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Research Article

Strategic CSR Practices and Sustainability in Bangladesh's Manufacturing SMEs: A Multimethod Analytical Approach

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This study investigates how corporate social responsibility (CSR) practices influence sustainable business performance (SBP) in Bangladesh's manufacturing small and medium-sized enterprises (SMEs). Drawing on data collected from 510 SMEs across six industrial sectors. The research employs a multi-method analytical framework comprising partial least squares structural equation modeling (PLS-SEM), fuzzy-set qualitative comparative analysis (fsQCA), and machine learning (ML) algorithms. Findings confirm that economic, environmental, and ethical CSR practices are key drivers of business sustainability. Legal and philanthropic CSR show moderate influence, while social CSR has limited effects. fsQCA reveals multiple effective CSR combinations that can lead to sustainability. ML results highlight environmental CSR as the strongest predictor of business performance. SME leaders are encouraged to integrate core CSR dimensions within strategic business planning. This research contributes methodologically by integrating statistical, configurational, and predictive techniques. The hybrid approach enhances understanding of CSR's dual explanatory and predictive capabilities. Nevertheless, it supports strategic planning by offering a practical and adaptable CSR decision framework. This study extends CSR literature with empirical evidence tailored to developing-economy SMEs.

Keywords: corporate social responsibility (CSR); CSR practice; multimethod analytical approach; small and medium-sized enterprise (SMEs); sustainable business performance (SBP)

1. Introduction

Corporate social responsibility (CSR) has evolved into a strategic imperative for firms across industries, receiving growing attention from academia, businesses, and society over the past 2 decades [1–4]. Within this context, the strategic alignment of CSR practices with the sustainable development goals (SDGs) has emerged as a global priority. The SDGs, introduced by the United Nations for the 2015–2030 agenda, underscore sustainability across economic, social, and environmental dimensions [5, 6]. Governments and global institutions increasingly urge firms to align their CSR initiatives with the SDGs to foster responsible and inclusive growth [7]. This integration reinforces the mission of sustainable development ensuring present needs are met without compromising future generations' ability to thrive.

Despite this global movement, the role of CSR practices in enhancing the sustainability of small and medium-sized enterprises (SMEs), particularly in developing countries, remains underexplored. The existing literature often focuses on large transnational corporations (TNCs), overlooking SMEs

that lack resources and institutional pressure to integrate CSR systematically [8–10]. In Bangladesh, CSR has traditionally been practiced through philanthropy and religious donations [11]. However, modern CSR, aligned with international standards and strategic business goals, has only recently begun gaining momentum, predominantly among large corporations [12]. SMEs, in contrast, often operate without structured CSR frameworks, constrained by limited awareness, financial resources, and regulatory support [1, 13].

Although policymakers, including Bangladesh Bank, have made efforts to institutionalize CSR among SMEs and multinational corporations (MNCs), academic research continues to emphasize CSR communication over implementation or evaluation [14]. Between 2018 and 2022, CSR-related research increased, yet recent years show a decline in publication rates [4]. This signals a pressing need for studies that investigate how CSR practices are embedded and contribute to sustainable business outcomes especially at the microenterprise level.

Globally, SMEs represent 91% of formal enterprises and employ around 60% of the global workforce [15–18]. In Bangladesh, SMEs contribute 15% to GDP and create 1.7 million manufacturing jobs [19]. Yet, their long-term viability remains fragile, with 70%–80% of small firms failing within the first year [20, 21]. Challenges such as poor managerial capability, weak business acumen, and limited industry experience continue to threaten SME sustainability [1, 22]. While integrating CSR practices can strategically enhance SME performance [23], empirical evidence on this relationship remains limited [24, 25].

The literature on SMEs and CSR in Bangladesh primarily focuses on financial outcomes [26–28], with minimal exploration of how specific CSR practices philanthropic, environmental, social, ethical, legal, and economic contribute to broader sustainable business performance (SBP). Moreover, studies rarely employ multimethod strategies that combine statistical, causal, and predictive analytics. This creates a clear research gap in understanding the strategic role of CSR practices in SME sustainability [29–31].

To address this gap, this study poses a central research question: to what extent do different CSR practices affect the SBP of SMEs in Bangladesh's manufacturing industry, and which practices have the most significant impact on financial performance? To answer this, the study adopts a novel three-stage analytical approach combining partial least squares structural equation modeling (PLS-SEM), fuzzy-set qualitative comparative analysis (fsQCA), and machine learning (ML). PLS-SEM assesses symmetric relationships, fsQCA identifies causal configurations, and ML predicts the influence of each CSR practice on SBP. This integration offers a rigorous, comprehensive framework that blends explanatory and predictive insights rare in CSR-SME literature. This paper contributes theoretically by extending Carroll's CSR framework and Freeman's stakeholder theory (ST) within the SME context. Practically, it offers actionable guidance to SME owners on prioritizing high-impact CSR strategies. Methodologically, it advances CSR research through its multimethod lens providing a data-driven roadmap for future studies and policy development.

Moreover, the paper proceeds as follows. Section 2 reviews the literature and presents the theoretical background. Section 3 outlines the research methods. Section 4 presents results. Section 5 discusses findings, and Section 6 concludes.

2. Literature Review and Hypothesis Development

2.1. Underpinning Theories. This study adopts legitimacy theory (LT) and ST to examine CSR's influence on SBP in Bangladeshi SMEs. These theories provide complementary perspectives on how businesses navigate social expectations and stakeholder demands. LT argues that firms must align their actions with societal norms to maintain legitimacy [32]. For SMEs, legitimacy fosters trust, strengthens reputation, and reduces stakeholder resistance. In Bangladesh's competitive and resource-limited environment, CSR helps SMEs meet public expectations and secure continued support [33]. CSR practices philanthropic, environmental, social, ethical, legal, and economic signal responsible behavior that aligns with community values and enhances corporate image [34].

ST [35] emphasizes that firms must consider diverse stakeholder interests, not just shareholder returns. SMEs depend on strong relationships with employees, customers, local communities, suppliers, and regulators [36]. These stakeholders have overlapping and sometimes conflicting interests. For example, investors seek profitability, while communities prioritize social and environmental impact. Strategic CSR helps balance these competing demands, ensuring broader support and long-term sustainability [1, 37].

Moreover, the integration of LT and ST offers a better-off perspective. LT focuses on external social approval, while ST addresses internal stakeholder dynamics. Together, they explain how CSR enhances both legitimacy and stakeholder alignment. This dual lens is essential for SMEs, which face high pressure from both the public and operational partners. These theories also inform our research design. LT supports our use of fsQCA to explore legitimacy configurations. ST justifies stakeholder-based variable selection for PLS-SEM and ML analysis. This theoretical grounding strengthens our study's ability to uncover causal pathways linking CSR and SBP.

2.2. Hypothesis Development

2.2.1. Philanthropic CSR Practices (PHI). Philanthropic responsibility involves voluntary actions that go beyond firms' legal or ethical duties. It reflects a firm's desire to contribute to society without immediate business returns. In Carroll's [38] CSR pyramid, philanthropy is the final tier after essential duties. Philanthropic CSR improves reputation, legitimacy, and stakeholder trust [39]. When well-aligned with stakeholder needs, it builds goodwill and enhances firm image. Porter and Kramer [40] emphasize strategic philanthropy to foster shared value. Recent literature views philanthropy as a trust-building and performance-enhancing strategy [11]. Fatima and Elbanna [4] highlight its relevance in institutional voids in emerging markets. Poveda-Pareja et al. [2] stress philanthropy's role in boosting

stakeholder engagement. Empirical studies find positive CSR–SBP links when actions are authentic and strategic [41]. However, philanthropic CSR may be ineffective or harmful if poorly executed [26]. Maqbool and Zameer [27] argue that perceived insincerity weakens stakeholder responses. SMEs often face resource limitations, making philanthropy burdensome [25, 37]. Kim [8] and Roy et al. [34] note cultural factors influence philanthropic perception. Freeman et al. [35] apply ST to link philanthropy with long-term trust. Danish et al. [42] empirically confirm philanthropy improves SBP through relational outcomes. Truong et al. [43] find that CSR actions strengthen stakeholder behavior and firm performance. Alulia and Savitri [44] support that philanthropic efforts mediate green impact on SBP. Omidvar et al. [45] suggest philanthropy boosts SME performance via reputation and innovation. These findings show philanthropy's performance effect is often positive but context-dependent. Based on this understanding, the following hypothesis is proposed:

> H1. Philanthropic CSR practices positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

2.2.2. Environmental CSR Practices (ENV). Environmental CSR includes actions to reduce harm and promote ecological sustainability goals. Key practices include carbon reduction, waste control, green innovation, and resource efficiency. Such efforts reflect growing global concern over climate change and environmental degradation. Fatima and Elbanna [4] view environmental CSR as essential in modern CSR strategies. Chungyalpa and von Rosing [20] emphasize green technology adoption among SME sustainability efforts. According to Fatoki [16], addressing environmental risks ensures long-term firm survival. Environmental CSR balances social, economic, and ecological responsibility [46]. It enhances resilience, risk mitigation, and long-term value generation [2]. Roy et al. [34] show environmental CSR boosts customer satisfaction and firm differentiation. Kim [8] and LT affirm CSR builds trust and public legitimacy. Environmental transparency reduces stakeholder uncertainty, enhancing firm credibility and stability. However, implementation is challenging, especially for resource-limited SMEs in competitive sectors. Bahta et al. [25] highlight short-term cost pressures as major adoption barriers. Le [37] warns that weak alignment reduces internal commitment and stakeholder support. Superficial practices may trigger accusations of greenwashing, harming firm reputation [4]. Sun and Ding [26] noted that sector-specific expectations affect CSR success. Jakhar [47] stresses that supply chain dynamics influence environmental CSR outcomes. Despite limitations, strategically applied CSR yields tangible and reputational performance benefits. Recent empirical studies strongly link environmental CSR to improve SBP. Danish et al. [42] find positive CSR–SBP effects via employee behavior alignment. Alkandi [41] supports the link between green practices and sustainable performance in SMEs. Truong et al. [43] show environmental efforts enhance sustainability in hospitality sector. These findings confirm that CSR positively affects SBP when applied contextually and strategically. In Bangladesh's SMEs, environmental CSR enhances competitiveness, reputation, and regulatory compliance. Based on this understanding, the following hypothesis is proposed:

> H2. Environmental CSR practices significantly and positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

2.2.3. Social CSR Practices (SOC). Social CSR involves actions that improve social welfare through inclusive stakeholder practices. It promotes equity, dignity, and well-being within internal and external stakeholder networks. Typical initiatives include employee development, community health, inclusive hiring, and educational programs. These programs promote fairness and drive positive change [47, 48]. Martínez-Conesa et al. [49] emphasize equity and life quality improvement through social efforts. Social CSR enhances trust, loyalty, and motivation [50]. Lee et al. [51] find positive social engagement boosts performance in service industries. Fatima and Elbanna [4] reported that social CSR drives customer loyalty and retention. Roy et al. [34] show improved loyalty through workforce and community alignment in SMEs. Carroll and Shabana [52] connect fairness and inclusion to competitive business advantage. Poveda-Pareja et al. [2] confirm social CSR reduces turnover and strengthens stakeholder trust. Bahta et al. [25] report improved firm image and long-term growth from social actions. Stakeholders' perceptions affect CSR impact through legitimacy and emotional connection [37]. However, poorly executed programs may appear disconnected or fail to meet expectations. Margolis and Walsh [53] note some initiatives yield insignificant results when misaligned. Thus, strategic alignment between business goals and social values is necessary. In Bangladesh, SME-level social CSR builds brand value and employee commitment. Recent studies confirm positive CSR-performance links in emerging markets. Truong et al. [43] highlight behavioral and cultural relevance in CSR performance gains. Danish et al. [42] confirm CSR strengthens internal engagement and long-term sustainability. Therefore, aligning CSR with community needs and core business values is essential for sustainable impact. Based on this review, the following hypothesis is proposed:

> H3. Social CSR practices significantly and positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

2.2.4. Ethical CSR Practices (ETH). Ethical CSR reflects a firm's obligation to uphold fairness, integrity, and responsibility. It involves principled behavior beyond legal compliance, grounded in moral expectations. Carroll [38] identified ethics as a foundational element of responsible business conduct. Ethical actions include transparency, anticorruption, fair pay, and human rights protections. Schwartz and Carroll [54] link ethical leadership to sustainable business legitimacy. Rahman et al. [55] highlight

ethical sourcing as vital in global CSR initiatives. Uddin et al. [50] stress employee rights and transparency for internal ethical alignment. LT suggests ethical conduct builds reputation and defends against stakeholder backlash. Suchman [32] and Donaldson & Preston [56] emphasize ethics for organizational legitimacy. Ethical firms attract trust, loyalty, and long-term performance gains [52]. Martínez-Conesa et al. [49] confirm ethics strengthens culture and public perception. Poveda-Pareja et al. [2] show ethical CSR improves both financial and nonfinancial performance. Truong et al. [43] find ethical practices elevate employee morale and sustainability engagement. Danish et al. [42] report enhanced SBP from responsible decision-making in competitive sectors. Yet, ethical CSR can face obstacles, especially in resource-constrained environments. Fatima and Elbanna [4] cautioned against weak ethical controls in SMEs. Bahta et al. [25] warn that superficial ethics may damage credibility. Le [37] identifies resistance from employees due to unclear ethical incentives. Regulatory gaps further complicate ethics enforcement in emerging markets. Managers must align ethical values with firm operations and cultural realities. Strategic integration of ethics protects firms and supports long-term sustainability outcomes. Ethical CSR builds stakeholder confidence, especially in trust-sensitive sectors like manufacturing. Therefore, aligning CSR with community needs and core business values is essential for sustainable impact. Based on this review, the following hypothesis is proposed:

> H4. Ethical CSR practices significantly and positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

2.2.5. Legal CSR Practices (LEG). Legal CSR refers to business adherence to laws, regulations, and industry standards. It includes compliance with labor rights, safety laws, and fair market regulations. Carroll [38] placed legal responsibility as a core layer of CSR. Schwartz and Carroll [54] linked legal compliance with corporate ethical foundations. Legal CSR ensures transparency, operational continuity, and reduced regulatory intervention risks. Uddin et al. [50] state it strengthens accountability and stakeholder protection mechanisms. Fatima and Elbanna [4] confirm legal compliance boosts confidence and operational efficiency. Freeman et al. [35] highlight the trust-building role of legal accountability in CSR. According to institutional theory, legal conformity legitimizes organizational actions [34]. DiMaggio and Powell [57] argue compliance improves survival in structured institutional settings. In global markets, legal CSR enhances credibility and access to sustainable supply chains. However, minimal compliance may limit innovation and stakeholder engagement [40]. Campbell [58] warns that passive compliance reflects short-term reactive strategies. Le [37] argues firms focused only on law may miss strategic value. Bahta et al. [25] and Kim [8] note resistance in SME legal enforcement. Poveda-Pareja et al. [2] cautioned that symbolic compliance can erode trust. Rahman et al. [55] show strategic alignment of legal CSR with ethics increases impact. In SMEs, rigid regulation without support leads to weak CSR commitment. Yet, strong legal CSR builds resilience, consistency, and market confidence. Truong et al. [43] emphasize the synergy between regulation and performance in SMEs. In Bangladesh's SMEs, legal CSR enhances market credibility, trust, and access to global supply chains. Based on these insights, the following hypothesis is proposed:

> H5. Legal CSR practices significantly and positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

2.2.6. Economic CSR Practices (ECO). Economic CSR integrates profit goals with social and environmental business responsibilities. Freeman et al. [35] and Carroll [38] identify profit as a core CSR pillar. Profitability sustains business viability and enables broader CSR strategy implementation. Lee et al. [51] emphasize profit's role in supporting social and ethical action. Elkington's triple bottom line advocates for balanced economic, environmental, and social performance [59]. Alhaddi [60] reinforces the importance of equilibrium among people, planet, and profit. Porter and Kramer [40] propose shared value for aligned economic and social outcomes. Cunha et al. [61] link economic CSR with firm growth and competitiveness. Lu and Wang [62] find efficiency and CSR together drive sustainable performance. Danish et al. [42] confirm CSR enhances profitability through better stakeholder engagement. Alkandi [41] reports CSR boosts economic performance in constrained SME environments. Omidvar et al. [45] show CSR-linked innovation strengthens firm-level performance metrics. However, profit-first strategies may restrict CSR scope and weaken ethical initiatives. Tziner and Persoff [63] cautioned that financial pressure reduces strategic adaptability. Pacheco-Ortiz et al. [64] show excessive cost-cutting harms trust and quality. Rahman et al. [55] warn that profit obsession can neglect environmental accountability. Bahta et al. [25] emphasize economic focus may dilute CSR consistency in SMEs. Fatima and Elbanna [4] note financial strain can hinder CSR in emerging markets. Strategically balanced economic CSR enhances resilience, trust, and innovation investment. Le [37] advocates aligning financial outcomes with community and environmental responsibility. Roy et al. [34] affirm economic responsibility strengthens SME brand and market presence. In Bangladesh, economic CSR supports growth, compliance, and resource optimization. In this context, strategic economic CSR supports resilience, growth, and balanced stakeholder value creation. Based on these insights, the following hypothesis is proposed:

> H6. Economic CSR practices significantly and positively influence sustainable business performance in manufacturing SMEs in Bangladesh.

Based on the theoretical foundation and earlier hypotheses, a structured research model has been developed for this study. This model provides a clear framework for analyzing the influence of CSR practices on SBP. As shown in Figure 1, the model tests the direct effects of six CSR

practices on performance outcomes. Each path corresponds to a specific hypothesis derived from the literature. The model integrates theoretical insights with empirical objectives, ensuring alignment between research questions and analytical design. It aims to reveal how different CSR strategies contribute to long-term sustainability.

3. Methods

This section outlines the methodology, including instruments, sampling, data analysis, and justification for multimethod integration.

3.1. Research Instruments. A structured questionnaire was designed to collect data from SME managers. It ensured precision, clarity, and minimized response bias. Each item was measured on a seven-point Likert scale from 1 (*strongly disagree*) to 7 (*strongly agree*). Six CSR practices and SBP formed the constructs. Philanthropic CSR (4 items) and ethical CSR (5 items) were adapted from Turker [65]. Environmental CSR (5 items) and legal CSR (4 items) were adapted from Henriques and Sadorsky [66]. Social CSR (4 items) and economic CSR (5 items) were sourced from recent CSR-focused instruments validated by Jing et al. [14] and Masud and Hossain [7]. SBP (6 items) was measured using indicators from Wentzel et al. [67]. Table 1 presents a complete list of measurement items.

3.2. Sample and Data Collection. This study focused on SMEs listed in the BSMEF 2023 national SME database. Dhaka and Chattogram were selected due to industrial density and CSR maturity. These cities also reflect economic centrality and high manufacturing sector concentration. Six manufacturing sectors were included based on CSR relevance and economic significance. Selected sectors were textiles, food processing, jewellery, carpets, machine tools, and ceramics. Each sector demonstrates varying degrees of CSR maturity and environmental responsibility. We applied stratified purposive sampling to ensure representation across selected sectors. Strata were defined by industry type to capture sector-specific CSR dynamics. Within each stratum, firms were chosen for access, CSR engagement, and relevance. The final sample consisted of 510 SMEs from six distinct manufacturing sectors. Sample size was determined using Cochran's formula for known populations. Cochran's formula helps estimate an appropriate size for generalization and precision. We used a 95% confidence level and 5% margin of error. Based on sector size and SME density, 384 was the minimum threshold. We exceeded this with 510 responses to improve reliability and representation. Our size aligns with Hair and Alamer [68] for SEM-based studies. They recommend at least 10 responses per item in complex models. Our model included multiple latent constructs and reflective indicators. This supports robust structural equation modeling and statistical power. Previous SME studies also support 400 samples in emerging economy research. A pilot test with 20 SME managers ensured clarity of instrument items. Minor wording adjustments were made for better local understanding and flow. Data collection followed ethical standards approved by the institutional ethics committee. Verbal and written consent was obtained from all participants before data collection. Questionnaires were distributed in person after initial telephone contact with SME managers. A cross-sectional design was used to collect data within a fixed time frame. Table 2 displays the distribution of firms across all selected sectors.

3.3. Analytical Approach. This study employs a multimethod approach to analyze CSR and performance relationships. Three techniques were used as follows: PLS-SEM, fsQCA, and ML. Each method serves a distinct analytical purpose within the research framework. PLS-SEM uncovers linear, symmetric relationships between CSR dimensions and firm performance. fsQCA identifies asymmetric, causal combinations that produce equivalent performance outcomes. ML predicts outcomes using CSR features and identifies key influencing variables. Together, these methods offer both explanatory and predictive insights into CSR impacts. PLS-SEM was applied using SmartPLS 3.2.9 for structural and measurement analyses. It suits small samples, formative constructs, and non-normal data distributions. fsQCA 3.0 determined necessary and sufficient conditions for achieving high performance. It addresses causal complexity by exploring CSR configurations across cases. ML models (random forest, AdaBoost, and XGBoost) were run in Python 3.7. ML captured nonlinear relationships missed by conventional regression models. Models used an 80–20 train-test split for predictive evaluation. Feature selection applied analysis of variance (ANOVA) F-score and recursive elimination techniques. Hyperparameters were tuned using grid search with 10-fold cross-validation. Evaluation metrics included accuracy, precision, recall, and AUC scores. Figure 2 illustrates the analytical flow aligned with research objectives.

3.3.1. Feature Selection. Wang et al. applied the ANOVA method to identify optimal features from configurations [69]. This variance-based technique evaluates features by calculating the ratio of variance between groups to variance within groups for each attribute [70]. ANOVA, rooted in strong statistical principles, offers an intuitive approach for assessing feature differences across groups, providing valuable insights for feature selection. The corresponding formula expressions are as follows:

$$F = \frac{S_b^2(u)}{S_w^2(u)}. \tag{1}$$

The F value represents the u^{th} dipeptide, $S_b^2(u)$ is the variance between groups, and $S_w^2(u)$ is the variance within groups. The calculation methods are shown in Equations (2) and (3), respectively:

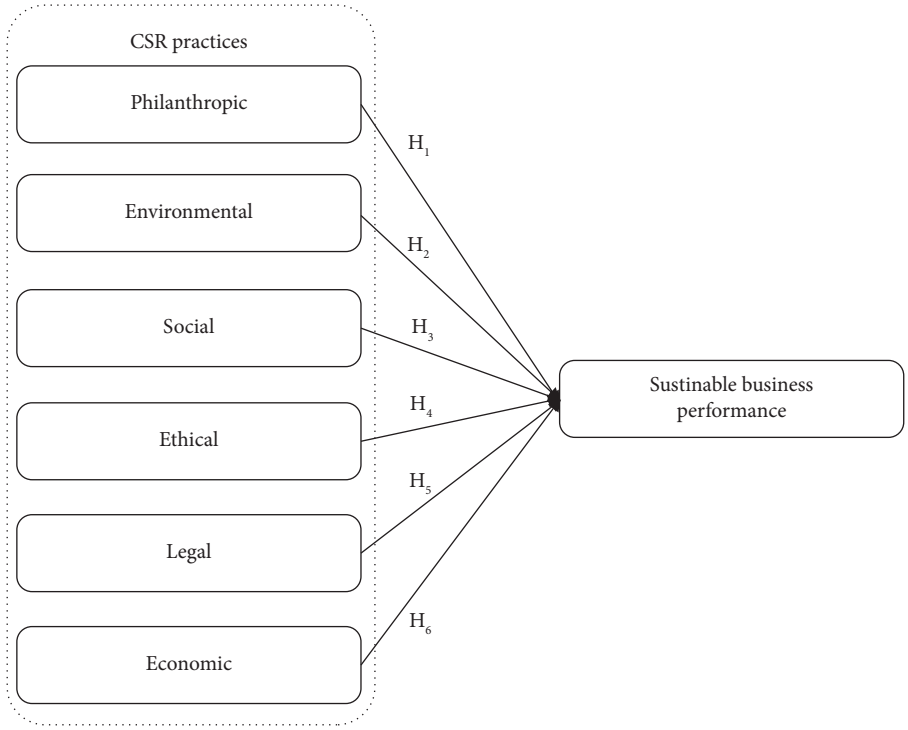

Figure 1: Conceptual model.

$$S_b^2(u) = \frac{SS_b(u)}{K-1}, \tag{2}$$

$$S_w^2(u) = \frac{SS_w(u)}{N-1}, \tag{3}$$

where K is the total of classes; N is the total of samples; $SS_b(u)$ is the sum of the squares between the groups; and $SS_w(u)$ is the sum of squares within the groups.

The F-score is a simple yet effective method for evaluating the discriminative power of individual features within a dataset. Although mathematically well-defined, it does not account for true negatives. Wu et al. [71] used the F-score to rank features for classifying SBP, highlighting its utility in feature selection.

$$F(i) = \frac{\sum_{k=1}^{3}\left(\overline{x}_i^k - \overline{x_i}\right)^2}{\sum_{k=1}^{3}\left(1/\left(N_k - 1\right)\right)\sum_{j=1}^{N_k}\left(x_{ij}^k - \overline{x}_i^k\right)^2}, \tag{4}$$

where $\overline{x}_i^k$ is the average frequency of the i^{th} feature in the k^{th} dataset; x_i the average frequency of the i^{th} feature in all of the datasets concerned; x_{ij}^k is the frequency of the i^{th} feature of the j^{th} sequence in the k^{th} dataset; N_k is the number of peptide samples in the k^{th} dataset. Therefore, the larger F-value indicates a stronger predictive capability of the feature.

Furthermore, FS is essential in reducing overfitting and enhancing model clarity. This study employed a filter method to improve SBP predictions. ANOVA identified features with high variance between groups, ensuring statistical relevance. It calculated the variance ratio across and within groups for precision. The F-score method ranked features based on their power to distinguish SBP outcomes. A higher F-value indicated greater predictive strength. Both ANOVA and F-score supported effective dimensionality reduction. These methods improved learning efficiency by selecting only key predictors. This streamlined the dataset and boosted model accuracy. The selected features reflected meaningful CSR extents.

3.3.2. Performance Matrix and ROC. Table 3 summarizes classification and model assessment findings, emphasizing prediction accuracy derived from the confusion matrix. Six primary evaluation metrics were applied: accuracy, true positives, false positives, precision, recall, and F-measure. Accuracy, expressed as a percentage, measures how closely a model's predictions align with actual outcomes. The jackknife test, known for its reliability with benchmark datasets, has been widely used in predictive analysis [72]. Additional metrics such as sensitivity (Sn), accuracy (A), average accuracy (AA), and overall accuracy (OA) are also commonly applied to evaluate model performance. All accuracy metrics were calculated based on data from the confusion matrix.

$$A = \frac{\mathrm{TP} + \mathrm{TN}}{\mathrm{TP} + \mathrm{TN} + \mathrm{FP} + \mathrm{FN}}, \tag{5}$$

$$S_n = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FN}}, \tag{6}$$

$$\mathrm{AA} = \frac{\sum s_n}{\mu}, \tag{7}$$

$$\mathrm{OA} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{TN} + \mathrm{FP} + \mathrm{FN}}, \tag{8}$$

Table 1: Measurement items.

Construct	Items	Code	Loading (λ)
Philanthropic CSR practices (PHI) [65]	(a) The company engages in activities that improve community well-being	PHI1	0.897
	(b) Philanthropy includes volunteering, donations, and supporting charitable events	PHI2	0.911
	(c) The company supports healthcare programs for underserved populations	PHI3	0.830
	(d) It contributes to community development through social initiatives	PHI4	0.940
Environmental CSR practices (ENV) [66]	(a) Environmental sustainability guides the company's operations and decisions	ENV1	0.947
	(b) Environmental performance is regularly monitored and evaluated	ENV2	0.944
	(c) The company chooses eco-friendly products and solutions	ENV3	0.958
	(d) Waste reduction strategies are actively implemented	ENV4	0.953
Social CSR practices (SOC) [7, 14]	(a) The company supports community outreach and development projects	SOC1	0.933
	(b) Social initiatives benefit local communities meaningfully	SOC2	0.944
	(c) Educational programs promote empowerment and social development	SOC3	0.947
	(d) Social causes and charities receive consistent support	SOC4	0.947
Ethical CSR practices (ETH) [65]	(a) High ethical standards guide all business activities	ETH1	0.933
	(b) Human rights and ethical sourcing are strictly upheld	ETH2	0.929
	(c) Organizational actions align with societal ethical norms	ETH3	0.928
	(d) Transparent processes ensure accountability and integrity	ETH4	0.910
Legal CSR practices (LEG) [66]	(a) The company complies with all relevant laws	LEG1	0.912
	(b) Regular audits ensure legal compliance and alignment	LEG1	0.955
	(c) Legal risks are proactively identified and addressed	LEG1	0.923
	(d) Laws and tax obligations are strictly followed	LEG1	0.945
Economic CSR practices (ECO) [7, 14]	(a) Economic sustainability and shareholder value are prioritized	ECO1	0.948
	(b) Investments target long-term economic prosperity	ECO1	0.947
	(c) Job creation supports local economic development	ECO1	0.924
	(d) Innovation and efficiency enhance economic sustainability	ECO1	0.938
Sustainable business performance (SBP) [67]	(a) CSR benefits contribute to long-term business performance	SBP1	0.921
	(b) Sustainability supports long-term profitability	SBP2	0.925
	(c) Sustainable practices are integrated into daily operations	SBP3	0.912
	(d) All operations prioritize sustainability at every level	SBP4	0.927

Table 2: Sample size determination.

Sectors	Sampling frame	Sample size (n)
Textile	290	210
Food processing	185	130
Jewellery	90	30
Carpet	150	90
Machine tools	70	25
Ceramics	65	25
	850	510

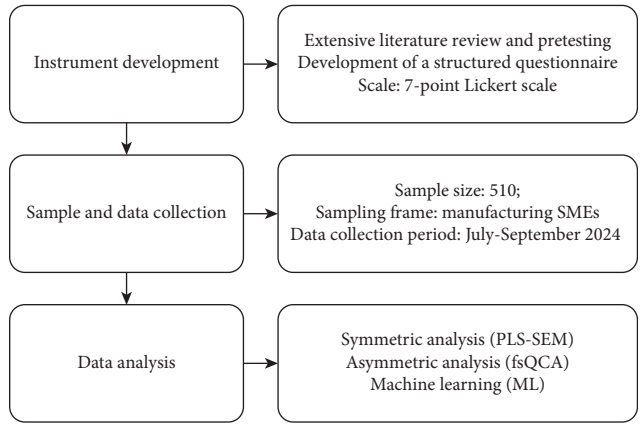

Figure 2: Research methods.

where TP, FP, TN, and FN, respectively, denote the number of true positives, false positives, true negatives, and false negatives; m is the type of samples.

In order to assess the classification performance of each ML model, this section introduces key evaluation metrics used to assess the classification performance of each ML model, including precision, recall, F1-score, GMean, and area under the curve (AUC) score. The calculation of these evaluation metrics is shown as follows:

$$\text{precision} = \frac{\text{TP}}{\text{TP} + \text{FP}}, \tag{9}$$

$$\text{recall} = \frac{\text{TP}}{\text{TP} + \text{FN}}, \tag{10}$$

$$F - \text{Measure} = \frac{2 \times \text{precision} \times \text{recall}}{\text{precision} + \text{recall}}, \tag{11}$$

$$\text{GMean} = \sqrt{\frac{\text{TP}}{\text{TP} + \text{FP}} \times \frac{\text{TP}}{\text{TP} + \text{FN}}} = \sqrt{\text{precision} \times \text{recall}}, \tag{12}$$

$$\text{AUC} = \frac{1 + ((\text{TP})/(\text{TP} + \text{FN})) - ((\text{FP})/(\text{FP} + \text{TN}))}{2}. \tag{13}$$

Moreover, precision shows how many predicted positives are correct. Recall measures the model's ability to detect true positives. The F1-score balances precision and recall. The F-measure weights precision to handle imbalanced data better. The ROC curve shows the trade-off between sensitivity and specificity. AUC quantifies this trade-off for easy comparison. A perfect model has an AUC of 1. A random guess scores 0.5. This study used both F-measure and AUC. These metrics ensured reliable predictions of SBP. They confirmed the classification accuracy and model effectiveness for Bangladeshi SME evaluation.

3.4. Multivariate Assumptions. Multivariate assumptions were tested before applying PLS-SEM to ensure statistical validity and model reliability. Normality was assessed using

skewness and kurtosis, with values within the acceptable ±2.58 threshold. Linearity was verified through ANOVA's deviation from linearity test, showing significant results at $p < 0.05$ in Table 4. Homoscedasticity was evaluated using standardized residual scatter plots, confirming equal variance across predicted values. Nonresponse bias was examined by comparing early and late responses using independent *t*-tests. Common method bias was addressed through Harman's single-factor test (variance < 50%) and Heckman's two-step procedure. Each method confirmed the robustness and suitability of the dataset for structural modeling.

4. Data Analysis

This study adopted a multimethod analysis integrating PLS-SEM, fsQCA, and ML techniques. Stage one applied PLS-SEM for symmetric testing. Stage two used fsQCA for asymmetrical causal exploration. Stage three employed ML to validate prediction accuracy and sensitivity patterns.

4.1. Symmetric Analysis (PLS-SEM) (Stage 1)

4.1.1. Measurement Model Evaluation. The measurement model demonstrated robust psychometric properties through convergent and discriminant validity assessments. Composite reliability (CR) for all constructs exceeded 0.70, ensuring internal consistency. Factor loadings ranged above 0.70, affirming item reliability across all constructs. Average variance extracted (AVE) values surpassed 0.50, confirming convergent validity [68]. Table 5 presents the detailed values. Discriminant validity was established using the HTMT criterion. All interconstruct HTMT values were below the 0.85 threshold. These results confirmed clear distinctions among the constructs [68]. Table 6 illustrates the HTMT matrix. No cross-loadings or inconsistencies were observed. Together, the CR, AVE, and HTMT values support the model's reliability and validity.

4.1.2. Structural Model Results. The structural model was tested using PLS bootstrapping ($n = 5000$ resamples). Results confirmed all six hypotheses (H1–H6) were statistically significant. Each CSR practices showed a positive impact on SBP. Philanthropic CSR ($\beta = 0.212$, $p < 0.001$) supported H1. Environmental CSR ($\beta = 0.419$, $p = 0.013$) supported H2. Social CSR ($\beta = 0.178$, $p = 0.015$) supported H3. Ethical CSR ($\beta = 0.401$, $p = 0.001$) supported H4. Legal CSR ($\beta = 0.182$, $p = 0.042$) supported H5. Economic CSR ($\beta = 0.513$, $p = 0.002$) supported H6. Table 7 presents full statistics. These results validate the positive and significant influence of all CSR practices on SBP in the study context.

Moreover, model strength was further confirmed through key evaluation metrics. The coefficient of determination ($R^2 = 0.384$) indicates that CSR practices explained 38.4% of SBP variance. This reflects a moderate-to-substantial explanatory power. Effect sizes (f^2) ranged from 0.08 to 0.36, per Cohen's guidelines, confirming practical impact of predictors. Predictive relevance was high, with $Q^2 = 0.6523$, supporting the model's predictive strength. Goodness-of-fit indices were within acceptable thresholds: CFI = 0.936, TLI = 0.925, RMSEA = 0.043, and (χ^2/df = 1.979). These indices collectively indicate excellent model fit. Therefore, the structural model demonstrates both empirical robustness and theoretical consistency.

4.2. Asymmetric Analysis (fsQCA) (Stage 2)

4.2.1. Calibration and Necessary Conditions Analysis (NCA). Fuzzy-set calibration was used to convert raw scores into fuzzy membership values between 0 and 1. The study followed Pappas and Woodside [73], where 5% equaled full nonmembership and 95% equaled full membership. The 50th percentile was selected as the crossover point due to non-normal data distribution. Wang et al. [74] justified this midpoint when data symmetry is lacking. Calibration was executed in fsQCA 3.0 software, using path coefficient weights from PLS-SEM as anchor references. Bangladesh's SME context shaped these thresholds, considering their diverse CSR maturity and sectoral variation. The logic ensures realistic representation for developing economies with uneven CSR implementation.

Succeeding, NCA) examined whether any single CSR factor was required for high SBP. Table 8 presents consistency and coverage scores for both positive and negative SBP outcomes. None of the CSR conditions exceeded the 0.90 consistency threshold. This implies no single CSR action alone guaranteed sustainability. Thus, Bangladeshi SMEs require multiple, interacting CSR elements to succeed sustainably. These findings align with prior studies by Ragin (2009), who argue that sufficiency often matters more than necessity. The results underscore the configurational nature of sustainable outcomes. The study results also highlight that isolated CSR efforts in Bangladesh may not yield strong performance.

4.2.2. Sufficient Conditions Analysis. The fsQCA analysis revealed multiple configurations driving both high and low SBPs. For high SBP, seven combinations emerged, highlighting legal, ethical, and philanthropic CSR as core enablers. Solution 1a showed the strongest impact when all six CSR practices aligned positively. Peripheral conditions like economic and environmental CSR further reinforced performance when included. These findings align with Pappas and Woodside [73], who emphasized the cumulative effect of multidimensional CSR. In Bangladesh's SME context, legal and ethical adherence is essential due to limited regulatory oversight and informal practices. For low SBP, environmental, social, and economic CSR absence formed the dominant pathways. In Solution 3, weak environmental commitment emerged as a major cause of poor outcomes. Solution 4 emphasized neglected ethical concerns; showing internal misalignment reduces SME resilience. Table 9 illustrates these contrasting patterns using Boolean logic symbols. The results support causal asymmetry, showing that high and low SBP arise through different factor

Table 3: Confusion matrixes for SBP prediction.

Actual	Predicted	
	SBP	No SBP
Sustainable business performance	True positive (TP)	False negative (FN)
No sustainable business performance	False positive (FP)	True negative (TN)

Table 4: Deviation from linearity test.

ANOVA table	Sum of squares	df	Mean square	*F*	Sig.	Linear
PHI ∗ SBP	90.848	20	4.542	3.781	0.000	Yes
ENV ∗ SBP	99.910	20	4.996	2.809	0.000	Yes
SOC ∗ SBP	77.659	20	3.883	2.279	0.002	Yes
ETHI ∗ SBP	65.779	20	3.289	2.490	0.000	Yes
LEG ∗ SBP	74.054	20	3.703	2.379	0.001	Yes
ECO ∗ SBP	83.966	20	4.198	3.175	0.000	Yes

Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SBP, sustainable business performance; SOC, social CSR practices.

Table 5: Convergent validity and reliability assessment.

Construct	Items	Loading (λ)	Cronbach's alpha (α)	Composite reliability (CR)	Average variance extracted (AVE)
Philanthropic CSR practices	PHI1	0.897	0.921	0.942	0.802
	PHI2	0.911			
	PHI3	0.830			
	PHI4	0.940			
Environmental CSR practices	ENV1	0.947	0.965	0.974	0.904
	ENV2	0.944			
	ENV3	0.958			
	ENV4	0.953			
Social CSR practices	SOC1	0.933	0.958	0.970	0.889
	SOC2	0.944			
	SOC3	0.947			
	SOC4	0.947			
Ethical CSR practices	ETH1	0.933	0.944	0.961	0.856
	ETH2	0.929			
	ETH3	0.928			
	ETH4	0.910			
Legal CSR practices	LEG1	0.912	0.952	0.965	0.872
	LEG1	0.955			
	LEG1	0.923			
	LEG1	0.945			
Economic CSR practices	ECO1	0.948	0.956	0.968	0.882
	ECO1	0.947			
	ECO1	0.924			
	ECO1	0.938			
Sustainable business performance	SBP1	0.921	0.941	0.957	0.849
	SBP2	0.925			
	SBP3	0.912			
	SBP4	0.927			

Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SBP, sustainable business performance; SOC, social CSR practices.

combinations. These findings are consistent with Ragin (2008) and Fiss [77], who argue for equifinality in organizational outcomes. The patterns highlight that partial CSR adoption may not guarantee performance improvements. In Bangladesh, fragmented CSR implementation may lead to inconsistent results. Hence, integrated, context-specific CSR configurations are more effective for manufacturing SMEs. This insight is crucial for policymakers targeting holistic development in Bangladesh's industrial sectors and aligns with sustainability goals.

Table 6: Discriminant validity matrix.

	HTMT criterion						
Constructs	**PHI**	**ENV**	**SOC**	**ETH**	**LEG**	**ECO**	**SBP**
PHI	-						
ENV	0.142	-					
SOC	0.142	0.132	-				
ETH	0.197	0.082	0.146	-			
LEG	0.158	0.182	0.237	0.157	-		
ECO	0.299	0.208	0.153	0.204	0.167	-	
SBP	0.121	0.131	0.096	0.065	0.214	0.133	-

Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SBP, sustainable business performance; SOC, social CSR practices.

Table 7: Hypothesis testing.

Hypothesis	**Relationship**	**Standard beta (β)**	***t*-value**	***p*-value**	**Supported (decision)**
H1	PHI -> SBP	0.212	15.142	0.001	Yes
H2	ENV -> SBP	0.419	5.318	0.013	Yes
H3	SOC -> SBP	0.178	5.235	0.015	Yes
H4	ETH -> SBP	0.401	10.522	0.001	Yes
H5	LEG -> SBP	0.182	2.983	0.042	Yes
H6	ECO -> SBP	0.513	10.469	0.002	Yes

Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SBP, sustainable business performance; SOC, social CSR practices.

Table 8: Analysis of necessary conditions for sustainable business performance.

Conditions	**SBP (sustainability)**		**~ SBP (negation of sustainability)**	
	Consistency	**Coverage**	**Consistency**	**Coverage**
PHI-CSR	0.831	0.840	0.824	0.569
~PHI-CSR	0.573	0.827	0.769	0.757
ENV-CSR	0.843	0.845	0.827	0.566
~ENV-CSR	0.567	0.828	0.774	0.771
SOC-CSR	0.577	0.830	0.775	0.762
~SOC-CSR	0.834	0.845	0.827	0.571
ETH-CSR	0.579	0.759	0.783	0.700
~ETH-CSR	0.771	0.839	0.729	0.544
LEG-CSR	0.869	0.859	0.847	0.571
~LEG-CSR	0.566	0.844	0.791	0.805
ECO-CSR	0.821	0.820	0.819	0.559
~ECO-CSR	0.559	0.818	0.737	0.737

Note: The tilde sign "~" indicates the negation of the conditions.
Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SBP, sustainable business performance; SOC, social CSR practices.

4.3. ML (Stage 3)

4.3.1. Evaluation and Practical Interpretation. Table 10 outlines performance results for 6 ML models across 10 repetitions. Random forest and AdaBoost achieved the highest accuracy, recall, and F1-scores across repeated cross-validations. This shows both models consistently predicted SBP with high precision. Dummy classifiers performed the worst, confirming that trained models provide meaningful predictions. Random forest's balance of precision and recall confirms its robustness for CSR-related prediction. These insights help firms identify which CSR dimensions matter most for sustainability. In Bangladesh's SME context, such findings are crucial for planning resource-efficient CSR strategies. For instance, knowing random forest prioritizes environmental and philanthropic dimensions helps target impactful areas. Policy-makers may also benefit by understanding which CSR practices predict performance.

The ROC curves' visual output simplifies model comparison across accuracy metrics. ROC curves in Figure 3 further supported model reliability, with AUC values close to 0.80. These curves highlight each model's ability to distinguish between high and low SBP outcomes. These results support evidence-based CSR planning and performance tracking. SMEs can implement these findings to align CSR initiatives with business outcomes. Ultimately, the predictive

Table 9: Sufficient configurations for "high level" and "negation" of sustainable business performance.

Conditions	Sufficient configurations for high level of sustainable business performance — configurations (high-level SBP)							Sufficient configurations for the negation of sustainable business performance— configurations (negation ~ SBP)							
	1a	1b	2	3	4	5	6	1a	1b	2	3	4	5a	5b	5c
PHI-CSR	●	●	○	○	●	◯	◯	○	○	●	○	○	○	○	●
ENV-CSR	●	●	●	●	●	◯	◯	○	○	○	○	●	○	○	●
SOC-CSR		◯	◯	◯	◯	◯		⊗	◯	◯	◯	◯	◯	○	●
ETH-CSR	○	○	○	○	○	●	●	●	●	●	⊗	●	●	●	●
LEG-CSR	○	○	○	○	○	○	●	●	●	⊗	●	●	○	●	⊗
ECO-CSR	◯				◯	◯	◯	◯	○	○	○	◯	◯	◯	⊗
Raw	0.4	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.3	0.3
Coverage	95	70	49	60	38	16	09	39	07	49	69	50	41	58	56
Unique	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Coverage	19	19	08	08	11	10	03	34	04	11	36	21	16	12	11
Consistency	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.9	0.9	0.9
Solution	96	95	94	95	93	16	62	82	65	53	36	26	71	04	33
Consistency Solution Coverage				0.952							0.803				
				0.595							0.659				

Note: The symbols "○" or "●" shows the presence of core or peripheral conditions, respectively. The symbols "⊗" or "◯" shows the absence of core or peripheral conditions, respectively. Blank cells show a "do not care" situation; philanthropic CSR practices (PHI);environmental CSR practices (ENV); social CSR practices (SOC); ethical CSR practices (ETH); legal CSR practices (LEG); economic CSR practices (ECO)
Abbreviation: SBP = sustainable business performance.

Table 10: Comparisons and performance analysis of ML models.

Fold	Classifier	TT (sec)	Accuracy	Precision	Recall	F1	AUC
10	Random Forest	**77.40**	**0.9786**	**0.9649**	**0.9786**	**0.9703**	**0.7997**
	KNN	43.40	0.6714	0.6205	0.6714	0.6215	0.6970
	Naive Bayes	57.30	0.9250	0.9016	0.9250	0.9083	0.7643
	Ada Boost	**76.20**	**0.9786**	**0.9643**	**0.9786**	**0.9700**	**0.7999**
	XGBoost	72.40	0.9571	0.9512	0.9571	0.9506	0.7966
	Dummy	55.80	0.4179	0.1749	0.4179	0.2465	0.4000

Note: Bold values indicate statistically significant and substantively important results, highlighting key conditions that meaningfully influence the outcome and support interpretation clarity.

strength and interpretability of these models provide practical tools for improving sustainability strategies in Bangladeshi SMEs.

4.3.2. Sensitivity Analysis (SnA) and CSR Implications. Table 11, SnA revealed that ENV factors had the highest normalized importance (1.000) in predicting SBP. This result aligns with Jing et al. [14], who reported environmental initiatives as vital for competitive advantage in Bangladeshi SMEs. PHI and LEG factors followed with values of 0.256 and 0.196, respectively. This supports Masud and Hossain [7], who emphasized philanthropy and legal compliance as drivers of stakeholder trust. SOC and ECO factors ranked moderately, while ETH had the lowest impact (0.051). This differs from findings in more developed regions, where ethical practices often score higher in influencing SBP.

In the Bangladeshi context, SMEs prioritize compliance and visible contributions, such as environmental and philanthropic actions. This trend reflects cultural values and regulatory pressures unique to Bangladesh. Linking these results to prior studies improves coherence and interpretation. For instance, Uddin et al. [50] noted limited focus on ethics due to resource constraints and governance gaps. These findings help tailor CSR strategies based on actual performance drivers. Firms in Bangladesh may emphasize environment-focused and philanthropic CSR to gain sustainable outcomes. Policymakers can also use this evidence to reinforce strategic CSR investments. Therefore, the results strongly relate to Bangladesh's socio-economic and institutional landscape.

5. Discussions and Implications

5.1. Discussions. This study explored how CSR practices influence SBP among manufacturing SMEs in Bangladesh. It fulfilled the main objectives by identifying significant predictors, explaining complex causal patterns, and validating predictions through robust methods. All CSR domains examined philanthropic, environmental, social, ethical, legal, and economic contributed uniquely to performance outcomes. The discussion integrates insights from symmetrical, asymmetrical, and ML analyses, offering meaningful implications for both theory and practice.

Philanthropic and environmental CSR emerged as strategic priorities for driving long-term sustainability. These domains appeared consistently across successful causal configurations. This aligns with prior studies in emerging markets (e.g., [78, 79]). Philanthropic actions improve public trust and brand image. Environmental initiatives reduce costs, increase stakeholder approval, and enhance competitive advantage. Practical suggestions include investing in local community initiatives, promoting green technology, and adopting responsible waste practices. For SMEs in Bangladesh, these actions align well with the country's developmental and ecological goals. Government incentives and NGO partnerships can further support such transitions. By embracing these CSR domains, SMEs can unlock reputational and financial benefits while aligning with national sustainable development priorities.

Subsequently, poor performance was linked to the absence of social and economic CSR practices [14, 80]. Social CSR, including employee safety, diversity, and welfare, is often under-prioritized in resource-constrained SMEs. Yet, neglecting this area can harm internal cohesion and external trust. Economic CSR, centered on responsible profit and fair pricing, remains essential for business continuity. SMEs should adopt basic workplace protections and transparent financial policies. Access to microfinance and low-cost training can support such CSR integration. International studies (e.g., [52, 81]) support this view. The challenge lies in balancing investment in CSR with financial constraints. This study offers practical strategies: start small, prioritize stakeholder engagement, and scale responsibly. A stepwise approach helps SMEs maintain profitability while improving sustainability. Legal and ethical domains, though less visible in configurations, still play supporting roles in securing compliance and stakeholder confidence.

From side to ML results affirmed the findings. Random forest and AdaBoost accurately predicted performance based on CSR inputs. Sensitivity analysis confirmed the critical importance of environmental and philanthropic CSR, mirroring findings from the previous stages. These models provide actionable insights. They help firms simulate CSR investment outcomes before making decisions. This capability reduces uncertainty and enhances planning. For Bangladeshi SMEs, it bridges the gap between data and strategy. Moreover, prediction tools help firms prioritize CSR areas with the most business value. Practical deployment could occur via simple dashboards or mobile platforms for SME managers. While implementing CSR remains challenging, predictive modeling and targeted interventions make it more manageable. Future efforts should address training and policy alignment to scale such strategies nationwide. This study offers a comprehensive and

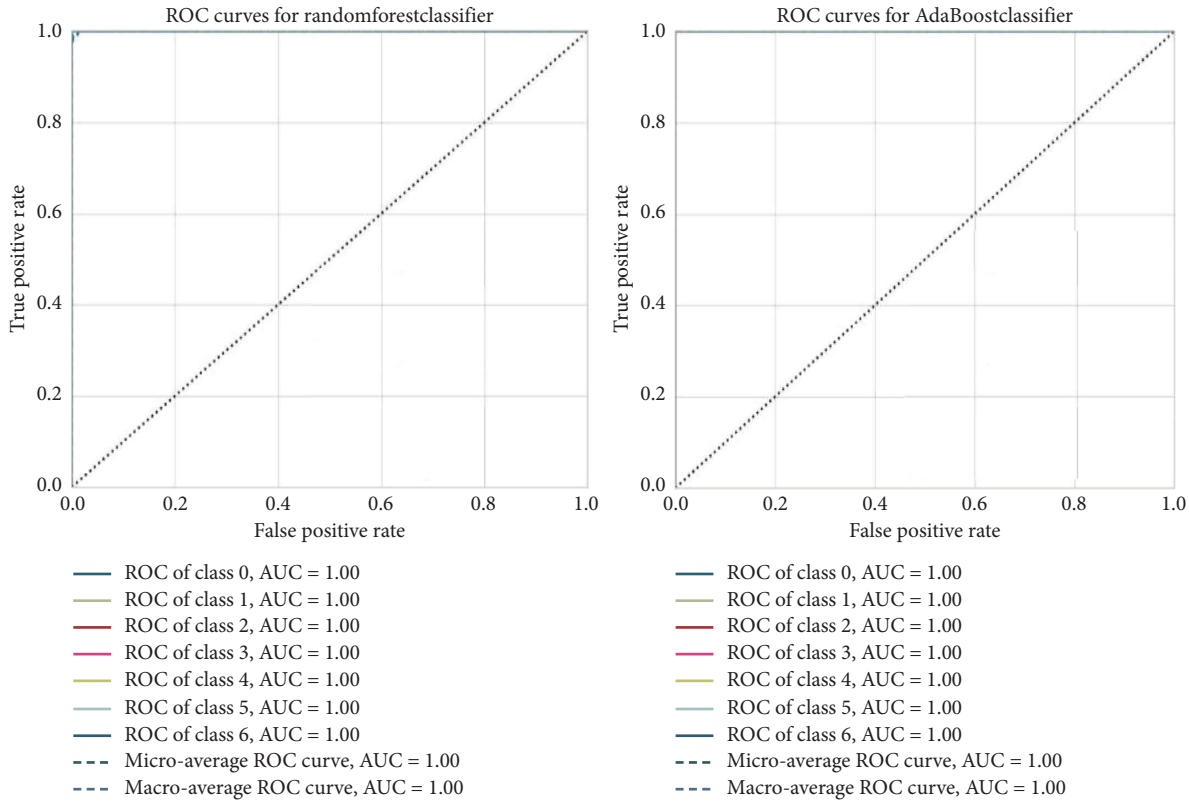

Figure 3: ROC curve for ML approach.

Table 11: Normalized variable importance.

Variable	Normalized importance (NI)
PHI	0.256
ENV	1.000
SOC	0.175
ETH	0.051
LEG	0.196
ECO	0.126

Abbreviations: ECO, economic CSR practices; ENV, environmental CSR practices; ETH, ethical CSR practices; LEG, legal CSR practices; PHI, Philanthropic CSR practices; SOC, social CSR practices.

contextualized framework for CSR-based business improvement. It contributes to theory, supports evidence-based policymaking, and equips managers with data-backed CSR planning tools.

5.2. Implications. This study offers both theoretical and practical implications by integrating LT and ST. LT frames CSR as a means to gain societal approval. ST emphasizes engaging diverse stakeholders in shaping strategic decisions. Together, they show how CSR enhances legitimacy, trust, and sustainable value creation. The results align with Carroll and Shabana [52], supporting CSR as both ethical responsibility and business advantage. Findings show philanthropic and environmental CSR improve reputation and operational effectiveness. This supports the strategic alignment between firm goals and public expectations. Similar evidence is found in Wang et al. [78], confirming that CSR is not merely symbolic but instrumental. The integration of PLS-SEM and fsQCA validates both linear and nonlinear patterns. The study bridges ST with causal complexity frameworks. Environmental CSR emerged as the most critical predictor of performance. This confirms earlier findings by Chen et al. [82], highlighting green initiatives as a core driver. The combination of quantitative models with ML added of predictive depth. This multimethod design sets a new benchmark for CSR research. It links theory and empirical findings in a structured, evidence-based framework.

Practically, the study guides businesses, governments, academia, and civil society toward effective CSR implementation. For businesses, the findings provide a roadmap for integrating CSR with operational goals. Emphasis is placed on aligning CSR with community development and environmental stewardship. This approach strengthens brand loyalty and stakeholder engagement. Companies should view philanthropy and ecoinitiatives as strategic investments, not costs. For governments, the study calls for regulatory clarity and incentives. This includes tax benefits, capacity-building, and sector-based CSR benchmarks. Policymakers must encourage transparent CSR practices with proper monitoring systems. For academics, this work illustrates how combining fsQCA, PLS-SEM, and ML enhances CSR evaluation. Future research can expand by applying this hybrid approach in other sectors. For SME managers, the results clarify where to focus limited resources. Investing in environmental upgrades, ethical

governance, and community engagement brings both social and economic returns. The findings also help SMEs in Bangladesh prioritize impactful CSR under resource constraints. Ethical CSR was less influential but remains important for trust and resilience. Lastly, this study offers actionable strategies rooted in empirical evidence.

6. Conclusion, Limitations, and Future Research Directions

This study confirmed the positive influence of CSR practices on SBP in SMEs. It developed a multimethod framework integrating Carroll's model, SEM, fsQCA, and ML. Each method contributed unique insights. SEM confirmed direct effects between CSR and SBP. fsQCA revealed various causal configurations. ML identified environmental CSR as the most impactful factor. These findings align with earlier research by Uyar et al. [83] and Anser et al. [84], reinforcing CSR's value in stakeholder trust and long-term growth. Managers should embed environmental and philanthropic actions into their business strategies. Examples include clean energy use, waste reduction, and targeted social programs. SMEs can benefit from CSR by linking goals to firm values and local needs. Government support, including training and tax incentives, can encourage responsible practices. Concrete CSR goals strengthen brand identity, legal credibility, and social contribution. This practical approach builds resilience and long-term sustainability. Nonetheless, this research also identified limitations. It focused on six CSR practices within the Bangladeshi SME context. Future work should include additional metrics like innovation, employee retention, or market expansion. However, cross-sector studies will offer broader insights and validate findings across industries. Integrating CSR with performance systems, policy frameworks, and stakeholder interests could advance theory and practice. These steps will enrich future research and promote more inclusive and actionable CSR frameworks for developing countries.

Data Availability Statement

The dataset supporting this study's findings is available from the corresponding author upon reasonable and justified request.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Gazi Md. Shakhawat Hossain: conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, writing–original draft, writing–review and editing, and visualization; Jing Zhang: validation, investigation, resources, and supervision; Mingxing Li: resources and writing–review and editing; Md. Shahinur Rahman: methodology, validation, formal analysis, and data curation.

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