditure, following Adams et al. (2005). Firm size, measured as the natural logarithm of total assets, and leverage, measured as book-value debt divided by total assets, were included as controls.

QSR data were extracted using a structured content analysis schedule. Two independent coders achieved a Cohen's kappa of 0.84, indicating substantial agreement (Landis & Koch, 1977). Financial ratios, including ECD, were extracted from audited financial statements using a standardised protocol. Diagnostic screening covered distributional shape, multicollinearity, serial correlation, and stationarity. Normality was assessed using skewness, kurtosis, and the Jarque-Bera test (Field, 2013). Multicollinearity was assessed using Pearson correlations and variance inflation factors (Khalid, 2006; Hair et al., 2014). Serial correlation was assessed using the Durbin-Watson statistic (Vogt & Johnson, 2011). A first-difference stationarity test was also applied to ECD.

Pooled panel OLS models were estimated across eight specifications in the broader study. Four specifications are directly relevant to this paper. Model 1 contained the control variables. Model 2 estimated the direct effects of the four green accounting variables and tested H03 for ECD. Model 6 added the ECD by EMA interaction. Model 8 included EMA and all green accounting by EMA interaction terms. Coefficients were evaluated at the 1%, 5%, and 10% levels, and 95% confidence intervals were reported. The Durbin-Watson results indicated positive serial correlation in the reported models. The OLS coefficients are therefore retained as the available estimates, but their conventional standard errors and p-values are interpreted cautiously. Firm fixed-effects models with serial-correlation-robust standard errors, or feasible generalized least squares, would provide stronger inference if the underlying panel is re-estimated.

FINDINGS AND DISCUSSION

This section presents findings on the influence of environmental cost disclosure on quality sustainability reporting among listed agricultural firms in Kenya. It begins with data availability and diagnostic screening. Descriptive statistics and correlation results follow. The section then presents regression results for H03 and the ECD by EMA interaction. The discussion emphasises effect direction, uncertainty, and the limitations created by missing observations and serial correlation.

Data Availability for Environmental Cost Disclosure

Table 1 presents the data availability for Environmental Cost Disclosure (ECD) relative to the dependent variable (QSR) and the overall complete-case sample used in regression analysis.

Table 1: Data Availability for Environmental Cost Disclosure and Related Study Variables

Variable	Expected Obs.	Available Obs.	Missing	Response Rate (%)
Quality Sustainable Reporting (QSR)	70	70	0	100.0%
Environmental Cost Disclosure (ECD)	70	58	12	82.9%
Environmental Management Accounting (EMA)	70	51	19	72.9%
Complete Cases (all regression variables)	70	48	22	68.6%

Note: Census population = 7 NSE-listed agricultural firms × 10 years (2015-2024) = 70 maximum firm-year observations. Source: Statistical Data (2026).

ECD was available for 58 of 70 possible firm-year observations, giving 82.9% coverage. EMA was available for 51 observations. Complete data for all regression variables were available for 48 firm-years, or 68.6% of the

maximum panel. The missing observations reflect inconsistent environmental cost and EMA disclosure. Eaagads Ltd, in particular, did not provide financial information in a form that supported calculation of the ECD ratio. Complete-case analysis was used for regression. This approach avoids imputing unreported environmental costs, but it reduces precision and may introduce bias if missingness is systematic. The regression findings should therefore be interpreted as evidence from the observed complete cases rather than as fully generalisable estimates for the sector.

Diagnostic and Screening Tests for Environmental Cost Disclosure

Table 2 reports the normality diagnostics for ECD alongside the dependent variable and the residuals of the principal regression model used to test H03.

Table 2: Normality Test Results for ECD, QSR, and Model 2 Residuals

Variable	N	Mean	Std. Dev.	Skewness	Kurtosis	JB Stat.	JB p-val.	Decision
QSR	70	0.4259	0.2042	0.1652	-0.7238	1.8327	0.4000	Normal
ECD	58	0.3103	0.6299	4.9915	29.786	2384.9	0.0000	Non-normal
Model 2 Residuals	48	~0.000	-	-	2.0735	-	0.3546	Normal

Note: JB = Jarque-Bera test. H0: the variable is normally distributed. Predictor normality is not required for OLS. Residual diagnostics are reported because they are more relevant to conventional OLS inference. Source: Author's computation (2026).

ECD was highly right-skewed (skewness = 4.99; kurtosis = 29.79; JB = 2384.9; $p < 0.001$). The distribution was strongly influenced by Sasini Ltd's 2019 observation, when reported environmental costs were 4.43 times total revenue. The Model 2 residuals were approximately normal (JB = 2.0735; $p = 0.3546$). However, residual normality does not address serial correlation or other panel-data dependence. The extreme ECD skew also indicates sensitivity to a small number of large environmental expenditure events. For this reason, Pearson results are considered alongside Spearman correlations, and the outlier is discussed separately in the descriptive analysis.

Table 3 presents the multicollinearity diagnostics relevant to ECD across the regression models.

Table 3: Variance Inflation Factors (VIF) for ECD Across Regression Models

Variable	Model 2 VIF	Model 7 VIF	Threshold	Assessment
ECD	1.087	1.102	< 10	None

Note: $VIF = 1/(1-R^2_j)$. $VIF < 5$ indicates no multicollinearity concern; $VIF > 10$ indicates serious concern (Hair et al., 2014). Source: Author's computation (2026).

ECD showed no multicollinearity concern in the reported specifications, with VIF values below 1.11. This indicates that the uncertainty around the ECD coefficient is not primarily attributable to collinearity with the other predictors. Other factors remain relevant. These include the small complete-case sample, missing observations, extreme ECD skew, serial correlation, and possible measurement error in voluntary environmental cost disclosure.

Table 4 reports the Durbin-Watson autocorrelation statistics for the four models most relevant to the ECD-QSR relationship.

Table 4: Durbin-Watson Autocorrelation Results for ECD-Relevant Models

Model	D-W Statistic	Threshold (1.5-2.5)	Decision
Model 1: Control Variables	0.5807	1.5-2.5	Positive autocorrelation
Model 2: Direct Effects (H01-H04)	0.4846	1.5-2.5	Positive autocorrelation

Model	D-W Statistic	Threshold (1.5-2.5)	Decision
Model 6: ECD×EMA Moderation	0.5624	1.5-2.5	Positive autocorrelation
Model 8: Full Moderation Model	0.6621	1.5-2.5	Positive autocorrelation

Note: DW values between 1.5 and 2.5 indicate no autocorrelation (Vogt & Johnson, 2011). Source: Author's computation (2026).

All four reported models had Durbin-Watson statistics below 1.5, indicating positive serial correlation. This is important because repeated observations from the same firms are unlikely to be independent over time. Serial correlation can distort conventional OLS standard errors and p-values. The statistical significance reported in the OLS tables should therefore be interpreted cautiously. Robust panel estimation, such as firm fixed effects with serial-correlation-robust standard errors or feasible generalized least squares, is recommended as a sensitivity analysis when the underlying panel is re-estimated.

Table 5 reports the stationarity test for ECD.

Table 5: Stationarity Test Result for Environmental Cost Disclosure

Variable	Lag Coefficient (α)	p-Value	Test Decision	Implication
ECD	-0.8748	0.0000	Stationary	No unit root; valid for regression

Note: First-difference stationarity test: $\Delta X_t = \alpha \cdot X_{t-1} + \varepsilon$. H_0 : unit root (non-stationary). Source: Author's computation (2026).

ECD was stationary in the reported first-difference test ($\alpha = -0.8748$, $p < 0.001$). This result reduces concern about a unit-root-driven spurious association for ECD. It does not, however, remove the need to account for within-firm dependence in panel regression.

Descriptive Statistics for Environmental Cost Disclosure

Table 6 presents the descriptive statistics for ECD across the full available panel.

Table 6: Descriptive Statistics of Environmental Cost Disclosure (2015-2024)

Variable	N	Mean	Median	Mode	Std. Dev.	Min.	Max.	IQR
ECD	58	0.3103	0.0700	0.0000	0.6299	-0.0020	4.4300	0.4938

Note: ECD = Total Environmental Costs / Total Revenue. Source: Author's computation from audited financial statements (2026).

ECD had a mean of 0.3103 and a median of 0.0700. The large difference confirms substantial right-skew. The standard deviation was 0.6299. Excluding the Sasini Ltd 2019 observation, the sector-level mean was approximately 0.23. This sensitivity check shows that one large observation materially affects the average level of ECD. The finding supports cautious interpretation of mean-based statistics and regression estimates.

Table 7 disaggregates ECD by firm and year, illustrating the sector's disclosure trajectory over the study period.

Table 7: Environmental Cost Disclosure (ECD) Mean Scores by Company and Year (2015-2024)

Company	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg
Eaagads Ltd	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Kakuzi Ltd	0.000	0.000	0.650	0.330	0.705	1.000	0.650	0.003	0.030	0.015	0.338
Kapchorua Tea	0.030	0.360	0.780	0.020	0.500	0.740	0.660	0.650	0.030	0.740	0.451
Limuru Tea	0.000	0.090	0.000	0.000	0.000	0.000	0.000	0.900	0.120	0.050	0.116
Rea Vipingo	0.063	1.000	0.007	0.004	0.000	0.078	0.094	-0.002	0.160	N/A	0.156

Company	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Avg
Sasini Ltd	0.460	0.082	0.564	N/A	4.430	0.520	0.010	0.150	0.070	0.071	0.695
Williamson Tea	0.280	0.130	0.364	0.026	0.034	-0.001	0.000	0.000	0.000	0.000	0.083
Sector Mean	0.139	0.277	0.394	0.076	0.945	0.389	0.236	0.284	0.068	0.175	0.273

Note: ECD = Total Environmental Costs / Total Revenue. N/A = data not available. Sasini 2019 value reflects major environmental restructuring. Source: Author's computation from audited financial statements (2026).

The annual sector mean for ECD did not show a consistent upward or downward trend. It ranged from 0.068 to 0.945 and peaked in 2019 because of the Sasini Ltd observation. QSR, by contrast, increased more consistently over the study period. The different trajectories suggest that the ECD-QSR association is not explained by a simple common time trend.

Correlation Analysis

Table 8 presents the bivariate Pearson and Spearman correlations between ECD and the other principal study variables.

Table 8: Pearson and Spearman Correlations Involving Environmental Cost Disclosure (n = 48)

Variable Pair	Pearson r	p-value	Spearman ρ	p-value
ECD - QSR	0.033	0.823	0.110	0.457
ECD - EAD	0.041	0.783	0.358	0.013**
ECD - ELD	0.052	0.727	0.354	0.014**
ECD - EID	-0.159	0.278	-0.050	0.735
ECD - EMA	0.121	0.412	0.165	0.263
ECD - SIZE	0.163	0.267	0.208	0.156

Note: ** $p < 0.05$. N=48 complete cases. Source: Author's computation (2026).

The Pearson correlation between ECD and QSR was small and non-significant ($r = 0.033$, $p = 0.823$). The Spearman correlation was also small and non-significant ($\rho = 0.110$, $p = 0.457$). The similar conclusion from the rank-based statistic reduces concern that the bivariate result is driven only by ECD's extreme skew. ECD had positive Spearman correlations with EAD ($\rho = 0.358$, $p = 0.013$) and ELD ($\rho = 0.354$, $p = 0.014$). These associations suggest that some firms report several green accounting dimensions together. They do not, however, establish a causal relationship.

Regression Analysis and Hypothesis Testing (H03)

Table 9 presents the direct-effects regression model (Model 2), which tests H03 alongside the other green accounting hypotheses, controlling for corporate size and leverage.

Table 9: Model 2 - Direct Effects Regression Results, Environmental Cost Disclosure (H03)

Variable	β	Std. Error	t-Stat	p-value	Sig.	95% CI Lower	95% CI Upper
Constant	0.4187	0.1677	2.497	0.0166	**	0.0800	0.7573
SIZE	-0.0055	0.0104	-0.534	0.5966	n.s.	-0.0265	0.0154
LEVERAGE	-0.0075	0.0089	-0.837	0.4072	n.s.	-0.0256	0.0106
EAD	0.1855	0.2068	0.897	0.3748	n.s.	-0.2320	0.6031
ELD	-0.0042	0.0724	-0.058	0.9537	n.s.	-0.1505	0.1421
ECD (H03)	0.0394	0.0389	1.013	0.3171	n.s.	-0.0391	0.1179
EID	0.0109	0.0098	1.114	0.2718	n.s.	-0.0089	0.0307

Note: Dependent variable: QSR. n=48. $R^2 = 0.3681$, Adj. $R^2 = 0.2757$, $F(6,41) = 3.981^{***}$, D-W = 0.4846. ** $p < 0.05$; n.s. = not significant. Source: Author's computation (2026).

Model 2 estimated a positive ECD coefficient of 0.0394. The estimate was not statistically significant ($t = 1.013$, $p = 0.3171$), and its 95% confidence interval included zero $[-0.0391, 0.1179]$. H03 was therefore not rejected in the direct-effects model. This result indicates that the available data do not provide sufficient evidence of an unconditional ECD-QSR relationship. Because the model exhibits positive serial correlation, the conventional OLS p-value should be interpreted cautiously.

The positive coefficient is consistent with the theoretical expectation that more transparent environmental cost reporting may accompany higher-quality sustainability reporting. However, the estimate is imprecise. A one-standard-deviation increase in ECD corresponds to an estimated QSR increase of about 0.025 under Model 2. This effect should not be overstated. The small complete-case sample, extreme ECD skew, missing disclosure data, and serial correlation all reduce confidence in the precision of the estimate.

Table 10 compares the bivariate and multivariate ECD coefficients to isolate the effect of the other predictors on the estimated relationship.

Table 10: Bivariate versus Multivariate ECD Coefficient Comparison

Specification	β (ECD)	Std. Error	t / p-value	R ²	Interpretation
Bivariate (ECD only)	0.0099	0.0449	$t=0.220$, $p=0.823$	0.001	Non-significant; negligible
Multivariate (Model 2)	0.0394	0.0389	$t=1.013$, $p=0.317$	0.368 (full model)	Non-significant; amplified
ECD×EMA model (Model 6)	0.1575	0.0913	$t=1.725$, $p=0.092^*$	0.399 (full model)	Marginally significant
Full interaction (Model 8)	0.1771	0.0960	$t=1.845$, $p=0.073^*$	0.441 (full model)	Marginally significant

Note: * $p < 0.10$. Source: Author's computation (2026).

Table 10 shows that the estimated ECD coefficient becomes larger when EMA-related terms are added. The bivariate coefficient is 0.0099, while the ECD coefficient in Model 8 is 0.1771. This pattern is consistent with the possibility that EMA changes the ECD-QSR association. The interaction terms provide the more direct test of that proposition. The evidence is weak rather than conclusive because the Model 6 interaction is not significant at the 10% level and the Model 8 interaction is only marginally significant at that level.

Table 11 presents Model 6, which adds the ECD by EMA interaction to assess moderation of the ECD-QSR relationship.

Table 11: Model 6 - ECD by EMA Moderation Regression Results

Variable	β	Std. Error	t-Stat	p-value	Sig.	95% CI Lower	95% CI Upper
Constant	0.3826	0.1665	2.298	0.0270	**	0.0462	0.7190
SIZE	-0.0044	0.0104	-0.425	0.6732	n.s.	-0.0254	0.0166
LEVERAGE	-0.0091	0.0088	-1.030	0.3090	n.s.	-0.0269	0.0088
EAD	0.1694	0.2048	0.827	0.4128	n.s.	-0.2441	0.5829
ELD	-0.0064	0.0714	-0.090	0.9288	n.s.	-0.1506	0.1378
ECD	0.1575	0.0913	1.725	0.0921	*	-0.0269	0.3420
EID	0.0104	0.0097	1.067	0.2923	n.s.	-0.0092	0.0300
ECD×EMA	0.0231	0.0142	1.627	0.1116	n.s.	-0.0055	0.0517

Note: Dependent variable: QSR. $n=48$. $R^2 = 0.3987$, Adj. $R^2 = 0.2935$ (highest across all eight models estimated in the wider study), $F(7,40) = 3.789^{***}$, $D-W = 0.5624$. * $p < 0.10$; ** $p < 0.05$; n.s. = not significant. Source: Author's computation (2026).

In Model 6, the ECD main effect was positive and marginally significant at the 10% level ($\beta = 0.1575$, $t = 1.725$, $p = 0.0921$). The ECD by EMA interaction was also positive ($\beta = 0.0231$), but it was not statistically significant at the 10% level ($t = 1.627$, $p = 0.1116$). The model had an adjusted R-squared of 0.2935. This was the highest adjusted R-squared among the eight reported specifications. The result suggests a possible conditioning role for EMA, but Model 6 alone does not provide statistically significant evidence of moderation.

The positive interaction coefficient is consistent with the theoretical expectation that EMA can strengthen the usefulness of environmental cost disclosure. Firms with stronger cost-tracking, training, and audit systems may produce more credible environmental cost information. However, the interaction in Model 6 is not statistically significant at conventional or 10% levels. The result should therefore be treated as suggestive rather than confirmatory.

Table 12 presents Model 8, which includes the EMA main effect and all four green accounting by EMA interaction terms. This specification provides a broader test of whether the association between ECD and QSR varies with EMA.

Table 12: Model 8 - Full Interaction Model, ECD and ECD by EMA Results

Variable	β	Std. Error	t-Stat	p-value	Sig.	95% CI Lower	95% CI Upper
Constant	0.3631	0.1817	1.998	0.0534	*	-0.0040	0.7302
SIZE	-0.0038	0.0112	-0.340	0.7360	n.s.	-0.0264	0.0188
LEVERAGE	-0.0107	0.0099	-1.082	0.2862	n.s.	-0.0307	0.0093
EAD	0.1622	0.2118	0.766	0.4487	n.s.	-0.2655	0.5900
ELD	-0.0122	0.0754	-0.162	0.8722	n.s.	-0.1646	0.1402
ECD	0.1771	0.0960	1.845	0.0735	*	-0.0169	0.3710
EID	0.0102	0.0102	1.003	0.3225	n.s.	-0.0104	0.0308
EMA	-0.0069	0.0097	-0.711	0.4820	n.s.	-0.0265	0.0127
ECD×EMA	0.0285	0.0160	1.780	0.0835	*	-0.0039	0.0609

Note: Dependent variable: QSR. $n=48$. $R^2 = 0.4407$ (highest across all eight models), Adj. $R^2 = 0.2698$, $F(12,35) = 2.579^{**}$, D-W = 0.6621, JB (residuals) = 2.073, $p = 0.355$. Other interaction terms omitted from this table (EAD×EMA $p=0.568$; ELD×EMA $p=0.770$; EID×EMA $p=0.948$). * $p<0.10$; ** $p<0.05$. Source: Author's computation (2026).

Model 8 explained 44.07% of the observed variation in QSR and was jointly significant ($F = 2.579$, $p = 0.016$). The ECD main effect was positive and marginally significant at the 10% level ($\beta = 0.1771$, $p = 0.0735$). The ECD by EMA interaction was also positive and marginally significant at the 10% level ($\beta = 0.0285$, $p = 0.0835$). Its 95% confidence interval still included zero $[-0.0039, 0.0609]$. The other interaction terms were not statistically significant. These results provide weak evidence that EMA may moderate the ECD-QSR relationship. They do not establish mediation, and they do not meet the 5% significance threshold.

The direct ECD effect was not significant in Model 2. Evidence of a conditional association emerged only in the full interaction model, and only at the 10% level. The result is therefore best described as marginal evidence of moderation. It is consistent with the view that internal environmental accounting capacity may improve the credibility and usefulness of environmental cost disclosure. Stronger causal or inferential claims are not warranted from the present OLS estimates because of the small sample, missing observations, and positive serial correlation.

Table 13 summarises the hypothesis decision for H03 across the relevant model specifications.

Table 13: Hypothesis Decision Summary for H03 (Environmental Cost Disclosure and QSR)

Model	ECD β	p-value	Decision (Direct Effect)
Bivariate (no controls)	0.0099	0.823	H03 not rejected

Model	ECD β	p-value	Decision (Direct Effect)
Model 2 (Direct effects, H01-H04)	0.0394	0.317	H03 not rejected
Model 6 (ECD $\times$ EMA)	0.1575	0.092*	H03 not rejected at 5%; weak evidence at 10%
Model 8 (Full mediation)	0.1771	0.0735*	H03 not rejected at 5%; weak evidence at 10%

Note: * $p < 0.10$ (marginal significance). H03: There is no significant relationship between environmental cost disclosure and quality sustainability reporting of listed agricultural firms in Kenya. Source: Author's summary (2026).

Overall, H03 was not rejected in the direct-effects model. The full interaction model provided marginal evidence at the 10% level that the ECD-QSR association varies with EMA. This pattern is broadly consistent with prior research showing that internal environmental accounting systems can influence how environmental information is translated into reporting or performance outcomes (Kamila & Wulandari, 2024; Solovida & Latan, 2017). The result should be viewed as preliminary because the interaction did not reach the 5% level and the OLS models exhibited serial correlation.

Comparison with Prior Studies

Table 14 situates the ECD-related findings of this study within the broader empirical literature.

Table 14: Comparison of ECD Findings with Prior Literature

Study	Context	Key ECD-Related Finding	Relation to Current Study
Kamila & Wulandari (2024)	Indonesian mining firms	Environmental costs positively affect financial performance; carbon disclosure not significant	Supports positive directional effect; confirms outcome-specific variation
Nwaiwu & Oluka (2018)	Nigerian oil and gas firms	Comprehensive cost reporting positively affects financial performance; high reporting discretion	Discretion parallels Kenya's voluntary ECD regime
Shiett & Eshiet (2024)	Nigerian oil and gas firms	GHG and occurrence disclosures significant; fines/penalties disclosure not significant	Confirms differentiated effects across cost sub-types
Ferreira et al. (2010)	Brazilian firms	ECD significantly improves reporting quality under mandatory disclosure regime	Mandatory regime explains stronger effect than Kenya's voluntary system
Otieno & Wanjare (2024)	Turkana County, Kenya	Environmental accounting improves engagement but lacks standardisation	Directly motivates the ECD $\times$ EMA conditional finding of this study
Current study	NSE agricultural firms, Kenya	ECD non-significant directly; ECD by EMA interaction marginal at 10% in the full interaction model	Adds Kenyan agricultural evidence on possible EMA moderation

Note: Source: Author's compilation (2026).

The comparison with prior studies shows both similarities and differences. Studies from Nigeria and Indonesia also report mixed effects across environmental disclosure categories. Evidence from Kenya points to continuing problems of standardisation. The present study adds evidence from listed agricultural firms and highlights a possible conditioning role for EMA. However, the Kenyan evidence is based on only seven firms and 48 complete regression observations. Direct comparisons with larger studies and other sectors should therefore be made cautiously.

CONCLUSION

This study examined the relationship between environmental cost disclosure and quality sustainability reporting among agricultural firms listed on the NSE. ECD had a positive but non-significant direct association with QSR

in Model 2. In Model 8, the ECD by EMA interaction was positive and marginally significant at the 10% level. This provides limited evidence that EMA may strengthen the ECD-QSR relationship. The finding is consistent with the view that internal systems for measuring and verifying environmental costs can improve the usefulness of external disclosure. The result is not conclusive. The effective regression sample was small, disclosure data were incomplete, and the OLS models showed positive serial correlation.

Limitations and Robustness Considerations

The study has four main limitations. First, the population contains only seven NSE-listed agricultural firms. This limits statistical power and external validity beyond the listed Kenyan agricultural sector. Second, complete-case regression used 48 firm-year observations because ECD and EMA were not reported consistently. If the missing observations are systematic, complete-case estimates may be biased. Third, ECD is highly skewed and includes one influential 2019 observation. The study therefore reports median values, discusses the outlier, and compares Pearson with Spearman correlations as sensitivity checks. Fourth, all reported regression models show positive serial correlation. Conventional OLS standard errors may therefore be unreliable. The reported coefficients are retained as descriptive multivariate estimates, but inference is treated cautiously. Future re-estimation should use firm fixed effects with heteroskedasticity and serial-correlation-robust standard errors, or feasible generalized least squares. Larger multi-sector and regional panels would also improve power and generalisability.

RECOMMENDATIONS

NSE-listed agricultural firms should strengthen environmental management accounting systems. Priority areas include environmental cost tracking, dedicated cost codes, staff training, and periodic environmental audits. ICPAK and the Capital Markets Authority should also consider clearer environmental cost classification guidance to improve comparability across firms and years. Future studies should separate environmental cost categories, including pollution control, waste management, remediation, and fines. They should also use larger multi-sector or East African panels. Robust panel estimators should be applied to address firm effects, heteroskedasticity, and serial correlation. These extensions would improve statistical power and external validity.

Disclosure of the Use of Artificial Intelligence

This manuscript was prepared with the assistance of an artificial intelligence (AI) language tool for organisation and language refinement. The tool did not generate, alter, or fabricate the underlying data, statistical results, or cited source material. All AI-assisted text was reviewed by the authors for accuracy and consistency with the study evidence. The authors retain full responsibility for the intellectual content, interpretation, and conclusions of the paper.

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