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Assessment of Environmental Cost Internalisation as Determinants of Sustainable Environmental Behaviour among SMEs in Lagos, Nigeria

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Abstract* - This study examines the role of environmental cost internalisation (ECI) as a determinant of sustainable environmental behaviour (SSEB) among small and medium enterprises (SMEs) in Lagos, Nigeria. SMEs play a critical role in economic development and contribute significantly to environmental degradation. Effective internalisation of environmental costs, such as the cost of compliance, the cost of pollution, and environmental resource damage, are determinant of sustainable environmental behaviour among SMEs. Using Partial Least Squares Structural Equation Modelling (PLS-SEM), data from 521 SMEs were analysed to determine the direct effects of ECI on SSEB. This study empirically analyses how ECI influences SMEs' sustainability practices, and the findings show that the model explains a substantial portion of the variance in SSEB (73.1%). The path coefficient from CCOMP to SSEB (0.751) indicates a strong relationship. Similarly, the path coefficient from CPOLU to SSEB (0.014) is very small and suggests a negligible relationship, while the path from ERDAM to SSEB (0.132), indicates a moderate effect. The study revealed that ECI has a significant positive impact on SSEB, showing that the cost of compliance, the cost of pollution, and environmental resource damage are determinants of sustainable SMEs' environmental behaviour in Lagos state. In contrast, the cost of pollution was found to be statistically insignificant. The study concludes that CCOMP, CPOLU, and ERADAM are determinants of sustainable SMEs' environmental behaviour in Lagos state. Training and capacity-building programs should be introduced to help SMEs internalize environmental costs and improve their sustainability performance

***Keywords*-Environmental Cost Internalisation, Sustainable Environmental Behaviour, SMEs, Lagos, Nigeria, PLS-SEM, Environmental Compliance**

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I.

II. INTRODUCTION

SMEs are critical to the economic development of Nigeria. Lagos State is the largest commercial hub in Nigeria, with a large number of small and medium enterprises (SMEs) that contribute substantially to economic growth [1]. But the activities of these SMEs impose environmental burdens; they are responsible for significant environmental impacts, including pollution, waste generation, and resource depletion.

The increasing environmental concerns stemming from business operations have intensified the need for enterprises to integrate sustainable practices [2]. The idea of sustainability as defined by economists includes tools for internalizing the environmental costs associated with the activities of SMEs in the economy [3]. Therefore, solutions must be found through initiatives aimed at changing SMEs' environmental behaviours and internalizing environmental costs from SMEs' activities.

Intergovernmental Panel on Climate Change [4]. Reported that despite growing awareness, many SMEs in developing countries struggle to implement sustainability measures. Research has identified gaps in SMEs' managerial and operational environmental insights [5],[6]. Many SMEs and startups lack the knowledge and skills needed to integrate sustainability into their business models. SMEs have not been considerate in the handling of ecological matters and lack tools and means for assimilating ecological work under their environmental actions [7]. Studies have reported that the effects of sustainability practices were extensively analysed in large and multinational companies than in SMEs [8][9][10]. This depicts the scenario in Nigeria, where studies have focused on larger firms, with limited research on SMEs. "Few studies have examined the ignorant behaviour prevalent among SMEs in developing countries" [11]. Existing literature has failed to examine how SMEs can be supported to deal with anti-environmental actions and build resilience in environmental behaviours, amid poor internal communication on sustainable environmental practices [12][13]. Reports have shown that many SMEs in Lagos do not internalise environmental costs, leading to externalities and unsustainable business practices. SMEs in Lagos and by extension, Nigeria, are yet to recognise the importance of implementing environmental sustainability as an essential component of their institutional operations. Thus, this study explores Environmental Cost Internalisation (ECI) as a determinant of Sustainable SMEs' Environmental Behaviour (SSEB).

Government regulations, consumer demand, and market forces (institutional pressures) have been established to influence SMEs' willingness to internalize environmental costs. However, SMEs often struggle with compliance due to financial constraints, weak regulations, and limited awareness. This study explores Environmental Cost Internalisation (ECI) as a determinant of Sustainable SMEs' Environmental Behaviour (SSEB). In other words, what is the influence of the cost of pollution, the cost of compliance, and environmental resource damage on SSEB? The scientific hypothesis is stated in null form, H_0: Environmental cost internalization has no significant effect on sustainable environmental behaviours among SMEs, was proposed.

The adoption of sustainable behaviour and environmental cost internalization frameworks by SMEs is the way forward for a developing economy like Nigeria in the face of global environmental challenges such as climate change and economic meltdown. Sustainable environmental costs internalization frameworks for SMEs go beyond the economic goals of creating economic value and image for SMEs. But include the creation of environmental and social benefits for both the firm and its external stakeholders [14], to further enhance the environmental behaviours of SMEs. Thereby enabling a transition from the current practices to more sustainable environmental cost internalization frameworks, this will foster a new regime of sustainable environmental management among SMEs and will give room for a "win-win situation" for the enterprise, the environment, the regulators, and other stakeholders. The subsequent part of the paper examined the methodology, results, and policy recommendations.

III. METHODOLOGY

The research design is quantitative and descriptive; the study population is 42,067 (small-37135, and medium-4932) SMEs domiciled in Lagos [15]. The sample size was determined using the inverse square root method, and the estimated sample size was approximately 521 SMEs, determined at a 5% significance level. A purposive sampling method was adopted to select six from the industrial clusters in Lagos state. Though the terms Small" and „medium" are relative and differ from industry to industry and from country to country [16], the SMEs were selected using quota sampling, a non-probabilistic sampling technique to choose SMEs from six industrial clusters (Apapa, Ikeja, Mushin, Oshodi-Isolo, Surulere, and Somolu) in the Lagos metropolis. A questionnaire was designed and distributed online between June and November 2024, and 521 SMEs participated in the survey. The Partial Least Squares Structural Equation Model (PLS-SEM) was used for data analysis with SmartPLS4. The use of PLS-SEM in this study became very important because predictive accuracy is paramount compared to other approaches of SEM, such as Covariance Based-SEM (CB-SEM), and Generalized Structural Component Analysis (GSCA).

TABLE I. MINIMUM SAMPLE SIZES FOR DIFFERENT LEVELS OF MINIMUM PATH COEFFICIENTS (PMIN) AND A POWER OF 80%

P_{min}	Significant level		
	1%	5%	10%
0.05-0.1	1004	619	451
0.11-0.2	251	155	113
0.21-0.3	112	69	51
0.31-0.4	63	39	29
0.41-0.5	41	25	19

Source: Adapted from [17]

IV. RESULTS AND DISCUSSION

A. Measurement Model for Environmental Cost Internalisation

a. Convergent Validity for ECI

Two criteria are recommended as the basis for concluding that a measurement model has acceptable convergent validity: the loadings should be 0.5 or higher, and the P values associated with the loadings should be less than 0.05 [18]. As recommended, outer loadings below 0.50 were deleted for this study, this is because those items contribute less towards the factors. A loading of 0.70 or higher is recommended; the loadings that are equal to or more than 0.7, 0.6, 0.5, or 0.4 are adequate if other items have high scores of loadings to complement AVE and CR values [19], [20]. It can be observed from the outer loadings of individual constructs that all loadings fulfil the requirement for reliability and convergent validity with a minimum value of 0.6.

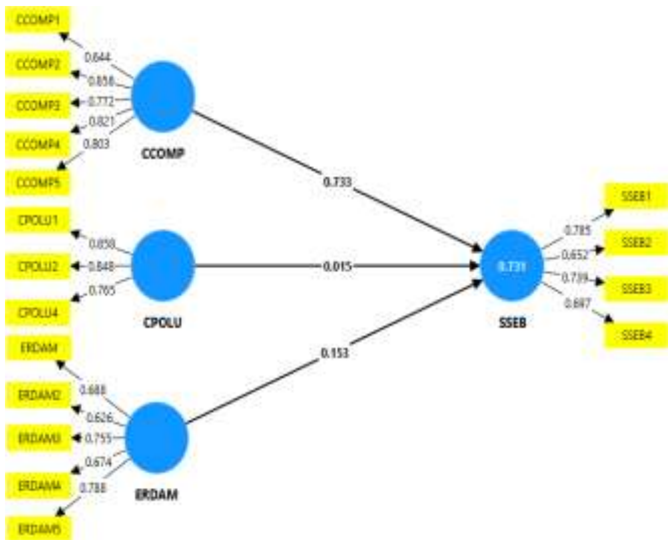

Fig. 1: Path model indicator loading for ECI

Source: SmartPLS4 output model for ECI, 2025

TABLE II. CONSTRUCT RELIABILITY AND VALIDITY FOR ECI

Indicators	Loadings	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
COMP1	0.644	0.841	0.854	0.887	0.613
CCOMP2	0.858				
CCOMP3	0.772				
CCOMP4	0.821				
CCOMP5	0.803				
CPOLU1	0.858	0.764	0.763	0.864	0.680
CPOLU2	0.848				
CPOLU4	0.765				
ERDAM	0.688	0.750	0.750	0.833	0.502
ERDAM2	0.626				
ERDAM3	0.755				
ERDAM4	0.674				
ERDAM5	0.788				
SSEB1	0.785	0.690	0.699	0.811	0.518
SSEB2	0.652				
SSEB3	0.739				
SSEB4	0.697				

Source: Field survey, 2025

Reliability refers to the consistency or stability of a measurement instrument, while validity refers to how well the construct or measure accurately represents what it is intended to represent. For this study, Cronbach's Alpha (α) measures internal consistency, with values ranging from 0 to 1; a value of 0.7 or above is generally considered acceptable. The composite Reliability (ρ_a and ρc) is an alternative to Cronbach's alpha, composite reliability is often considered a better measure in structural equation modelling. It is generally recommended to have values above 0.7 for good reliability. By extension, Average Variance Extracted (AVE) represents the level of variance captured by the construct, with values above 0.5 indicating good convergent validity.

Table 3. revealed that Cronbach's Alpha (α) for Cost of Compliance (CCOMP) is 0.841, which suggests good reliability, above the threshold of 0.7. The Composite Reliability (ρ_a and ρc) are 0.854 and 0.887, respectively, implying good reliability, above the 0.7 threshold. The average variance extracted AVE (0.613) indicates good convergent validity, above the 0.5 threshold. For the Cost of Pollution (CPOLU), Cronbach's Alpha (α) is 0.764, which implies good reliability, above 0.7. The composite Reliability (ρ_a and ρc), 0.763 and 0.864, also indicate good reliability. The AVE value is 0.680, which implies good convergent validity, above the 0.5 threshold. The construct Environmental Resource Damage/ Depletion (ERDAM) result shows a Cronbach's alpha: 0.750, composite reliability (ρ_a) 0.750, and composite reliability (ρc) 0.833, all indicating good reliability, above 0.7; while the AVE value of 0.502 implies an acceptable convergent validity, slightly above the 0.5 threshold. SSEB displays a Cronbach's alpha of 0.690, though acceptable but slightly below the ideal 0.7. The composite reliability (ρ_a) 0.699 is close to 0.7, and is acceptable, while the composite reliability (ρc) 0.811 implies good reliability, and an AVE value of 0.518 suggests good convergent validity. In conclusion, all constructs (CCOMP, CPOLU, EERDAM, SSEB) exhibit good reliability, with CCOMP and CPOLU showing excellent values for Cronbach's alpha and composite reliability. For the convergent validity, most constructs (except ERDAM and SSEB) meet the recommended AVE threshold of 0.5, thus suggesting good convergent validity overall.

b. Discriminant Validity

Heterotrait-Monotrait Ratio (HTMT) for ECI

The HTMT is the modern method used to assess discriminant validity, which determines whether constructs are sufficiently distinct from one another. Generally, HTMT values below 0.85 suggest good discriminant validity, while values above 0.85 might indicate that constructs are too similar.

TABLE III. HETEROTRAIT-MONOTRAIT RATIO (HTMT) FOR ECI

	CCOMP	CPOLU	ERDAM	SSEB
CCOMP				
CPOLU	0.747			
ERDAM	0.867	0.760		
SSEB	1.94	0.739	0.901	

Source: Field survey, 2025

Table 3. revealed that CCOMP vs CPOLU (0.747) has an HTMT value below 0.85, thus indicating good discriminant validity. For CCOMP vs ERDAM (0.867), the HTMT value is above 0.85, indicating no discriminant validity between both constructs. CCOMP vs SSEB (1.094) displays a value above 1.0, indicating a very high correlation between both constructs, thus, no discriminant validity. CPOLU vs. EREDAM (0.760) and CPOLU vs. SSEB (0.739) have HTMT values below 0.85, indicating good discriminant validity. But ERDAM vs. SSEB (0.901) has an HTMT value above 0.85, indicating that discriminant validity was not attained.

Fornell-Larcker Criterion

TABLE IV. FORNELL-LARKER CRITERION FOR ECI

	CCOMP	CPOLU	ERDAM	SSEB
CCOMP	0.783			
CPOLU	0.604	0.825		
ERDAM	0.688	0.585	0.708	
SSEB	0.847	0.547	0.666	0.720

Source: Field survey, 2025

The Fornell-Larcker criterion is another way to assess discriminant validity. According to this criterion, discriminant validity is demonstrated when the square root of the AVE (Average Variance Extracted) for each construct is greater than the correlations between the construct and other constructs.

The square root of the AVE (Average Variance Extracted) for CCOMP is 0.783, and all correlations with other constructs (CPOLU (0.604), ERDAM (0.688), SSEB (0.847) are below the square root of AVE, indicating good discriminant validity. Similarly, the square root of the AVE for CPOLU (0.825) is above the values correlations with other constructs (CCOMP (0.604), EREDAM (0.585), SSEB (0.547), indicating good discriminant validity. Furthermore, the square root of the AVE for ERDAM (0.708) and all correlations with other constructs (CCOMP (0.688), CPOLU (0.585), and SSEB (0.666)) are below the square root of AVE, indicating good discriminant validity. SSEB with a square root of the AVE of 0.720, indicates a value above its correlations with other constructs (CCOMP (0.847), CPOLU (0.547), EREDAM (0.666), but the correlation between CCOMP and SSEB (0.847) exceeds the square root of AVE (0.720), which implies poor discriminant validity between both constructs.

TABLE V. CROSS LOADINGS FOR ECI

	CCOMP	CPOLU	ERDAM	SSEB
CCOMP1	0.644	0.429	0.478	0.462
CCOMP2	0.858	0.552	0.607	0.699
CCOMP3	0.772	0.413	0.455	0.695
CCOMP4	0.821	0.492	0.556	0.707
CCOMP5	**0.803**	0.481	0.597	0.710
CPOLU1	0.492	**0.858**	0.462	0.452
CPOLU2	0.418	**0.848**	0.427	0.405
CPOLU4	0.565	**0.765**	0.542	0.485
ERDAM	0.509	0.455	**0.688**	0.452
ERDAM2	0.474	0.430	**0.626**	0.444
ERDAM3	0.477	0.373	**0.755**	0.390
ERDAM4	0.437	0.393	**0.674**	0.557
ERDAM5	0.534	0.407	**0.788**	0.471
SSEB1	0.735	0.438	0.461	**0.785**
SSEB2	0.526	0.297	0.362	**0.652**
SSEB3	0.627	0.393	0.465	**0.739**
SSEB4	0.536	0.430	0.612	**0.697**

Source: Field survey, 2025

Cross loadings provide insights into how well each indicator (item) loads onto its respective construct compared to the other constructs. It is generally expected that each indicator should load most highly on its construct, indicating good reliability and validity. The loadings on CCOMP are much higher than on other constructs, indicating good convergent validity for CCOMP. However, some of the loadings on SSEB (e.g., 0.699, 0.710) are relatively high compared to the others, indicating potential issues with discriminant validity for these items. Similarly, the loadings on CPOLU are consistently the highest for each item (CPOLU1, CPOLU2, CPOLU4), which demonstrates good discriminant and convergent validity for the CPOLU construct. On the other hand, the loadings on ERDAM are much higher than on the other constructs, indicating good convergent validity for ERDAM. However, some loadings on SSEB (e.g., 0.557, 0.471) are noteworthy and suggest potential discriminant validity concerns. The loadings on SSEB are highest for the SSEB construct (e.g., 0.785, 0.739, 0.697), showing good convergent validity.

c. The coefficient of Determination for ECI

This coefficient is a measure of the model's predictive accuracy and is calculated as the squared correlation between a specific endogenous construct's actual and predicted values. For this model, the R^2 is 0.731, which indicates that the model explains 73.1% of the variance in SSEB. This is a high R^2 value, meaning the model explains a significant portion of the variation in SSEB. While the adjusted R^2 is 0.730. Since the adjusted R^2 accounts for the number of predictors in the model and adjusts for any overfitting. The fact that the adjusted R^2 is very close to the R^2 suggests that the model is well-specified, with minimal overfitting.

d. *Evaluation of Model Fit for ECI*

Model fit indicators provide insights into how well the model fits the data. The saturated model assesses the correlation between all constructs. On the other hand, the estimated model is based on a total effect scheme, which considers the model structure.

TABLE VI. EVALUATION OF MODEL FIT FOR ECI

Measures	Saturated model	Estimated model
SRMR	0.095	0.095
d_ULS	1.370	1.370
d_G	0.648	0.648
Chi-square	1747.266	1747.266
NFI	0.648	0.648

Source: Field survey, 2025

The Standardized Root Mean Square Residual (SRMR) is one of the indices that measure how well a model fits. If the SRMR value is less than 0.08 or 0.10 it indicates an acceptable model fit. The result for the saturated model (0.095) and the estimated model (0.095), suggests an acceptable model fit, although it is slightly above the ideal threshold of 0.08. Another index is the Unweighted Least Squares Distance (d_ULS) with a saturated model (1.370) and an estimated model (1.370). since a lower value indicates a better fit. The value of 1.370 seems acceptable, indicating that the estimated model fits well compared to the saturated model. Similarly, Geodesic Distance (d_G), with a saturated model (0.648) and an estimated model (0.648). Since the geodesic distance has a low value of 0.648, it is significantly reasonable. The Normed Fit Index (NFI) results for the saturated model, 0.648, and the estimated model, 0.648, are equal. The NFI value ranges from 0 to 1, with higher values indicating a better fit. As can be seen, the NFI values of both estimated and saturated models are close to 1, which indicates that the model has a good fit. The model has an acceptable fit based on the indices provided, but there might be room for improvement. The SRMR and NFI values suggest the model could be refined further to improve fit.

B. Structural Model Evaluation of ECI

a. Evaluation of Path Coefficient

TABLE VII. PATH COEFFICIENT MEAN, STDEV, T VALUE, P VALUE FOR ECI

	Original sample	mean	STD	T stat	P val	Bias	5.0%	95.%
CCOMP -> SSEB	0.751	0.751	0.034	22.107	0.000	0.000	0.696	0.808
CPOLU -> SSEB	0.014	0.014	0.035	0.384	0.350	0.000	-0.042	0.074
ERDAM -> SSEB	0.132	0.133	0.038	3.488	0.000	0.002	0.065	0.190

Source: Field survey, 2025

Table 7. presents the breakdown of the path coefficients, their means, standard deviations, t-values, and p-

values for the paths, and confidence intervals bias-corrected in the model. The path coefficient from CCOMP to SSEB is 0.751, with a very low standard deviation (0.034), which indicates a strong relationship. The t-value (22.107) is highly significant, and the p-value (0.000) is less than the conventional significance level of 0.05, suggesting that this path is statistically significant. This implies a very strong and highly significant effect. Similarly, the path coefficient from CPOLU to SSEB is 0.014, which is very small and suggests a negligible relationship. The t-value (0.384) is quite low, and the p-value (0.350) is greater than 0.05, indicating that this path is not statistically significant. This implies that there is no significant relationship between CPOLU and SSEB in the model. Furthermore, the path coefficient from ERDAM to SSEB is 0.132, which indicates a moderate effect. While the t-value (3.488) is quite high, and the p-value (0.000) is less than 0.05, indicating that this path is statistically significant. This implies that there is a significant positive effect of ERDAM on SSEB.

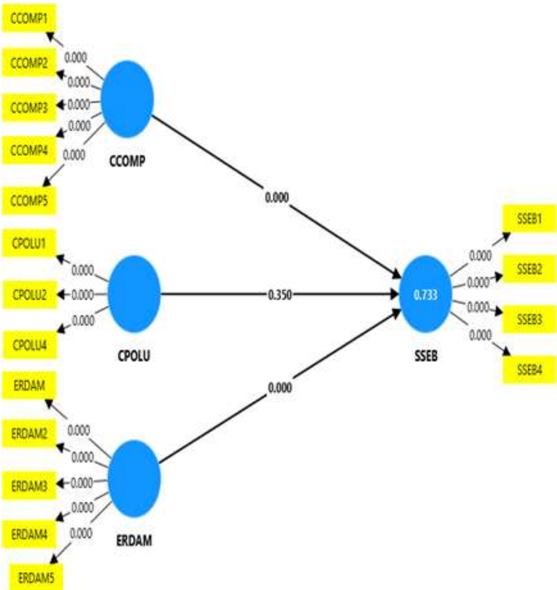

Fig. 2: Bootstrapping for the ECI model
Source: SmartPLS4 output model for ECI, 2025

The bias-corrected values (0.000) of the path coefficient from CCOMP to SSEB are negligible (close to zero). The confidence interval (CI) ranges from 0.696 to 0.808, which suggests a strong positive relationship that is statistically significant, as the entire interval is above zero. Similarly, the bias (0.000) is negligible for the path coefficient from CPOLU to SSEB, while the confidence interval ranges from -0.042 to 0.074, which includes zero, indicating that the relationship is not statistically significant. This suggests that CPOLU has an insignificant effect on SSEB. The path coefficient from ERDAM to SSEB has a very small bias (0.000). The confidence interval ranges from 0.065 to 0.190, suggesting that the effect of ERDAM on SSEB is statistically significant and positive.

b. *Effect Size and Significance of the Path Coefficients*

The f^2 statistic measures the effect size of individual predictors in a model, showing how much each independent variable contributes to explaining the dependent variable. The f^2 value for CCOMP is 0.920, this implies that CCOMP has a large effect on the dependent variable in the model, especially in explaining variance in SSEB. While CPOLU with an f^2 0.001, implies that CPOLU has an extremely small effect on SSEB, essentially negligible. On the other hand, the f^2 value for ERDAM is 0.042, which indicates that ERDAM has a small effect on SSEB, suggesting it contributes slightly to the variance in SSEB.

c. *Predictive Power of the Study Model*

TABLE VIII. SUMMARY OF PLS PREDICT MEASUREMENT VARIABLES

	Q^2predict	pls-sem RMSE	pls-sem MAE	LM_RMSE	LM_MAE	IA_RMSE
SSEB1	0.517	0.818	0.662	0.641	0.418	1.178
SSEB2	0.264	0.997	0.772	0.970	0.692	1.162
SSEB3	0.390	0.904	0.716	0.838	0.602	1.157
SSEB4	0.323	0.923	0.748	0.792	0.500	1.121

Source: Field survey, 2025

The Q^2predict values indicate the model's predictive relevance, with SSEB1 having a moderate Q^2predict (0.517) and SSEB2 the lowest (0.264). RMSE and MAE metrics for measurement variables suggest that SSEB1 has the least error, especially in IA RMSE and IA MAE.

TABLE IX. SUMMARY OF PLS PREDICT LATENT VARIABLES

	Q^2predict	RMSE	MAE
SSEB	0.726	0.525	0.389

Source: Field survey, 2025

TABLE X. CVPAT LV SUMMARY

	PLS loss	IA loss	Average difference	loss	t value	p-value
SSEB	0.833	1.334	-0.501		11.983	0.000
Overall	0.833	1.334	-0.501		11.983	0.000

Source: Field survey, 2025

The latent variable summary for SSEB shows good predictive performance with a Q^2predict of 0.726, RMSE of 0.525, and MAE of 0.389. The CVPAT results indicate that the predictive performance of the PLS model is significantly better than the IA model, as evidenced by the t value of 11.983 and a p-value of 0.000, showing strong statistical significance. The model's PLS prediction results demonstrate overall strong performance in predicting both measurement and latent variables, particularly for SSEB.

V. CONCLUSION

From the above findings the study conclude that the model explains a substantial portion of the variance in SSEB (73.1%), the PLS prediction results demonstrate overall strong performance in predicting both measurement and latent variables. The study concludes that the cost of compliance, cost of pollution, and environmental resource damage are determinants of sustainable SMEs' environmental behaviour in Lagos state. However, the contribution of the determinants is varied, with CCOMP having a very large effect on the model, while CPOLU has a negligible effect, and ERDAM contributes a small effect.

The path from CCOMP -> SSEB depicts a strong and significant positive effect. This means that as more SMEs comply with environmental regulatory standards, there is an attendant increase in sustainable SMEs' environmental behaviour. While the path from CPOLU -> SSEB shows an insignificant effect. The cost of pollution has no significant effects on the sustainable environmental behaviour of SMEs. However, the path from ERDAM -> SSEB exhibits moderate and statistically significant positive effects. This implies that provision to mediate environmental resource damage/depletion will moderately enhance the sustainable environmental behaviour of SMEs.

VI. RECOMMENDATION

Policymakers should develop more SME-friendly environmental regulations that encourage compliance without imposing excessive financial burdens on SMEs operating in Lagos. This can be achieved when regulatory bodies streamline approval processes for SMEs adopting green initiatives to reduce bureaucratic bottlenecks, develop regulations that distinguish between large corporations and SMEs, ensure proportionate compliance requirements, and, lastly, create flexible compliance timelines to allow SMEs a grace period to adjust to new environmental policies before full enforcement.

Training and capacity-building programs should be introduced to help SMEs internalize environmental costs and improve their sustainability performance. Expand training and awareness through online and in-person courses tailored to SMEs on cost-effective sustainability strategies. Government-sponsored sustainability workshops should be organized in partnership with business associations and universities. Increase awareness through TV, radio, and social media campaigns that educate SMEs on the benefits of sustainable practices. By implementing these recommendations, SMEs and industrial associations in Lagos can align their business models with sustainability principles, reduce operational costs, enhance competitiveness, and contribute to a healthier environment.

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