

CSR and sustainable performance in Indonesian recycling firms: The mediating role of company ability in the circular economy era



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ABSTRACT

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This study sought to investigate the role of corporate social responsibility (CSR) in sustainable performance with company ability as a mediating variable among recycling companies in Indonesia during the era of the circular economy. This quantitative study was conducted on recycling industries that use the waste bank system to process plastic, paper, textiles, and wood materials into furniture, organic fertilizers, and handicrafts. Of the 241 questionnaires sent to commercial recyclers in Indonesia, 151 were completed and returned with valid answers. SmartPLS was used for PLS-SEM to perform confirmatory factor analysis, correlation and multicollinearity tests, reliability analysis, predictive relevance (Q^2), common method bias testing, and bootstrapped structural path coefficients. The findings reveal that the company's ability significantly drove the mediated link between CSR and sustainable performance. CSR affects sustainable performance ($\beta = 0.387$; $p < 0.01^{***}$) and is indirectly affected by company ability (indirect $\beta = 0.425$; $p < 0.01^{***}$). The model explains 80.5% of the variance in sustainable performance. These findings highlight the need for a long-term approach that prioritizes sustainability over short-term costs, especially in developing economies facing the global climate crisis. This study provides a seldom-seen integrated perspective on recycling in Indonesia. It shows that company competence is key to sustainable value creation, while supporting the ESG and circular economy agendas as drivers of green growth.

Contribution/ Originality: This study is original because it investigates how a company's ability mediates the relation between CSR and sustainable performance among Indonesian recycling companies. This study contributes to the circular economy literature by revealing empirical evidence from a developing-country context and establishing organizational capability as a decisive factor for achieving sustainable value.

1. INTRODUCTION

Modern enterprises need to innovate the way that they operate as well as the products and services that they provide, and they need to do so with the lowest possible environmental impact. Well into a century of competing global contexts, discourses of economic sustainability are now dominated by concern with the environment [1]. The TBL framework, originally proposed by Loviscek [2], provides an established interpretive foundation for examining sustainability in SSC-I4.0 research, as SSCs inherently encompass interconnected economic, environmental, and social

dimensions of value creation [3], balancing profit, people, and planet. More factories are encouraged to adopt green standards to improve their strategic position [4]. Environmental safety awareness and knowledge are essential contributors to conservation and can play crucial roles in effective conservation [5]. Moreover, CSR efforts demonstrate corporations' commitment to social welfare and sustainable development [6]. GI, on the other hand, can be viewed as strategic know-how that supports sustainable, long-term processes through innovation in product design, operations, and management practices [7], complementing the investment and reputation effects of CSR. As argued by Sasmoko et al. [8], recycling is a key approach to reducing the depletion of natural ecosystems and maintaining environmental health.

The stakeholder theory states that companies should meet the needs of all stakeholders, such as consumers, employees, the local community, and even ecological systems [9, 10]. CSR demonstrates a firm's sustainability practices in the recycling industry in Indonesia [11]. The implementation of sustainability principles, in combination with green innovation, reinforces stakeholder relationships and strengthens competitive advantage [12, 13], thereby increasing profits [14]. Despite the recycling industry in Indonesia processing about 2.54 million tons per year (at 87% capacity) and employing nearly 3 million workers, significant challenges persist. Indonesia produces approximately 29.36 million tonnes of waste each year, with 37.71% remaining unmanaged [15]. The National Waste Management Information System estimates that these statistics highlight the challenges in national solid waste management and the urgent need for future sustainability [16].

Extensive research exists on CSR sustainable performance linkages, yet studies on the mediating role of company capabilities, especially in the context of developing countries with weak recycling infrastructure, such as Indonesia, are limited [17]. First, we find that dominant literature examines the direct effects of CSR on sustainable performance to the exclusion of internal firm phenomena promoting CSR impacts [18]. This contribution is significant in providing new sustainability strategy lenses that frame corporate capabilities as fundamental sustainable value creation capabilities. Results foreseen will devote evidently into advancing agile policy and resilient industry practices to overcome climate change and global industrial upheaval [19].

This study explores the mediating role of organizational capabilities on the relationship between CSR and Sustainable Performance in the recycling industry in Indonesia. Previous studies have investigated green-oriented practices in distinct financial settings: firms listed on the Pakistan Stock Exchange [20], Ecuadorian manufacturing firms [21], and firms listed on the Indonesia Stock Exchange [22]. In addition, Indonesian SMEs are also the subject of academic interest [23] and service firms in the Maldives-Morocco region [24]. However, previous studies mainly focus on the influences of green practices on aspects of firm capabilities, economic value, and environmental performance, while the social aspect is still a significant research gap [25, 26]. Thus, the present study aims to expand sustainability literature by addressing the recycling aspect, using Indonesia's recycling industry as a case study. In particular, this study focuses on the following two research questions: (1) Does CSR directly influence sustainable performance? (2) To what extent does organizational capability mediate this relationship?

This portion tells in detail about the science and how to form a hypothesis. We'll then walk you through the research we conducted & how we collected the data. The paper then outlines key results, backed by extensive analysis and discussion. The constraints are addressed in the concluding section of the work, along with the justification of theoretical and practical consequences and recommendations for further research.

2. THEORETICAL STUDY

2.1. Theory of Stakeholders

The Stakeholder Theory posits that corporations have obligations to a broader array of entities that desire fulfilment, including customers, employees, communities, and the environment [27]. In this context of research, CSR can be expressed as corporate accountability towards corporate stakeholders, especially in the recycling industry in Indonesia [28]. By adopting green innovation and practices of sustainability, the principles raise harmonious

stakeholder interactions and develop the capabilities of firms [29]. These dynamics, in turn, enhance business continuity and the achievement of responsible corporate objectives [30].

2.2. Development of Hypotheses

2.2.1. CSR and Company's Ability

Sustainable Performance refers to when a firm incorporates social, environmental, and economic factors into its operational decision-making processes [31]. SP denotes the trans-conditioning with these domains so that these three factors coexist [5]. Some critical indicators within this framework include social performance, which involves measuring community health, employee welfare, and occupational safety [32], and economic performance, which encompasses profitability, market share, and customer base [33], as well as environmental performance, which concerns resource consumption and recycling efficiency [34]. The inclusion of this dimension. The company's capability refers to its organisational capacity to achieve superior performance through cost leadership, differentiation, or market focus strategies, reflecting a holistic perspective that goes beyond normative conformity. Organizations that develop this integrative capacity exhibit a strategic ability to address shifting stakeholder expectations in an adaptive manner [6]. In order to embrace this paradigm, companies are not only able to embed CSR initiatives into internal capability development but also strengthen the internal basis for competitive advantage and further improve long-run sustainability management effectiveness [35]. CSR is mainly ethical commitments concerning economic, environmental, and societal progress [36, 37], which may include green behaviours, assurance of social protection, and product safety [38]. Product- and process-related innovations in the scope of CSR primarily focus on energy and ecological implications [39, 40]. From the details explained above, the hypothesis that can be proposed is:

H₁: CSR has a positive effect on CA.

2.2.2. Company's Ability and Sustainable Performance

A core pillar of sustainable performance is a company's ability [41]. The concept of green economy itself is a principle that aims to encourage the direction of the economy towards chosen sustainability, by multiplying the ability of the organization by developing a green economy-based business operation that has an impact to attract more investment and to give a positive contribution to the environment [42]. The economic aspects of sustainability reporting have been shown to increase firm value (as opposed to environmental and social aspects) [43]. It highlights the need for companies to begin working on their internal capabilities to support the adoption of sustainable practices, to transition them towards better & long-lasting performance [44]. From the above discussion, we are proposing the following hypothesis.

H₂: CA will positively influence to SP.

2.2.3. CSR and Sustainable Performance

Recent scholarship shows that corporate social responsibility (CSR) adoption has a positive impact on sustainable performance [45, 46]. CSR commitments are reflected in sustainable practices such as optimum resource usage, emission reduction, and minimized waste that stimulate economic growth over the long run [47, 48]. Therefore, adopting competitive strategies such as cost leadership, differentiation, and innovation is critical to facing fierce competition in highly dynamic environments [49, 50]. They open doors to new business opportunities, while also helping in the improvement of corporate reputation and brand equity [51]. In addition, they continuously promote financial performance and improve global competitiveness [52]. CSR is, therefore, increasingly viewed as an important strategy for firms that aim at achieving sustainable growth using strong competitiveness strategies in a volatile business environment [53, 54]. Research Hypothesis.

H₃: CSR has a positive impact on SP.

Table 1. Cross-country comparison of CSR and sustainable performance research.

Author	Country	Method	Main finding
Bahta et al. [55]	Cross-sector context	Quantitative	CSR can increase green innovation, which ultimately strengthens sustainable performance outcomes.
Shahzad, et al. [56]	Pakistan	PLS-SEM and gray relational analysis	CSR plays an important role in promoting eco-friendly practices that positively affect sustainable performance and green innovation.
Padilla-Lozano and Collazzo [57]	Ecuador	Quantitative model with 325 managers	CSR and green innovation significantly affect manufacturing competitiveness, indicating a strong link with corporate sustainability.
Fosu, et al. [58]	Ghana	Multiple regression with a mediation model	CSR and green innovation both improve environmental performance; green innovation mediates the CSR–environmental performance link.
Katenova and Qudrat-Ullah [59]	Kazakhstan	Quantitative survey and correlation analysis	CSR has a positive relationship with firm performance, including Net Profit Margin, and strengthens reputation and stakeholder engagement.
Owusu, et al. [60]	Indonesia	PLS-SEM	CSR enhances green innovation and supports sustainable performance through green dynamic capabilities.
Aftab, et al. [61]	Emerging market context	Quantitative model	CSR, green dynamic capabilities, and green innovation capabilities are interconnected and contribute to corporate sustainable performance.

Our research offers a more comprehensive approach than the previous studies shown in Table 1, which mainly focused on the direct effects of recycling issues. This research delineates firm capability as a crucial mediating variable in the correlation between recycling challenges and resultant outcomes. This research aims to elucidate the strategic significance of firm capabilities in enhancing the processes and benefits of recycling activities, in line with contemporary advances in scientific research methodologies.

2.2.4. Mediating Company Ability

The impact of corporate social responsibility (CSR) on sustainable performance is positive [62, 63]. Moreover, CSR adopts sustainable-oriented technologies and innovation because they drive efficient resource utilization, waste reduction, and operational cost savings, thus leading to improved profitability [64]. The above shows how CSR pertaining to natural resource management accelerates economic performance directly and indirectly via superior company capability mediation, among others [65, 66]. The marketability of sustainability activities through company capability [67]. As such, companies utilise CSR as a means for cost savings, increasing profits and market share [68]. Firm capability as a new mediator [69] between CSR and sustainable performance has a positive effect on economic performance agglomeration enhancer.

H₄: CA mediates the relationship between CSR and SP.

2.2.5. Research model framework

The study's conceptual framework is based on theoretical synthesis and empirical evidence collected through four hypotheses, which were tested after applying the SmartPLS algorithm. Research Outcomes: The Overall model shows that Corporate Social Responsibility positively affects sustainable performance, with green innovation partially mediating this effect in a recycling company in Indonesia, as shown in the following figure. PLS-SEM Analysis. The results of the PLS analysis show that path coefficients are significant and the mediating effect of green innovation has been confirmed for the three critical relationships, so that the relation model can be expressed as follows.

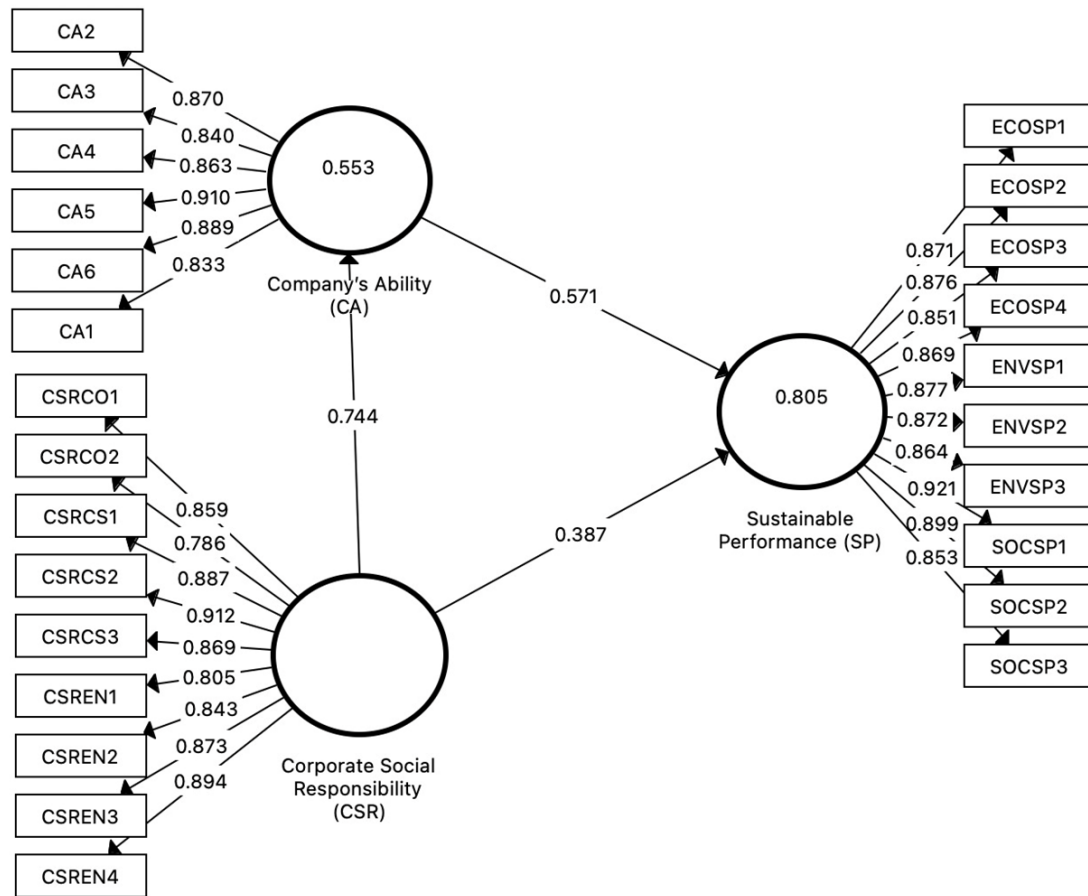


Figure 1. Research model framework.

3. METHODOLOGY

With a quantitative approach, this research explores the significant mediating role of CA between CSR and SP. Data were analyzed using SEM-PLS with SmartPLS software, including bootstrapping (5,000 resamples) to confirm the path coefficients. It improves the stability of the results and elucidates interactions among variables. Research Model Framework Based on SmartPLS algorithm outputs (from Figure 1).

3.1. Procedures and Data Collection

A structured questionnaire was developed and distributed via Google Forms (a web-based survey) to company representatives to collect primary data. Respondents were contacted through contact information found on the companies' websites and official social media profiles. Multi-item measures developed on a five-point Likert scale were used to evaluate the relationships among the predefined variables. In this study, independent, dependent, and mediating variables were included. As detailed in Appendix Table A1, all measurement items were carefully refined (based on pretests) to improve response reliability and reduce potential bias.

Table 2. Latent variable descriptive.

Variables	Obs.	Mean	Median	Min.	Max.	SD	Excess Kurtosis	Skewness
CA	151	0.000	0.238	-3.179	1.519	1.000	-0.182	-0.683
CSR	151	0.000	0.142	-3.082	1.299	1.000	-0.285	-0.655
SP	151	0.000	0.168	-2.992	1.427	1.000	-0.293	-0.649

The mean and standard deviation of all the latent variables in Table 2 are 0.000 and 1.000, which means that the data were standardized [70]. The skewness and excess kurtosis values for the three variables are within the expected

ranges, indicating that the distributions are close to normal [71]. The minimum and maximum values also indicate that the data has sufficient variation for further analysis. These results confirm that the data's statistical properties are appropriate for structural model testing in contemporary quantitative analysis.

3.2. Population and Samples

The unit of analysis in this study comprises enterprises within Indonesia's recycling industry that implement waste bank systems and convert waste materials (plastic, paper, textile, wood) into high-value economic products (furniture, organic fertiliser, handicrafts). Due to the lack of previous studies in recycling contexts, this sector was chosen. Furthermore, it is proactively promoting sustainability initiatives and becoming new alternative solution for environmental problems with a huge potential to grow in Indonesia.

3.3. Method of Data Analysis

The present study used descriptive statistics to profile respondents and describe the characteristics of recycling firms. To estimate and interpret the mediating effect of the Company's Ability (CA), the collected data were analyzed using the SEM-PLS technique in SmartPLS [72]. The SmartPLS output was used to develop the model in a few steps. The analyses included confirmatory factor analysis (CFA), correlations, multicollinearity, reliability, model predictive relevance (Q^2), common-method bias tests, and structural model testing (bootstrapped path coefficients). PLS-SEM was chosen because the research is exploratory (mediation testing) and because the data do not need to be multivariate normal.

4. RESEARCH RESULTS

4.1. Research Respondent Data

Data were collected using 241 questionnaires distributed to Indonesian recycling companies and resulted in 151 valid responses (62.7% response rate). In Figure 2, the respondent's profile is presented, which includes their gender, education, and job position, and which are the basis of a deeper highlight of the other paragraphs. Firm characteristics such as recycling material type, operational length, and state of breakdown are further explained in Figure 3. Results: These descriptive analyses offer detailed information on study sample characteristics in terms of participant demographics and organizational profiles.

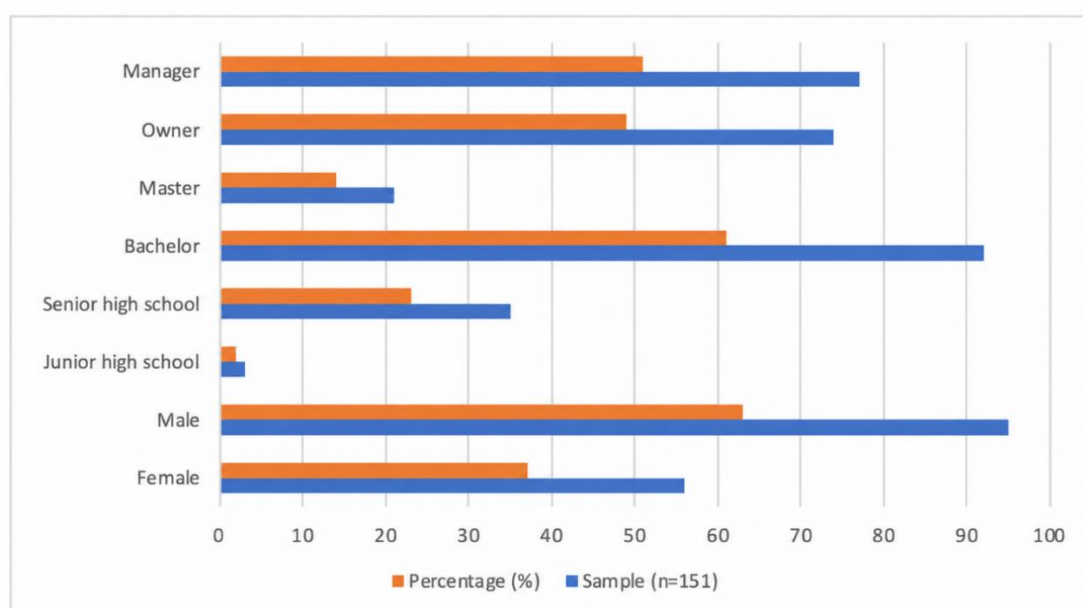


Figure 2. Characteristics of the respondents.

According to Figure 2, most respondents are male (63%), while females account for only 37%. The highest education level is held by bachelor's degree holders (61%), followed by high school graduates (23%), master's degree holders (14%), and junior high school graduates (2%). In terms of position, respondents are nearly evenly split between business owners (49%) and managers (51%). These findings indicate that the observed industry is dominated by males and highly educated professionals, consistent with recent studies on business actors in the formal sector.

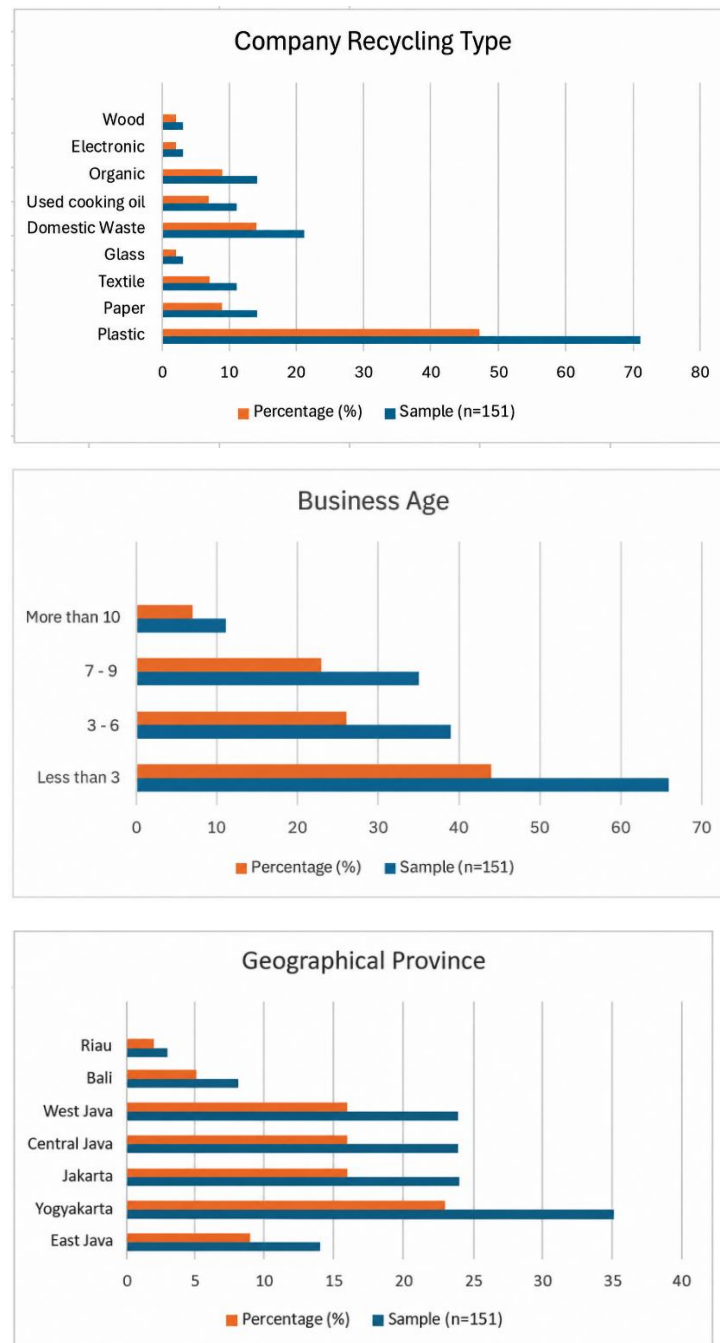


Figure 3. Company characteristics.

The data in Figure 3 show that the majority of companies are in plastic recycling (47%), followed by domestic waste (14%), paper and organic waste (each 9%), and used cooking oil and textiles (each 7%), as well as glass, electronic, and wood (each 2%). This means that plastic continues to be the main target of waste management in Indonesia, consistent with national data, which states that plastic waste is the largest component of urban waste.

Business experience is also limited, with 44% of the companies operating for no more than 3 years, indicating the recycling space is moving fast, but still early for many players. The remaining have been in the business for several years: 26% operated for 3-6 years, 23% for 7-9 years, and only 7% for more than 10 years. For the company location, 23% of the companies are domiciled in Yogyakarta, 16% in Jakarta, Central Java, and West Java, 9% in East Java, 5% in Bali, and 2% in Riau. These results show that recycling works are dominated by Java, in accordance with the previous findings related to the concentration of the waste disposal industry in Indonesia.

4.2. Measurement Model and Confirmatory Factor Analysis (CFA)

In line with the two-step approach suggested by Anderson and Gerbing [73], this research performed statistical analysis in steps to guarantee a thorough evaluation of model quality. In the first stage, confirmatory factor analysis (CFA) assessed the measurement model using Smart PLS-SEM and determined indicator validity and reliability. The following stage explored structural relationships between latent constructs to extract meaningful causal insights. This approach, to be performed before model examination for structure, is in accordance with current PLS-SEM guidelines [74]. Confirmatory factor analysis (CFA) results and the measurement properties are reported in Table 3, whilst construct indicators information is provided in the Appendix.

Table 3. Measurement model and confirmatory factor analysis.

Constructs and the sources of the measures	VIF Value	Standardized Loadings	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Company's Ability [75]			0.934	0.936	0.948	0.753
CA1	2.741	0.833				
CA2	3.235	0.870				
CA3	2.588	0.840				
CA4	3.289	0.863				
CA5	3.012	0.910				
CA6	3.566	0.889				
Corporate Social Responsibility [75]			0.956	0.956	0.962	0.739
CSRCO1	3.431	0.859				
CSRCO2	2.503	0.786				
CSRCS1	3.323	0.887				
CSRCS2	3.205	0.912				
CSRCS3	3.520	0.869				
CSREN1	2.382	0.805				
CSREN2	2.994	0.843				
CSREN3	3.573	0.873				
CSREN4	3.614	0.894				
Sustainable Performance [75]			0.966	0.966	0.970	0.767
ECOSP1	3.268	0.871				
ECOSP2	3.328	0.876				
ECOSP3	3.803	0.851				
ECOSP4	3.850	0.869				
ENVSP1	3.608	0.877				
ENVSP2	3.203	0.872				
ENVSP3	3.116	0.864				
SOCSP1	3.501	0.921				
SOCSP2	3.283	0.899				
SOCSP3	3.439	0.853				

The results of the measurement model and CFA for the constructs Company's Ability, CSR, and SP are provided in Table 3. All measurement items have a standardized loading value higher than 0.70 and thus meet the criteria for acceptable convergent validity [74]. (see) As Cronbach's Alpha and Composite Reliability (CR) values consistently

exceed the recommended minimums of 0.90 and 0.70, respectively [76], construct reliability is further confirmed due to their very high internal consistency. Moreover, the Average Variance Extracted (AVE) values for all constructs are also higher than 0.50, which demonstrates that the variance captured by the constructs exceeds the error variance [77]. VIF values are all < 5.0 , additionally reinforcing the absence of a severe multicollinearity problem flagged in the model [78]. Such results highlight that the measurement model passes strict psychometric evaluation for subsequent hypothesis testing.

4.3. Correlation, Multicollinearity, Reliability

Table 4 presents mean, standard deviations, and zero-order correlations. Correlation analysis shows coefficients far below the 0.75 reference threshold for the conservative definition of multicollinearity absence. The inter-class correlation ranged from 0.132 to 0.616. The Interjurisdictional Variance Inflation Factor (VIF) results also yield values below 5.00, confirming that no structural collinearity problems are likely to occur in this analysis [74]. Construct discriminant validity was assessed using the Fornell-Larcker criterion as well as HTMT ratios, which were presented in Table 3, respectively, so that square roots of AVE values (0.71-0.86) are higher than inter-construct correlations, therefore fulfilling the requirements of the discriminant validity condition [79].

Diagonal AVE square roots exceed all off-diagonal correlations, meaning that the Fornell-Larcker criterion holds and all HTMT ratios are below the conservative 0.90 threshold. The external VIF of the factors are listed in Table 3. Such metrics that are aligned with updated PLS-SEM evaluation guidelines provide assurance of the measurement model quality before any structural analysis is performed [74].

Table 4. Descriptive statistics: Means, standard deviations, zero-order correlations.

Variables	Mean	SD	CA	CSR	SP
Fornell-Larcker criterion					
CA	0.000	1.000	0.868		
CSR	0.000	1.000	0.744	0.860	
SP	0.000	1.000	0.859	0.812	0.876
Heterotrait Monotrait Ratio					
CA	0.000	1.000			
CSR	0.000	1.000	0.783		
SP	0.000	1.000	0.803	0.845	

Table 4 displays the results of discriminant validity for CA, CSR, and SP. The Fornell-Larcker criterion demonstrates that the square root of the Average Variance Extracted (AVE) for each construct exceeds its correlations with other constructs, hence confirming sufficient discriminant validity [77]. Further evidence of the robustness of discriminant validity in the research model is also shown by HTMT ratio values that were lower than the 0.85 or 0.90 thresholds considered conservative for constructs [79]. Such results guarantee that each construct within the model is mutually exclusive – or at least non-overlapping – and meets the psychometric thresholds for structural modeling in a subsequent linear hierarchical regression.

4.4. Model Predictive Accuracy

The model predictive accuracy was evaluated with R^2 (Coefficient of Determination), Q^2 (Predictive Relevance), and f^2 (Effect Size). These assess the model's ability to explain endogenous variance and predict out of sample, as described in the accompanying table. This assessment follows that of conventional PLS-SEM guidelines for evaluating explanatory power and predictive utility [74].

Table 5. R^2 and adjusted R^2 ; Q^2 and effect size.

Variables	R^2	Adjusted R^2	Q^2_{predict}	RMSE	MAE	Effect Size
CA	0.553	0.550	0.550	0.682	0.518	Medium
SP	0.805	0.803	0.658	0.593	0.462	Medium

Table 5 indicates a good predictive quality of the PLS-SEM structural model. For Company Ability (CA): $R^2 = 0.553$ (55.3% variance explained), adjusted $R^2 = 0.550$, $Q^2_{\text{predict}} = 0.550$ (medium prediction), medium effect size. SP shows higher explanatory power: $R^2 = 0.805$ (80.5% variance), adjusted $R^2 = 0.803$, $Q^2 = 0.658$ (strong prediction), RMSE = 0.593, MAE = 0.462. Predictive relevance is confirmed by [74]. Results of this model (and subsequent analysis) are model based subsequently mediation analysis.

Table 6. f^2 Values explanation.

Variables	CA	SP
CA	0.349	0.349
CSR	0.390	0.345

Table 6: f^2 values of exogenous influences on the endogenous constructs in PLS-SEM. CSR shows a large effect on Company Ability (CA) ($f^2 = 0.39$ (>0.35), making CSR the most predictive of Company Ability (CA) [74]. CSR is medium to SP ($f^2 = 0.345$; $0.15-0.35$) while category CA $\rightarrow$ SP is large ($f^2 = 0.349$). The substantive contributions across all hypothesized paths confirm a robust mediation model for follow-up structural analysis.

4.5. Common Method Bias Assessment

However, with self-reported survey data, analytical integrity should be preserved by conducting thorough common method bias (CMB) tests [80]. Multi-method procedures were used: Harman's single-factor test explained 24.67% of the variance (below the 50% threshold), indicating no significant CMB. As additional validation responding to validity critiques of Harman's [81] test, the latent variable approach produced inner VIF <3.3 , confirming lack of common method bias [78].

4.6. Structural Model Testing

The structural model was evaluated utilising PLS-SEM, incorporating route analysis via bootstrapping processes, confirmatory factor analysis, and assessment of measurement properties as detailed in the following table.

Table 7. Results of hypothesis testing [Path coefficients bootstrapping].

Hypotheses	Relationships	Original Sample	Sample Mean	Standard Deviation	T Statistics	P Values	Result
H1	CSR $\rightarrow$ CA	0.744	0.745	0.048	15.535	0.000***	H1_Accepted
H2	CA $\rightarrow$ SP	0.571	0.566	0.062	9.282	0.000***	H2_Accepted
H3	CSR $\rightarrow$ SP	0.387	0.394	0.059	6.530	0.000***	H3_Accepted
Mediating Hypotheses							
H4	CSR $\rightarrow$ CA $\rightarrow$ SP	0.425	0.421	0.051	8.296	0.000***	H4_Accepted

Note: ***sig <0.01 (1%).

Table 7 shows the results of hypothesis testing using bootstrapped path coefficients in SEM-PLS. These results strongly support all of the proposed hypotheses. Hypothesis H1 investigates the direct correlation between Corporate Social Responsibility (CSR) and Company's Ability (CA), resulting in an original sample path coefficient (O) of 0.744, a sample mean (M) of 0.745, a standard deviation (STDEV) of 0.048, a T-statistic of 15.535, and a p-value of 0.000*** (significant at $\alpha < 0.01$). The T-statistic surpassing the 1.96 threshold signifies a substantial positive impact of CSR on corporate capabilities, consistent with recent findings in Indonesia's recycling industry.

Hypothesis H2 validates CA's direct influence on Sustainable Performance (SP), indicated by $O=0.571$, $M=0.566$, $STDEV=0.062$, T-statistic 9.282, and p-value 0.000***. This affirms that company capabilities, especially those enhanced by AI, are essential for sustainable outcomes, reflecting mediation research on green innovation in CSR settings.

H3 supports the direct CSR-SP pathway ($O=0.387$, $M=0.394$, $STDEV=0.059$, T-statistic 6.530, p-value 0.000***), Complementary partial mediation. The mediating hypothesis H4 ($CSR \rightarrow CA \rightarrow SP$) exhibits $O=0.425$, $M=0.421$, $STDEV=0.051$, T-statistic 8.296, and p-value 0.000***, thereby validating significant mediation as the indirect effect exceeds the threshold ($VAF > 20\%$).

These findings collectively reinforce the mediation model in the context of the circular economy, establishing CA as a strategic conduit from CSR to SP within Indonesian recycling enterprises. Comprehensive empirical support across pathways (all $p < 0.01$) underscores the significance of CSR-capability integration in tackling global climate issues, with ramifications for ESG policies. This study enhances the literature by employing a localized PLS-SEM approach, similar to recent research on sustainability Performance. The path diagram illustrating outer loadings, path coefficients, and bootstrapping p-values is presented in the following figure. Figure 4 illustrates the data analysis results obtained using SmartPLS through bootstrapping to strengthen the findings presented in Table 7 on hypothesis testing based on path coefficients.

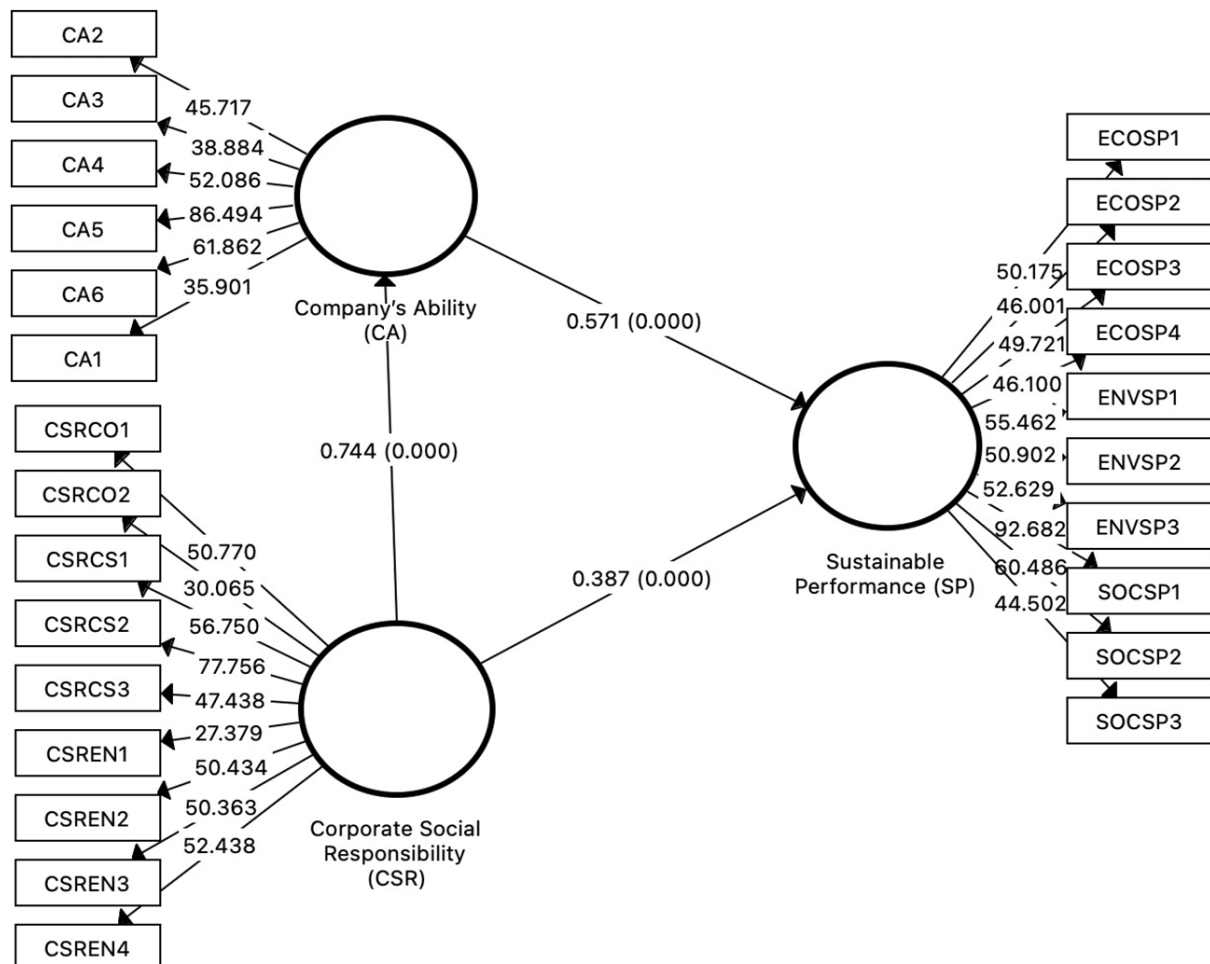


Figure 4. Path diagram Bootstrapping.

5. DISCUSSION

In the context of Indonesia [82], this research emphasizes that recycling industries face different challenges on their way to sustainability, very similarly to the literature findings related to circular economy-based business

ecosystems and plastic waste management [83, 84]. Nonetheless, the rapid build-up of plastic waste has recently attracted growing attention domestically and internationally. An efficient management plan is needed that will minimize the release of environmentally harmful pollutants and their impact on human health [83, 84]. The situation has been aggravated by either the scarcity of plastic recycling coordination or, in some places, the limited capacity to manage it. Operating the principle of extended product responsibility has become a must [85, 86]. Finally, this research also examines how organizational capabilities mediate the relationship between CSR and SP [87]. Theoretical studies of CSR initiatives targeting communities, customers, or the natural environment are presumed to have a positive effect on a firm's long-term economic profitability [88]. Yet such initiatives are only partly effective in achieving environmental and social goals if they do not function within a coherent sustainable development framework [14]. Thus, the success of CSR in improving a firm's stakeholder management capability and overall performance rests on a firm's ability to align its responsibilities towards these multiple stakeholders with a sustainable development strategy in a holistic and integrated manner [35].

CSR forces organizations to use resources in an efficient and ethical manner or maximize the impacts of CSR [89, 90] in economics. The role of CSR implementation is not only to protect ecosystems and strengthen community ties [89, 91]. These findings provide empirical evidence that superior capabilities in corporations can lead to expected CSR programs directly improving sustainable productivity [92, 93]. But capability mediation is weak in the absence of strong controlling effects, making the CSR-sustainable performance nexus theoretically constrained [94, 95]. Therefore, CSR benefits must be actualized in a timely and sustainable manner through tighter strategic collaboration and greater investment [96, 97].

Corporate capabilities are fundamental strategic assets that affect all the sustainable performance dimensions, meaning that they quietly act as effective CSR-sustainable performance linkages [98, 99]. Such capabilities help organizations bundle resources and capabilities to generate non-mimetic competitive values [100]. Firms integrate CSR with green process innovation to sustain organizational capability superiority in recycling industries [101]. As part of their business strategy, firms in the recycling industry also need to design unique and inimitable CSR initiatives [88]. Sustainable innovation, process efficiency, and product differentiation are strategic responses to the market complexities associated with business sustainability [22]. Hence, organizational capabilities are not only fundamental for competitive advantage but also serve as the main drivers for achieving better sustainable performance [6].

This study provides new insights that the sustainability of the recycling industry is much wider than CSR itself and depends on the dynamics of integrated CSR, corporate capabilities, and sustainable performance [102]. The framework includes the dimensions of sustainable development, innovation, and competitiveness, elements that are interconnected [103, 104]. While some advanced recycling firms in Indonesia show significant potential (as they do in other parts of the world), recycling is still largely in the nascent stages with regional variations [105, 106]. Future researchers may explore an established sector and investigate the effect of regional heterogeneity on CSR engagement and sustainability [107, 108]. It is important to identify the drivers which lead organizations to implement CSR and to use such findings to enable organizations to convert such findings into a competitive advantage in sustainability-driven markets [109, 110].

6. CONCLUSION

Our results support the positive impact of corporate social responsibility (CSR) on sustainability performance. Company capabilities act to mediate the CSR-sustainable performance relationship due to their strategic value as resources that bundle idiosyncratic traits to create sustainable competitive advantage in terms of long-term value. To survive in volatile markets, recycling firms therefore depend on sustainable innovation, process efficiency, and a diversified product portfolio. We advocate for further research on digital technology and circular economy

ramifications on sustainable performance, climate change adaptation, and firm environmental compliance management.

6.1. Research Limitations

There are a few problems with this study. To begin with, it uses a cross-sectional design, which means it cannot show cause and effect. Second, the data are self-reported, which could introduce bias into responses or the method used. Third, the study is confined to a singular national context, Indonesia, thereby limiting the applicability of the findings to other nations or industrial environments. Subsequent research must rectify these limitations by employing longitudinal or mixed-method designs, incorporating a broader range of industries and regions, and facilitating country comparisons to enhance robustness and external validity.

6.2. Theoretical Contributions

This theoretical work contributes to knowledge on the mediating role of corporate capabilities in CSR-sustainable performance linkages in recycling contexts. Important implications are presented, positioning organizational capabilities as new CSR effectiveness amplifiers for sustainability outcomes.

6.3. Practical Implications

Training programs subsidized by the Indonesian government that provide specific assistance to small and medium-sized businesses on recycling, CSR, and innovation, as well as organizational skills that will further their business opportunities, must be encouraged, specifically in waste management, process efficiency, and digital technology. In this way, small enterprises will benefit maximally in the long run. In addition, relevant ministries should offer tax exemptions and technical assistance to recycling companies that integrate CSR into their circular-economy-based business strategies. In the long run, this will lead them to develop new products, serve new customers, and comply more strictly with environmental regulations.

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Informed Consent Statement: Informed oral consent was obtained from all participants prior to their participation in the study. All data were anonymized to protect participant confidentiality.

Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.

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Disclosure of AI Use: This research was designed, executed, and analyzed independently by the authors, including the selection of methods, data collection, PLS-SEM statistical analysis, and interpretation of findings. We used ChatGPT only for language polishing, rewording, and improving the clarity of the text, and did not allow it to influence the scientific content. The authors of this manuscript are entirely responsible for the accuracy of the data and methods used, as well as the content of the paper. The manuscript was edited professionally by independent English language services to comply with international journal publication requirements.

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Appendix

Table A1 in the appendix presents the definitions of variables, indicators, and the list of questions used in the study.

Table A1. The definitions of variables, indicators, and the list of questions used in the study.

Variables	Indicator	A list of questions
Corporate Social Responsibility (CSR) A company's concern for its surrounding environment reflects a strategic commitment that contributes to the achievement of sustainable performance	Engagement in environmental preservation efforts	The company actively implements programs to reduce carbon emissions and utilize renewable energy sources.
	Allocates investments to benefit future generations	The company promotes diversity and inclusion in the workplace, including aspects of gender, disability, and cultural background.
	Implements programs to minimize its negative impact on the natural environment.	The company maintains transparency in reporting CSR activities to the public and stakeholders.
	Long-Term Sustainability Orientation	The company provides tangible support for employees' mental health and well-being.
	Contributes financially to charities	The company contributes to local community development through education, training, or economic empowerment programs.
	Contributes to the well-being of the society.	The company ensures its supply chain is free from forced labor and child exploitation practices.
	Commits to protecting consumers beyond the minimum legal standards	The company utilizes technology responsibly, including safeguarding consumer data privacy and security.
	Accessible and honest information	The company actively participates in efforts to mitigate the impacts of climate change, such as water conservation and waste management.
	Ensuring customer satisfaction is a top priority	The company openly receives and responds to community feedback or complaints related to its CSR activities.
Sustainable Performance (SP) The level of achievement or outcomes attained, considering economic, social, and environmental aspects in performance evaluation.	ROA	My company consistently implements sustainability principles in every business process.
	Profit growth	My company prioritizes the use of renewable resources in daily operations.
	Sales growth	My company regularly reports sustainability performance to stakeholders.
	Market share growth	Waste and emission reduction initiatives are effectively implemented in my company.
	Improved relationship with the community and stakeholders	My company has clear policies regarding social and environmental responsibility.
	Enhance living quality of the local community	Employee well-being is a primary focus in my company's sustainability strategy.

Variables	Indicator	A list of questions
	Improved work safety	My company actively engages in social activities to support the local community.
	Improved compliance with environmental standards	Sustainable innovation is part of my company's strategic objectives.
	Reducing the amount of hazardous chemicals generated	My company is committed to increasing energy efficiency throughout all operational processes.
	Reduction of energy consumption	My company regularly evaluates the environmental impact of all business activities.
Company's Ability (CA) A company's ability to outperform other companies in the same industry or market. This is achieved by leveraging the company's unique characteristics and resources	The resulting Value	My company is able to quickly adapt to changes in applicable environmental regulations.
	Rareness	My company has competent human resources to support sustainable innovation.
	Imperfectly non-imitable	My company manages business risks effectively in facing global challenges, such as climate change.
	Product differentiation	My company is able to integrate digital technology to improve operational efficiency.
	R&D capabilities	My company consistently enhances internal capacity through employee training and development.
	Managerial Capabilities	My company is responsive to customer needs and expectations regarding environmentally friendly products or services.

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