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Assessing Sustainability Performance in the Textile Industry Using a Triple Bottom Line and SEM Approach: Evidence from a Developing Economy

Junaid Arshad[1], Ubaid Ullah[1], Muzammil Hafeez[1], Muhammad Arshad[1], Mansoor Mustafa[2], Sikandar Bilal Khattak[1]

[1]Department of Industrial Engineering, University of Engineering & Technology, Peshawar.

[2]Riphah International University, Islamabad.

***Correspondence**: marshad@uetpeshawar.edu.pk

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Textile industry can be considered as one of the most resource-intensive manufacturing sectors that poses significant environmental, social, and economic challenges, especially in developing economies. Despite growing interest, empirical research on the interdependencies among sustainability dimensions remains limited., although there is an increasing interest in sustainable textile production. The proposed study will evaluate the performance of sustainability in the textile industry by applying the Triple Bottom Line (TBL) framework and Structural Equation Modelling (SEM). A structured questionnaire survey was conducted on 120 textile manufacturing companies in Pakistan to collect primary data. The outcome shows that social sustainability positively affects economic performance ($\beta = 0.794$, $p < 0.001$) and environmental performance ($\beta = 0.659$, $p < 0.001$), and economic sustainability also has a strong effect on environmental sustainability ($\beta = 0.730$, $p < 0.001$). Some critical aspects contributing to sustainability performance include economic stability, waste management, energy efficiency, and adherence to human rights standards. Even though all the structural relationships are deemed to be statistically significant, the overall model fit indices (CFI = 0.704; RMSEA = 0.094) provide evidence of potential improvement of the measurement model.

Keywords: Sustainability, Textile Industry, Structural Equation Modeling (SEM), Circular Economy, Eco- Design, Resource Efficiency.

Introduction:

Vehicle security remains a critical concern owing to the increasing incidence of car battery theft. The textile industry is one of the most economically significant manufacturing sectors in the world, with a significant contribution made in terms of employment generation, export earnings, and industrial development. Major producers of textile such as China, India, Bangladesh, Turkey, and Pakistan, have been largely dependent on this industry to grow their economies and compete in the industrial sector nationally [1]. Although the textile industry has been critical in the economy, it has generally been known to be one of the most resource-intensive manufacturing industries, which involves significant consumption of water, energy, chemicals, and raw materials throughout the production cycle [2][3].

The rapid growth of the textile industry has magnified the intensity of its impact on the environment, leading to severe ecological problems, which include environmental pollution through ever-increasing levels of water pollution, greenhouse gas emissions, excessive energy use, and high volumes of textile waste products [4][5]. During wet processing processes such as dyeing, finishing, and washing, a large volume of wastewater is produced, often containing toxic substances. that can pose a serious threat to the environment and the health of the people in the event they are not treated properly [6]. Moreover, the growing popularity of synthetic fibers has led to pollution by microplastics, and recent findings approximate these numbers to around 35 percent of microplastics in marine waters to have a textile-related source [7]. The above environmental issues have put mounting pressure on textile producers to shift towards more sustainable production processes.

In response, sustainability has become a strategic focus for the world textile industry. Sustainable textile production aims to find equilibrium between environmental care, social responsibility, and economic feasibility by adopting the Triple Bottom Line (TBL) model, which incorporates the environmental, social, and economic aspects of the performance [8]. Approaches to sustainability in common are eco-design, cleaner technologies of production, responsible sourcing, waste reduction, and implementation of a circular economy [9][10]. The purpose of the circular economy paradigm is to redesign the old paradigm of the linear take–make-dispose model with regenerative systems that focus on reuse, recycling, remanufacturing, and product lifecycles [11].

Despite these efforts, the adoption of sustainable practices remains uneven, especially in developing economies. There are high costs of investment, low access to green technologies, poor infrastructure, and poor enforcement of regulations, which still hamper sustainability transitions [12][13]. SMEs that control textile production in most developing nations tend to lack the financial strength as well as technical abilities required to deploy sustainable innovations [14]. Moreover, consumer awareness of sustainable fashion is still growing, but the choice of purchase is still more price-sensitive and based on a favorable brand image, which restricts the demand for sustainably produced textiles [15][16].

To address these challenges, governments and international bodies have developed regulatory models and voluntary certification schemes aimed at improving sustainability performance in the textile value chains. Such initiatives as the Sustainable Textiles Strategy 2030 of the EU, the Global Organic Textile Standard (GOTS), and the Higg Index of sustainable apparel coalition are devoted to enhancing environmental performance, supply chain transparency, and labor standards [17][18]. Meanwhile, digitalization, artificial intelligence, blockchain, and life cycle assessment (LCA) are becoming more widely implemented as Industry 4.0 technologies to enhance the efficiency of resources and facilitate the process of data-driven sustainability choice in the textile manufacturing [19].

Recent empirical studies have increasingly employed Structural Equation Modelling (SEM) to examine sustainability performance in manufacturing and textile sectors. For instance, Nguyen et al. [15] applied SEM to analyze sustainability drivers in the apparel industry, while

Harsanto et al. [14] examined sustainability strategies in manufacturing firms using a quantitative framework. More recently, Mušič [9] and Plakantonaki et al. [17] investigated circular economy practices and Industry 4.0–enabled sustainability using SEM-based approaches. Although these studies provide valuable insights, they predominantly focus on developed economies or analyze isolated sustainability dimensions, offering limited empirical evidence on the integrated interrelationships among social, economic, and environmental sustainability in developing-country textile industries.

Despite the increased significant academic interest in sustainable textiles in recent years, the current research is still very fragmented, and it still deals mainly with the developed economies. There is little empirical evidence on the drivers of sustainability in the context of developing countries, although there are specific structural, financial, and regulatory limitations. Furthermore, although other researchers tend to research environmental, social, or economic sustainability independently, there is a lack of studies that explore the interrelationship between the dimensions of sustainability through a single analytical system.

It is against this backdrop that the current work determines the sustainability performance of the textile industry through the Triple Bottom Line model as well as Structural Equation Modelling (SEM). With the context of a developing economy, the research is expected to determine the critical sustainability drivers as well as analyze the interdependencies between social, economic, and environmental aspects. The research offers an empirical finding in a resource-restricted environment and can act as a contribution to the sustainability literature, as well as provide practical information to policymakers and industry players in need of speeding sustainable change in the textile manufacturing.

This study offers three key contributions to the sustainability literature. First, it empirically applies an integrated Triple Bottom Line (TBL) framework within a Structural Equation Modelling (SEM) approach to simultaneously examine the causal interrelationships among social, economic, and environmental sustainability dimensions, rather than treating them independently. Second, the study provides firm-level empirical evidence from a developing-economy textile industry context, which remains underrepresented in existing SEM-based sustainability research. Third, by identifying and quantifying the directional effects among sustainability dimensions, the findings extend current knowledge by demonstrating how social and economic sustainability act as enabling mechanisms for environmental performance in resource-constrained industrial settings.

Research Objectives & Hypothesis:

The purpose of this study is to empirically assess sustainability performance in the textile industry using the Triple Bottom Line (TBL) framework and Structural Equation Modelling (SEM). Specifically, the study seeks to examine the causal relationships among social, economic, and environmental dimensions of sustainability in the context of a developing economy.

This research aims to evaluate the sustainability performance of the textile industry through the TBL framework and Structural Equation Modelling (SEM) empirically. Particularly, the research aims at analyzing causal relationships among social, economic, and environmental aspects of sustainability in the developing economy.

Based on the reviewed literature and the proposed conceptual framework, the following research objectives are formulated:

RO1: To evaluate sustainability performance in the textile industry using the Triple Bottom Line framework.

RO2: To examine the causal role of social sustainability on economic sustainability.

RO3: To examine both the direct and indirect implications of social and economic sustainability on environmental sustainability.

To achieve these objectives, the following hypotheses are proposed:

H1: Economic sustainability is positively and significantly influenced by social sustainability.

H2: Environmental sustainability is positively and significantly impacted through social sustainability.

H3: Economic sustainability has a positive and significant effect on environmental sustainability.

Literature Review:

The field of the textile industry has been subject to growing academic interest because of its massive environmental footprint, intricate global supply chains, and intricate social connotations. Sustainability studies within this industry often take the Triple Bottom Line (TBL) approach that focuses on the combination of environmental preservation, social accountability, and economic feasibility [1][2]. Previous research always mentions the textile manufacturing sector as one of the most resource-intensive industrial processes with intensive consumption of water and energy, high levels of chemical resources, and huge amounts of solid and liquid waste [3][4].

The prevailing research on textiles has been on the topic of environmental sustainability. Available literature records the environmental consequences of the wet processing process, especially dyeing and finishing, which have led to water pollution and consequently greenhouse gases [5][6]. Recent literature identifies the possibility of four principles of the circular economy to reduce those effects by recycling, reuse, eco-design, and long lifespan of products [7][8]. Circular practices have the potential to minimize the level of resource dependency and waste generation, but their implementation is still not widespread, particularly in small and medium-sized enterprises (SMEs), because of the large capital investments and technological limitations [9].

Social sustainability in the textile sector is often discussed in terms of labor standards, occupational health and safety, and adherence to human rights. The existing experience of developing economies suggests that there are still unresolved issues associated with the problems of unsafe working conditions, low wages, and poor enforcement of regulations [10][11]. Even though social compliance programs and certification systems have enhanced transparency and awareness, they are not always effective due to their reliance on enforcement systems and management dedication instead of free will participation [12]

The impact of financial stability, efficiency in the processes, and technological upgrading on sustaining the long-term sustainability transitions is highlighted in economic sustainability research. Companies that have high economic performance tend to be in a better position to invest in cleaner technologies of production and sustainability innovations [13]. On the other hand, the shortage of profits and overall lack of financial means discourage investment in sustainability; this contributes to the support of short-term operational priorities in long-term environmental and social goals [14].

The reason is that consumer behavior was found to be another important issue affecting sustainability adoption in the textile sector. Although the consumer consciousness about the environmental and social concerns in textile manufacturing is on the rise, consumer purchasing behavior is highly price responsive, convenient, and brand sensitive [15][16]. This disconnects between awareness of sustainability and actual purchasing behavior constrains market-based motivation towards sustainable production of textiles.

Digitalization and data analytics, blockchain, and life cycle assessment are also listed as Industry 4.0 technologies, being considered essential contributors to the improvement of sustainability performance, emerging much more recently. These technologies are highly efficient in resource use, supply chain transparency, and sustainability monitoring. However, adoption is uneven due to high investment costs and organizational resistance, particularly in traditional manufacturing systems.[17].

Recent literature published between 2021 and 2024 demonstrates a growing application of SEM to investigate sustainability in manufacturing and textile industries. Studies such as [15][9] empirically validate sustainability constructs related to circular economy practices, economic resilience, and social compliance. However, most of these studies emphasize isolated sustainability dimensions or specific operational practices, with limited attention to the causal interdependencies among Triple Bottom Line (TBL) dimensions. Moreover, empirical investigations within developing-economy textile contexts remain scarce, highlighting the need for integrated TBL–SEM frameworks capable of simultaneously modeling social, economic, and environmental sustainability.

Regardless of the increasing literature, there is still a paucity of empirical research studies to investigate the interrelationships between the social, economic, and environmental sustainability dimensions, particularly those in the context of developing countries. Current literature investigates sustainability aspects independently and studies only the developed economies without considering the structural limitations that the textile producers in emerging markets experience. The lack of this suggests the necessity of combined analytical tools, including Structural Equation Modelling (SEM), to acquire a better insight into how the dimensions of sustainability relate and cooperate to produce performance outcomes.

Table 1. Summary of Key Literature on Sustainability in the Textile Industry

Ref.	Authors	Focus Area	Methodology	Key Findings	Research Gap
[1]	Niinimäki *et al.* (2020)	Environmental impact of fast fashion	Conceptual review	Textile production imposes severe environmental burdens across global value chains.	Lacks firm-level empirical evidence from developing economies
[2]	Muthu (2017)	Sustainability in textile manufacturing	Book synthesis	Identifies environmental, social, and economic challenges in textile production	No integrated quantitative modeling of sustainability dimensions
[3]	Koszewska (2018)	Circular economy in textiles	Conceptual analysis	Circular practices face cost and infrastructure barriers	Limited empirical validation of adoption drivers
[4]	Allwood *et al.* (2019)	System-level textile sustainability	Industry assessment	Energy, water use, and waste are major sustainability challenges	Does not analyze interactions among TBL dimensions
[6]	Muthu and Gardetti (2020)	Sustainable textile production	Edited volume	Cleaner production and waste reduction are critical for sustainability	Lacks causal analysis at the firm level
[7]	Auta *et al.* (2017)	Microplastic pollution	Environmental analysis	Synthetic textiles are a major source of marine microplastics	No linkage to manufacturing sustainability strategies
[8]	Elkington (1997)	Triple Bottom Line framework	Conceptual	Introduced integrated social, economic, and environmental sustainability	Requires sector-specific empirical validation
[11]	Moreira *et al.* (2023)	Circular economy adoption	Empirical case study	Circular practices improve sustainability but increase operational costs	Limited generalizability to developing economies
[14]	Mušič (2023)	Circular business models	Survey-based study	SMEs face financial and technological barriers to circularity	Interactions with social and economic

					dimensions are not explored
[15]	Nguyen *et al.* (2023)	Sustainable apparel consumption	Survey-based SEM	Consumer intention does not always translate into purchasing behavior	Focuses on consumers rather than producers
[16]	Peters *et al.* (2021)	Fast fashion behavior	Environmental impact assessment	Price and convenience dominate sustainability considerations	Limited relevance to production-side decision-making
[17]	Plakantonaki *et al.* (2023)	Industry 4.0 and sustainability	Empirical analysis	Digital technologies enhance transparency and efficiency	Adoption barriers in developing economies not examined
[10]	International Labour Organization (2022)	Social sustainability	Policy report	Labor standards and skills gaps remain persistent issues	Does not integrate economic or environmental dimensions
[12]	Seuring and Müller (2008)	Sustainable supply chains	Conceptual framework	Sustainability requires integrated supply chain approaches	No textile-specific SEM validation
[13]	Govindan and Hasanagic (2018)	Drivers of sustainability	Systematic review	Economic stability enables sustainable investment	Lacks causal modeling across TBL dimensions

From the literature review, several unresolved gaps remain regarding the integrated assessment of sustainability in the textile industry. Table 2 summarizes these gaps and outlines how the present study addresses them.

Table 2. Identified Literature Gaps and Contribution of the Study

Ref.	Identified Gap in Existing Literature	How This Study Addresses the Gap
[1][4]	Limited firm-level empirical analysis of textile sustainability in developing economies	Provides survey-based empirical evidence from textile firms in a developing-country context
[2][8]	Sustainability dimensions are often discussed conceptually without quantitative integration.	Applies the Triple Bottom Line framework within a quantitative SEM model
[3][11][14]	Circular economy studies focus on isolated practices rather than systemic sustainability performance.	Examines circularity-related indicators within an integrated sustainability framework
[6][7]	Environmental impacts emphasized without linkage to economic and social drivers.	Model's interrelationships among social, economic, and environmental dimensions
[15][16]	Consumer-centric studies overlook production-side sustainability decision-making.	Focuses on manufacturing-level sustainability drivers rather than consumer behavior
[10][12]	Social sustainability is treated separately from economic and environmental outcomes.	Demonstrates the causal influence of social sustainability on economic and environmental performance
[13][19]	Lack of causal modeling explaining how economic stability enables environmental sustainability	Uses SEM to quantify direct and indirect effects among TBL dimensions

Methodology:

Research Design:

This study employs a quantitative, cross-sectional research design is a quantitative and cross-sectional research design to assess the sustainability performance of the textile industry based on the Triple Bottom Line (TBL) framework. The data were gathered using a structured questionnaire as primary data, and analyzed using Structural Equation Modelling (SEM) to investigate the relationships between social, economic, and environmental dimensions of sustainability. The quantitative methodology was used because it allows testing causal relationships between latent constructs empirically and ensures methodological rigor.

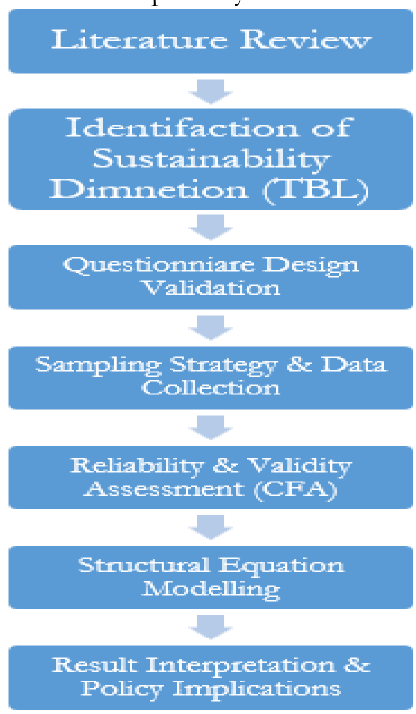

Figure 1. Research Methodology Flow Diagram

Figure X shows the research methodology flow diagram, illustrating the sequential process from literature review from literature review and identification of sustainability dimensions to questionnaire development, data collection, confirmatory factor analysis, structural equation modelling, and interpretation of results.

Questionnaire Design and Measurement Constructs:

The questionnaire was designed after carrying out a comprehensive literature review on available sources on sustainability and was refined with expert input to ensure it addresses contextual issues in the textile industry. Three TBL dimensions (measurement constructs) were formed: Their social sustainability includes: workforce management, labor rights, human rights, health and safety, labor standards, skill development, and labor cost. Economic sustainability: financial stability, organizational growth, upgrading process, productivity, lead time, and production efficiency. Environmental sustainability: waste, energy use, adopting green technology, resource efficiency, and the circular economy. A summary of the selected factors and their relevance is provided in Table 3 below.

Measures were applied to all items in a five-point Likert scale between Very High (5) and Negligible (1). The scale was selected because it was necessary to record the perception of the respondents on the intensity of sustainability implementation and make it statistically relevant to SEM analysis.

In this work, the key indicators of environmental sustainability operationalize circadian economy practices, which represent the primary principles of the circular economy, namely waste management, resource efficiency, energy efficiency, and the use of green technologies. These indicators represent circular strategies like waste minimization, resource use efficiency, and process optimization, which are generally known as the convenient roles in the textile industry, as far as the implementation of a circular economy is concerned. Instead of thinking of the circular economy as a self-contained latent construct, the practices are incorporated within the environmental sustainability dimension to indicate the integrated and functional nature of the sustainability performance of firms.

Table 3. Factor Selection Table

Factor	Category	Source	Relevance
Energy Efficiency	Environmental	Literature, Industry Experts	Reduces carbon footprint in textile production
Labor Rights	Social	Literature, Stakeholder Interviews	Ensures ethical working conditions
Waste Management	Environmental	Literature, Industry Reports	Minimizes textile waste and pollution
Financial Viability	Economic	Industry Reports, Economic Data	Supports long-term sustainability

Sampling and Data Collection:

The target population entailed the textile manufacturing companies in operation in Pakistan, which are spinning, weaving, dyeing, finishing, and garment production. It used a stratified random sampling method that guaranteed the proportional representation of various subsectors of the textile industry and positions. The lowest sample size was obtained using the 95 percent confidence level with the 10 percent margin of error, which gave 96 respondents as the required sample. In order to increase the strength, 120 legitimate answers were gathered and factored into the ultimate analysis. Data were collected through on-site visits, an email-based survey, and professional networks in the industry. The respondents were also free to participate and informed about the purpose of the research before the collection of the data.

Reliability and Validity Assessment:

Cronbach's Alpha and McDonald's Omega Coefficients were used to determine the scale reliability and internal consistency. Any value that has values greater than 0.70 was deemed acceptable. According to Table 4 (Reliability Analysis Results), all the constructions were higher than the recommended thresholds, which means that there is strong internal consistency.

Table 4. Reliability Analysis Results

Measure	Cronbach's Alpha	Mean Score	Standard Deviation	McDonald's Omega
Social Factors	0.891	3.54	0.47	0.913
Economic Factors	0.874	3.61	0.45	0.908
Environmental Factors	0.908	3.63	0.48	0.913
Overall Sustainability	0.908	3.61	0.47	0.913

Construct validity was evaluated through Confirmatory Factor Analysis (CFA). Factor loadings greater than 0.50 and statistically significant p-values ($p < 0.001$) were used as criteria for convergent validity. The results confirm that all observed variables adequately represent their respective latent constructs.

Construct validity was evaluated through Confirmatory Factor Analysis (CFA). Factor loadings of 0.50 or higher were considered desirable. However, theoretically important indicators with marginally lower loadings were retained to preserve content validity, provided overall construct reliability met recommended thresholds.

Structural Equation Modelling Approach:

The measurement and structural parts of the sustainability framework were tested using SEM. The analysis was divided into two phases:

Measurement model: Construct and indicator validity were examined using CFA.

Structural model: Path analysis was conducted to test the causal relationship between the three dimensions (social, economic, and environmental) of sustainability.

The reasons why SEM was chosen were that it can model the latent variables, it adds measurement error, and it can also estimate direct and indirect effects at the same time. Various goodness-of-fit indices such as Chi-square (χ^2), RMSEA, CFI, TLI, and SRMR were used to evaluate the model fit.

Within the SEM framework, circular economy practices influence sustainability performance indirectly through the environmental sustainability construct. The model structure enables the evaluation of the role of both social and economic sustainability dimensions that facilitate the adoption of circular practices that subsequently improve the environmental performance. This combined representation implies how the circular economy is a mechanism that is embedded within broader sustainability processes and is not a single working strategy.

Ethical Considerations:

Moral principles were upheld during the research examination. Participation was voluntary, and informed consent was taken from all respondents. Confidentiality and anonymity were assured. No personally identifiable data was gathered, and all data was utilized purely for academic work.

Methodological Summary:

The methodology adopted combines validated measurement tools, a sound sampling plan, and analysis of sustainability performance using SEM to offer an empirical evaluation of sustainability performance in the textile industry. remaining in line with the TBL model and ensuring statistical reliability and validity, the methodology enables a comprehensive analysis of sustainability drivers within the framework of a developing-economy setting.

Data Analysis:

This part of the research paper offers empirical findings of the study, such as respondent demographics, reliability test, model validation of measurement, and analysis of the structural relationships among the sustainability dimensions on the basis of the Triple Bottom Line (TBL) framework.

Demographic Profile of Respondents:

The demographic analysis demonstrates sufficient representation in terms of age, job positions, and experience. Many of the respondents were under the age of 30 years (48.04%), followed by 30-40-year-old individuals, who were 33.33%. On occupational roles, employees in the private sector were the highest (33.33%), followed by managers (23.53%) and supervisors (15.69%). In terms of work experience, 34.78% of the respondents had less than five years of work experience, and 19.57% of the respondents had over twenty years of experience in the industry. This distribution is a good manifestation of a balanced mix of junior and senior professionals, which confirms the credibility of the obtained responses.

Descriptive Statistics and Reliability Analysis:

The Structural Equation Modelling (SEM) was preceded by descriptive statistics and reliability analyses. Internal consistency was assessed using Cronbach's Alpha and McDonald's Omega coefficients. As seen in Table 5, constructs are above the recommended value of 0.70, which shows high reliability. The mean score of 3.61 indicates a moderate to high level of sustainability adoption among the surveyed textile firms.

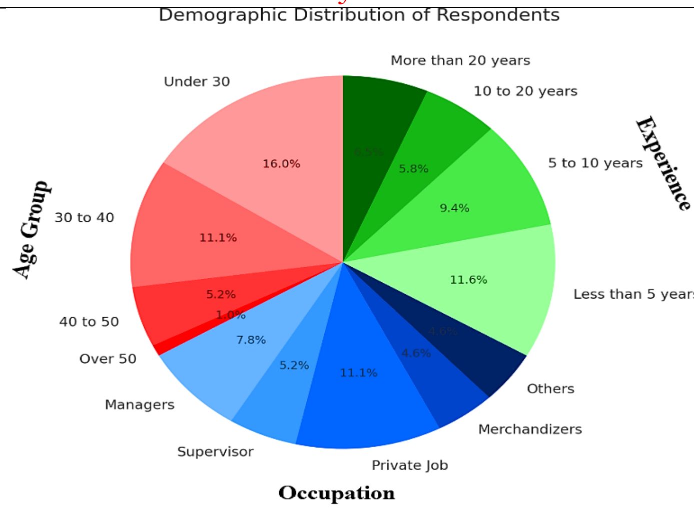

Figure 2. Respondent Demographics

Table 5. Factor Analysis Results

Measure	Cronbach's Alpha	Mean Score	Standard Deviation	McDonald's Omega
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Overall Sustainability	0.908	3.61	0.47	0.913

Covariance Analysis Among Sustainability Dimensions:

The covariance analysis was conducted to test the relationships between social, economic, and environmental sustainability dimensions. The findings indicate statistically significant positive correlations among all constructs ($p < 0.001$). Covariance between social and economic sustainability (0.794) and economic and environmental sustainability (0.730) had the strongest covariance. These results suggest that improvements in one aspect of sustainability may support improvements in other aspects.

Table 6. Factor Covariance

Factor Pair	Estimate	Standard Error	Z-Value	P- Value
Social → Economic	0.794	0.0582	13.63	<0.001
Social → Environmental	0.659	0.0617	10.689	<0.001
Economic → Environmental	0.730	0.0649	12.992	<0.001

Measurement Model: Confirmatory Factor Analysis:

The measurement model was validated, and the reliability of the indicators was evaluated by means of Confirmatory Factor Analysis (CFA). Within the social dimension, human rights, labor standards, and health and safety exhibited the highest factor loadings. Economic stability and organizational growth were the primary contributors to economic sustainability., whereas green technology adoption and waste management were the most dominant issues influencing environmental sustainability. Every loading of the factor was statistically significant ($p < 0.001$), which establishes an adequate convergent validity.

Table 7. Factors Loading

Latent Variable	Indicator	Estimate	SE	Z-Value	P-Value
Social	Workforce Management	0.4494	0.0865	5.194	<0.001
	Skill Level of Workforce	0.3632	0.0716	5.071	<0.001
	Labor Cost	0.4417	0.0808	5.467	<0.001
	Human Rights	0.6886	0.0820	8.399	<0.001
	Health and Safety	0.6342	0.0784	8.091	<0.001

	Labor Standards	0.6977	0.0951	7.336	<0.001
Economic	Updating of Process	0.4699	0.0731	6.431	<0.001
	Organization Growth	0.5161	0.0784	6.581	<0.001
	Economic Stability	0.6837	0.0975	7.012	<0.001
Environmental	Use of Green Technology	0.6416	0.0796	8.057	<0.001
	Waste Management	0.6334	0.0861	7.357	<0.001
	Energy Consumption	0.5724	0.0832	6.875	<0.001

Although factor loadings greater than 0.50 are commonly recommended for establishing convergent validity, several indicators in this study exhibited loadings marginally below this threshold. These indicators were retained due to their strong theoretical relevance and contribution to content validity, as supported by prior literature and expert consultation during questionnaire development. All latent constructs also demonstrated satisfactory internal consistency, with Cronbach's alpha and McDonald's omega exceeding the recommended threshold of 0.70. Previous SEM studies have also acknowledged that retaining theoretically meaningful indicators with slightly lower loadings is acceptable, particularly in exploratory or context-specific research settings within developing economies.

Structural Model and Path Analysis:

The outcomes of the path analysis show that there are high and positive causal links between sustainability dimensions. Social sustainability is very important to economic sustainability ($\beta = 0.794$, $p < 0.001$) and environmental sustainability ($\beta = 0.659$, $p < 0.001$). There is also a strong positive influence of economic sustainability on environmental sustainability ($\beta = 0.730$, $p < 0.001$). The findings suggest that improvements in social sustainability can indirectly enhance environmental and economic performance.

Table 8. Path Analysis Results

Path	Coefficient	SE	P-Value
Social → Economic	0.794	0.0582	<0.001
Social → Environmental	0.659	0.0617	<0.001
Economic → Environmental	0.730	0.0649	<0.001

Model Fit Assessment:

Results with model fit indices show mixed results. The SRMR value (0.058) is within an acceptable range, whereas the values of RMSEA (0.094), CFI (0.704), and TLI (0.680) do not correspond to the recommended values. Even though the structural paths are statistically strong, the overall fitting indicates that the measurement model can be improved. The misfit might partially be due to the complexity of the constructs of sustainability and the heterogeneity of firms at this level.

Table 9. Model Fit Indices

Index	Threshold	Value
Chi-Square (χ^2)	>0.05	114
RMSEA	<0.06	0.0944
CFI	>0.90	0.704
TLI	>0.90	0.680
SRMR	<0.08	0.058

While the structural relationships in the model are statistically significant, the overall goodness-of-fit indices indicate scope for improvement in the measurement model. Future research may enhance model fit through construct refinement, removal of indicators with low explanatory power, or testing alternative model specifications that better capture the multidimensional nature of sustainability. Additionally, increasing sample size or employing longitudinal data may further improve model stability and fit. These remedial measures were not pursued in the present study to preserve theoretical completeness and comparability across sustainability dimensions.

Summary of Data Analysis:

Overall, the discussion supports the existence of high levels of interdependence between social, economic, and environmental sustainability dimensions. Economic stability and social responsibility emerge as primary drivers of environmental sustainability. Although the structural relationships are statistically significant, further research should streamline the measurement of the construct. This may increase the overall model fit. The moderate model fit may reflect the inherent complexity and contextual heterogeneity of sustainability practices among textile firms in developing economies.

Results and Discussion:

The research results of this paper reveal the increased significance of sustainability-oriented practices in the textile sector. The issue of environmental sustainability becomes a major concern, as there is growing regulatory pressure and market demands for cleaner production systems.

Significant Sub-Factors Affecting Sustainability Performance:

The analysis reveals that there are several important sub-factors in the dimensions of sustainability. Under the social component, there is a significant impact on labor costs and the implementation of human rights, with a focus on the human rights of fair wages and ethical labor practices. The economic stability and process upgrading are the main drivers of economic sustainability, which implies that financially sound firms are in a better position to implement sustainability initiatives. Waste management and energy consumption are key factors in the environmental dimension, playing a critical role in mitigating environmental impacts.

Table 10. Significance of Sub-Factors

Sub-Factor	Latent Variable	Loading	P-Value
Labor Cost	Social	0.6342	<0.001
Human Rights Implementation	Social	0.4417	<0.001
Economic Stability	Economic	0.6837	<0.001
Updating of Process	Economic	0.5161	<0.001
Waste Management	Environmental	0.6416	<0.001
Energy Consumption	Environmental	0.5591	<0.001

Non-Significant Sub-Factors:

Other variables—including the number of employees, production volume, lead time, and firm age—were not statistically significant. These results suggest that firm size or scale of operations is not the sole factor that determines better sustainable performance. Rather, strategic commitment and focused investments appear to have a decisive influence.

Table 11. Non-Significant Sub-Factors

Sub-Factor	Latent Variable	Loading	P-Value
Number of Employees	Social	0.1498	0.173
Product Production	Economic	0.0956	0.345
Lead Time	Economic	0.0113	0.883
Distance from Supplier	Economic	0.2286	0.351
Firm Age	Economic	0.1267	0.057

Structural Model Interpretation:

The outcomes of the models indicate that labor-related issues are predominant in social sustainability, economic stability, and process upgrading influence economic sustainability, and waste management and energy efficiency are primary drivers of environmental sustainability. The relative importance of these factors provides a clear basis for prioritizing managerial and policy interventions.

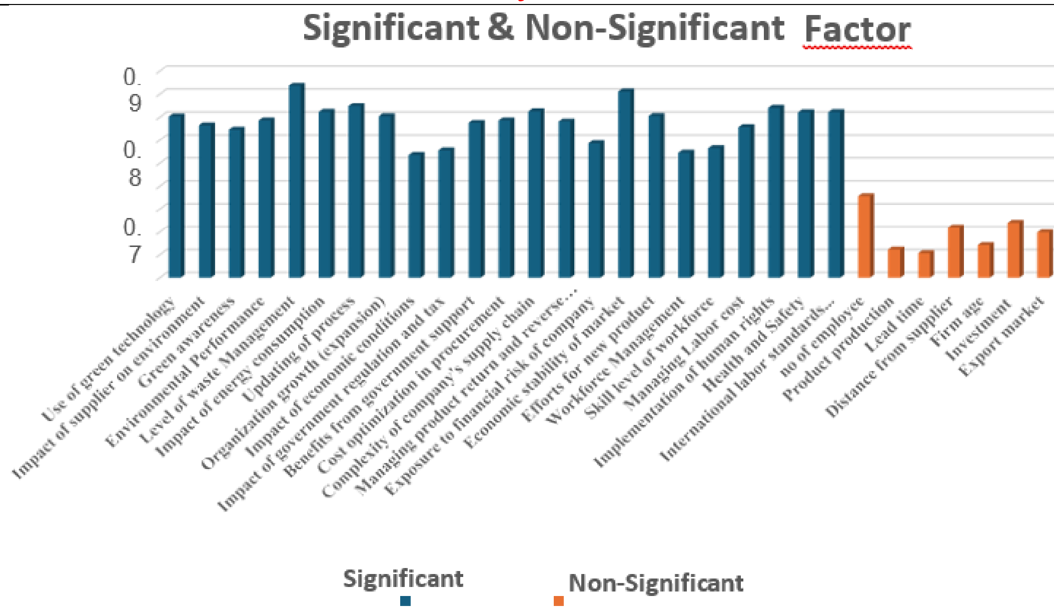

Figure 3. Significant and Non-Significant Factors

Discussion in the Context of Existing Literature:

The findings of the research are consistent with the findings of previous studies that highlight the prevalence of environmental sustainability programs among the textile industries. Other research on eco-design and circular economy approach, and cleaner production, also emphasizes waste minimization and energy efficiency as key drivers of sustainability. Nonetheless, the results also support the significance of social sustainability as a supporting factor that determines the economic and environmental performance, which is not frequently investigated in previous research. The small size and age effect are in line with previous findings that indicated that sustainability performance was more related to managerial orientation and investment power than the maturity of an organization alone. The gap between sustainability awareness and purchasing behavior, as observed, has also been supported by consumer-related studies that still limit the adoption of sustainability in a market-based scenario. Beyond confirming prior empirical findings, the present study also extends recent sustainability literature by empirically examining the causal interdependencies among TBL dimensions.

This research is consistent with the latest empirical studies that present the interdependency of the dimensions of sustainability in manufacturing systems. As an example, the studies conducted indicate that social and economic capabilities have a great impact on the environmental performance, which confirms the causal relationships that have been found throughout this study. On the same note, the study incorporates circular economy practices, like waste reduction and resource efficiency, in reinforcing the idea of environmental sustainability, which aligns with the prominent role of waste management and energy efficiency as in the current model. However, unlike many prior studies that examine sustainability dimensions in isolation, this study extends existing knowledge by empirically demonstrating the directional and reinforcing relationships among social, economic, and environmental sustainability within a single integrated TBL–SEM framework, particularly in a developing-economy textile context.

Implications and Future Outlook:

The results indicate that sustainability changes in the textile sector need to be achieved through concerted actions in regulatory enforcement, technological rehabilitation, and social responsibility projects. Although new developments in circular economy activities and digital technologies provide some promising opportunities, Financial and organizational motivation remains a key challenge, especially in the case of SMEs. Such challenges will be resolved through special policy assistance, access to green financing, and capacity-building projects.

Conclusion and Policy Recommendations:

Conclusion:

The paper gives an empirical evaluation of sustainability performance in the textile sector by the Triple Bottom Line (TBL) framework and Structural Equation Modelling (SEM) in a developing-economy environment. The results indicate that sustainability in textile production is influenced by high interrelations between social, economic, and environmental aspects instead of single efforts. The findings indicate that social sustainability is a platform of operation since it impacts highly on economic and environmental performance. Labor standards and human rights practices, as well as working conditions practices, are not only associated with improved social outcomes but also with economic stability and the management of the environment. Economic sustainability is a decisive precondition for environmental performance. Financially sound firms are better positioned to invest in cleaner production technologies and waste mitigation measures. Waste management and energy efficiency play a major role in environmental sustainability, which is the reason why their relevance continues to decrease the environmental imprint of the textile manufacturing industry. Conversely, the effects of certain factors, such as the size of the firm, the volume of production, and organizational age, on sustainability performance is insignificant, and the conclusion is that it is the strategic orientation and managerial commitment that play a decisive role as opposed to the structural peculiarities. Despite the statistical strength of the structural relationships observed in the study, the overall framework model fit indicates that more improvements can be made in the sustainability measurements frameworks. However, the findings still have valuable empirical information within a developing-country textile situation and may be applied to clarify the mechanisms of sustainability in a more holistic view within the context of resource-limited industrial settings.

Policy and Managerial Recommendations:

According to empirical evidence, numerous specific policy and managerial suggestions are made to facilitate sustainability change in the textile sector.

Strengthening Regulatory Enforcement:

The strong positive effect of social sustainability on both economic ($\beta = 0.794$) and environmental performance ($\beta = 0.659$) implies that regulatory enforcement related to labor standards, workplace safety, and human rights can produce cascading sustainability impacts. Policymakers should therefore prioritize enforceable social compliance regulations rather than voluntary guidelines, as improvements in social sustainability are empirically shown to enhance both the stability of the economy and the environment.

The policymakers ought to improve the implementation of the environmental and social policies, rather than employing voluntary compliance policies. The sustainability reporting can be mandatory, periodic environmental audits should be conducted, and international sustainability standards should be observed in the textile value chains to increase accountability and transparency.

Financial Support for Sustainable Investment:

This indicates that economically viable firms are more likely to invest in cleaner production methods as well as waste management mechanisms since the correlation between economic sustainability and environmental performance is high ($\beta = 0.730$). Therefore, special financial incentives like green financing programs, tax exemptions, and subsidized credit lines should be channeled towards enhancing the economic sustainability of firms as one way of achieving environmental sustainability.

Green financing, particularly that of small and medium enterprises (SMEs), should be enhanced. The economic cost of an investment in energy-saving technologies, waste management systems, and cleaner production processes can be reduced by means of subsidized credit schemes, tax reliefs, and public-private finance schemes.

Promoting Circular Economy Practices:

The prevalence of waste management and energy efficiency as part of the environmental sustainability construct explains the feasibility of the circular economy practices. Considering the empirically proven correlation between economic ability and environmental results, the policies and business associations must promote the development of the circular processes that are both economically feasible and scalable, and correlate with the operational potentials of firms.

Government agencies and industry associations should facilitate the establishment of circular textile ecosystems. This includes stimulating recycling infrastructure, extended producer responsibility programs, and the use of recycled and eco-designed materials. Eco-designed materials. Resource dependency can be reduced by incentivizing circular practices to enhance competitiveness in the long term by reducing resource dependency.

Enhancing Social Sustainability Practices:

The SEM findings reveal that social sustainability is an enabler in the sustainability framework. Investments in the rights to labor, health, and safety of occupation, and skill development not only enhance social performance, but indirectly enhance economic and environmental performance, as well. Managers ought to also consider social sustainability programs as strategic investments and not compliance costs. The improvement of the labor standards, workplace safety, and the introduction of human rights should be a strategic concern and not an obligatory condition. Investment in the workforce can strengthen organizational performance, and fair remuneration schemes can be used to support the greater sustainability agenda.

Capacity Building and Technological Adoption:

Given that process upgrading and economic stability are major factors in sustainability performance, the capacity-building programs that would focus on the enhancement of managerial competencies and technological preparedness can be used to make sustainability interventions more effective. The training programs must be aimed at creating connections between operational efficiency and the improvement of environmental and social performance. The creation of the training programs related to sustainable manufacturing, environmental management systems, and digital technologies is to be promoted to enhance the abilities of the firms at the firm level. The technical and managerial competencies are to be developed to ensure the successful implementation of sustainability innovations, particularly in the environment of a developing economy.

Future Research Directions:

Further studies need to consider ways of improving sustainability measurement models to enhance explanatory power and model fit. Longitudinal research would be able to offer more information about the change of sustainability practices over time, and comparative studies across different countries could shed more light on the impact of the institutional and regulatory environment. Besides this, further research is required in the future to find low-cost and scalable sustainability solutions to suit the SMEs that are constrained by the available resources.

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