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Research paper

Impact of Macro-Environmental Factors on Business Sustainability in The Leather Industry of Kanpur and Unnao, Uttar Pradesh

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Abstract

This study examines the influence of macro-environmental factors on business sustainability in the leather industry, focusing on firms in Kanpur and Unnao, Uttar Pradesh, India. A quantitative approach was employed, utilizing a structured questionnaire administered to 397 industry participants. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the study assessed the relationships between various external forces—economic conditions, government policies, environmental regulations, technological advancements, socio-cultural influences, and global market trends—and business sustainability. Results indicate that economic conditions and government policies significantly enhance sustainability, while technological advancements have a significant negative impact, suggesting implementation barriers. Other factors showed no statistically significant direct effects. The research is limited to two cities and a cross-sectional design, without consideration of mediating or moderating variables. Findings inform policymakers and industry leaders on the importance of financial access, regulatory simplification, and technology support. This study contributes to the sustainability literature by integrating diverse macro-environmental factors into a unified analytical model within a traditional manufacturing context.

Keywords: *Sustainability; Leather Industry; Macro-Environmental Factors; Government Policy; Technological Challenges.*

1. Introduction

The global textile and apparel sector has witnessed significant transformation over the last few decades, driven by evolving market dynamics, technological innovations, environmental imperatives, and policy shifts(Göke, 2012). Within this evolving industrial landscape, the leather industry occupies a unique position due to its blend of traditional production methods and export-oriented growth potential(Kaklauskas et al., 2010). India, a key player in this domain, is among the top global producers and exporters of leather and leather goods(Raghavan, 2013). The cities of Kanpur and Unnao in Uttar Pradesh represent one of the most vital leather production clusters in the country, housing a dense concentration of tanneries, manufacturers, and suppliers that cater to both domestic and international markets.

Despite its economic and strategic importance, the leather industry in this region faces mounting challenges in maintaining long-term sustainability(Fassin et al., 2015). Sustainability is a concept and approach with the overarching goal of satisfying existing needs without jeopardizing the capacity of future generations to meet their needs (Vijerathne, De silva & Devasiri et al,. 2025). Unlike short-term profitability, sustainability emphasizes resilience, adaptability, and continuity in business operations while aligning with broader environmental and social objectives(Hu et al., 2021). In recent years, this concept has gained considerable attention due to the increasing influence of macro-environmental factors that affect how businesses operate and evolve(Gray et al., 2019).

One of the most pressing issues confronting the leather industry is the tightening of environmental regulations(Priporas et al., 2020). Due to the inherently polluting nature of leather processing, tanning firms are particularly subject to a complex framework of environmental compliance (Qiu et al., 2021). Leather industry pollution in the clusters of Kanpur & Unnao can be referred to in Annexure A1-A4. These include requirements for effluent treatment, waste management, air and water quality controls, and adherence to both national and international standards(Macioszek & Cieśla, 2022). While these regulations aim to mitigate environmental damage, they also impose significant costs and procedural burdens on firms, particularly small and medium enterprises (SMEs), which constitute most businesses in Kanpur and Unnao(de Sousa & Castañeda-Ayarza, 2022). In addition, global buyers increasingly demand sustainability certifications such as REACH

compliance or Leather Working Group (LWG) ratings, pushing firms to modify practices and invest in cleaner technologies(Navickas et al., 2022).
Economic factors also play a pivotal role in shaping the sustainability landscape of the leather sector(Singh et al., 2022). Fluctuations in raw material prices, inflationary pressures, currency volatility, and limited access to affordable finance are recurring challenges that hinder strategic planning and operational stability(Hasan et al., 2022). These macroeconomic conditions directly influence input costs, pricing strategies, and international competitiveness. For many firms, especially those reliant on exports, the ability to respond swiftly to such fluctuations is critical to sustaining profitability and avoiding long-term disruptions(Künle & Minke, 2022).
Technological advancements offer potential avenues for enhancing productivity and sustainability(Iyer et al., 2023). The adoption of automated machinery, water-efficient tanning processes, digital supply chain tools, and sustainable materials can improve efficiency and environmental performance(Acevedo et al., 2023). However, financial constraints, lack of skilled personnel, and insufficient institutional support often limit the capacity of leather firms in this region to fully leverage technological opportunities(Bhavsar et al., 2023). While innovation is widely acknowledged as a catalyst for competitiveness, its implementation remains inconsistent, especially among SMEs(Spyromitros, 2023). Small and medium-sized enterprises (SMEs) are pushed to introduce new technologies due to different requirements and changes in the business setting. (De mattos,Pallegrini &Hagelaar et al 2023)
Socio-cultural dynamics further complicate the sustainability equation. Growing global awareness regarding animal welfare and environmental degradation has contributed to negative perceptions of leather products among certain consumer groups(Isa et al., 2024). This trend is particularly pronounced in Western markets, where ethical consumption patterns and the rise of veganism have led to a shift in demand. Social media activism and public scrutiny have also placed firms under pressure to demonstrate responsible sourcing, fair labour practices, and community engagement (Bebronne et al., 2024). Moreover, the industry is experiencing a shortage of skilled labour, as younger generations increasingly avoid employment in sectors associated with pollution and low social prestige(Singh et al., 2024).
Global market trends, including demand fluctuations, trade restrictions, and changing buyer expectations, further complicate the strategic environment for leather businesses(Mohan et al., 2025). Increased competition from synthetic materials, evolving fashion preferences, and the requirement to meet international sustainability benchmarks have made it imperative for firms to continuously adapt(Mishra et al., 2024). Export-oriented manufacturers are particularly sensitive to such changes, as their long-term survival often hinges on their ability to align with international norms and anticipate market shifts.
In view of these multidimensional challenges, understanding the impact of macro-environmental factors on business sustainability becomes crucial for both academic inquiry and industry practice(Mishra, Kushwaha, Gupta, et al., 2023). Although various studies have explored isolated aspects such as environmental compliance or economic barriers, there remains a research gap in systematically assessing the collective influence of macro-environmental dimensions on the sustainability of leather businesses in specific industrial clusters(Mishra, Kushwaha, & Gupta, 2023).
This study seeks to address that gap by empirically examining how six major macro-environmental factors, government policies and regulations, environmental regulations, economic conditions, technological advancements, socio-cultural factors, and global market trends affect the business sustainability of leather firms in Kanpur and Unnao. Using a structured questionnaire survey and structural equation modelling (SEM), this research identifies key drivers and inhibitors of sustainability in this industry context. The findings contribute to both theory and practice by offering a nuanced understanding of how external pressures influence business behaviour and by suggesting strategic directions for industry stakeholders, policymakers, and researchers.

2. Review of literature

Business sustainability (BS) has emerged as a strategic imperative for firms operating in resource-intensive industries such as textiles and leather. It refers to the ability of enterprises to maintain long-term viability while balancing economic performance, environmental stewardship, and social responsibility(Singh et al., 2024). The triple bottom line framework, economic, environmental, and social, forms the theoretical foundation for assessing sustainability, especially in industries prone to ecological and ethical scrutiny. In the context of the leather industry, where operations are tightly regulated and market-sensitive, macro-environmental factors play a crucial role in influencing sustainability outcomes(Ahmad et al., 2025).

2.1. Economic conditions (EC) and business sustainability

Economic conditions directly shape business operations through factors such as inflation, credit availability, currency fluctuations, and raw material pricing(Rath et al., 2024). In the leather industry, where firms operate with relatively low margins, disruptions in macroeconomic stability can significantly influence profitability and decision-making(Surahio et al., 2022). Studies have shown that inflationary pressures, volatility in material costs, and restricted access to capital affect the growth trajectory and sustainability of manufacturing firms. High costs of inputs and unstable demand can weaken financial resilience, while a stable economic environment promotes long-term investments and operational continuity(Oloso et al., 2024).
H1: Economic conditions have a significant positive impact on business sustainability.

2.2. Environmental regulations (ER) and business sustainability

Environmental regulations impose strict compliance requirements on leather manufacturing due to the sector's association with pollution and waste generation(Yetilmezsoy et al., 2011). This can also be referred to from annexure A, which showcases certain aspects of pollution from the leather industry in the vicinity of Kanpur & Unnao. While compliance with environmental norms ensures eco-friendly practices, it also increases the cost and complexity of operations, especially for small-scale firms(Eichhorn et al., 2024). Prior research highlights a dual relationship. On one hand, stringent regulations can enhance sustainability by compelling firms to adopt cleaner technologies; on the other, overly burdensome regulations may constrain growth and competitiveness if adequate support mechanisms are not in place(Karlsson & Gilek, 2020).
H2: Environmental regulations have a significant impact on business sustainability.

2.3. Global market trends (GM) and business sustainability

Leather exports are heavily influenced by global market conditions, including demand cycles, sustainability certification requirements, and competition from synthetic alternatives(Iacob et al., 2025). International buyers now increasingly evaluate suppliers based on environmental and ethical standards, which has prompted many Indian firms to rethink production and branding strategies(Gaur & Bansal, 2010). The ability to adapt to these evolving demands and secure international clients depends on firms' awareness and responsiveness to global trends. Competitive pressures from countries with cheaper production or advanced sustainability frameworks further compel Indian exporters to improve their practices(Debnath & Phukan, 2022a).
H3: Global market trends have a significant impact on business sustainability.

2.4. Government policies and regulations (GP) and business sustainability

Government support in the form of policies, subsidies, infrastructure, and export facilitation plays a pivotal role in shaping sustainability outcomes for manufacturing sectors(Debnath & Phukan, 2022b). Effective regulatory frameworks, timely policy communication, and streamlined approval processes reduce operational uncertainties and promote strategic investments(Chen et al., 2018). Prior studies have emphasized that favourable government interventions can significantly enhance environmental compliance, technology adoption, and market competitiveness(Pandya & Kumar, 2023). In the Indian leather sector, schemes such as the Integrated Development of Leather Sector (IDLS) and Leather Cluster Development programs have positively influenced business sustainability(Ashall et al., 2024).
H4: Government policies and regulations have a significant positive impact on business sustainability.

2.5. Socio-cultural factors (SC) and business sustainability

Societal perceptions regarding environmental damage and animal welfare have reshaped public attitudes toward leather products(Nogueira et al., 2025). Increasing ethical awareness and activism, particularly via social media, have led to growing scrutiny of leather firms' practices(Zhu et al., 2018). Moreover, labour shortages and declining interest from younger workers present significant socio-cultural challenges in maintaining production capabilities(Afeadie, 2022). Social acceptance and community support are essential for operational stability, particularly in regions where the industry has a strong local presence(Ulya et al., 2022).
H5: Socio-cultural factors have a significant impact on business sustainability.

2.6. Technological advancements (TA) and business sustainability

Technology adoption enables firms to improve productivity, reduce environmental footprints, and align with international quality and sustainability standards(Das et al., 2024). Automation, cleaner production techniques, and digital monitoring systems enhance efficiency and transparency in the leather manufacturing process(Himani Srihita et al., 2025). However, the cost of acquiring and implementing new technologies, coupled with limited training, remains a barrier, particularly for SMEs. While technology can be a catalyst for sustainability, its impact varies based on firm size, resource availability, and institutional supportt (D'Ulizia et al., 2024).
H6: Technological advancements have a significant impact on business sustainability.

3. Research methodology

This study adopts a quantitative research design to examine the impact of macro-environmental factors on business sustainability in the leather industry of Kanpur and Unnao, Uttar Pradesh. Given the industry's contribution to employment, exports, and regional development, understanding how external forces influence firm-level sustainability has both academic and practical relevance. The research was conducted within a positivist framework, using a structured questionnaire to collect data from industry professionals.
The leather industry in Kanpur and Unnao represents a diverse mix of firms(Research, 2018), including tanneries, export units, leather goods manufacturers, and suppliers of chemicals and equipment. These firms face a common set of macro-environmental challenges but respond differently depending on their resources, market orientation, and strategic priorities. To capture this diversity, the study targeted stakeholders across various roles-owners, managers, supervisors, environmental officers, and suppliers. Respondents were selected using purposive sampling, ensuring they possessed relevant experience and were involved in strategic or operational decision-making.
Primary data were gathered through a structured questionnaire administered between July and October 2024. Before the main survey, a pilot study was conducted with 20 respondents from the leather sector to assess the clarity and relevance of the items. Feedback from the pilot led to minor revisions in wording to ensure the instrument was easily understood and contextually appropriate. The final questionnaire was distributed in both physical and electronic formats to accommodate accessibility and maximize response rates. A total of 500 questionnaires were distributed, and 474 valid responses were retained for further study.
The questionnaire was divided into two sections. Section A captured demographic information such as age, gender, role, firm type, years of experience, annual turnover, number of employees, market orientation, and city of operation. This data helped in describing the sample and understanding potential contextual variations across respondent categories. Section B focused on the constructs of interest: economic conditions, environmental regulations, global market trends, government policies and regulations, socio-cultural factors, technological advancements, and business sustainability.
Each construct was measured using multiple statements rated on a seven-point Likert scale, ranging from 1 (strongly disagree) to 7 (strongly agree)(Joshi et al., 2015). This approach allowed for capturing the intensity of respondents' perceptions across a spectrum of agreement. The constructs were operationally defined based on an extensive review of previous literature, ensuring theoretical validity and contextual applicability. The items were framed to reflect actual business experiences in dealing with macro-environmental challenges and sustainability strategies in the leather sector.
To develop the measurement scale, established items from prior studies were adapted and, where necessary, modified to suit the specific industrial and regional context. These included dimensions related to regulatory frameworks, economic fluctuations, technological readiness, social perception, and international market forces. Care was taken to ensure that the scale items were both comprehensive and distinct, covering the full range of potential influences on business sustainability without redundancy. The complete set of constructs, their operational definitions, item codes, and corresponding scale statements are presented in Table 1 (Scale Development). This table serves as the

foundation for the instrument used in the study and reflects the integration of theoretical insights with empirical grounding in the realities of the Indian leather industry.

Table 1: Scale Development

Construct	Item Code	Statements	Source
Business Sustainability	BS1	Our business has a clear long-term strategy to remain competitive in the leather industry.	(Ashaal et al., 2024)
	BS2	We are consistently able to meet our operational and production goals.	(Chen et al., 2018)
	BS3	Our business profitability has remained stable or improved in recent years.	(Nogueira et al., 2025)
	BS4	We comply with all relevant environmental and industry regulations.	(Nogueira et al., 2025)
	BS5	We have plans to expand or upgrade operations in the near future.	(Ulya et al., 2022)
Government Policies & Regulations	GP1	Current government policies are favourable for leather industry operations.	
	GP2	Regulatory approvals are obtained without significant delays.	
	GP3	Tax policies and subsidies support our business growth.	(Rehman et al., 2024)
	GP4	Changes in government policy are communicated clearly and in time.	(Abbas et al., 2020)
	GP5	We receive adequate support from government departments for business-related queries.	(Lotfi & Pisa, 2024)
	GP6	Export-import policies positively influence our business performance.	(Zhou et al., 2025a)
Environmental Regulations	ER1	Environmental regulations have significantly increased our compliance costs.	(Costa et al., 2022)
	ER2	We have installed equipment to meet pollution control norms.	(Khaw et al., 2024a)
	ER3	Monitoring by environmental authorities is regular and stringent.	(Shabur & Ali, 2024)
	ER4	Environmental compliance procedures are complex and time-consuming.	(Korabayev & Korabayev, 2023)
	ER5	We have faced penalties or warnings related to environmental issues.	(Gahlaut et al., 2024)
	ER6	The pressure from environmental NGOs affects our operations.	(Rickards et al., 2014)
Economic Conditions	EC1	Fluctuations in raw material prices affect our profitability.	(Orji & Liu, 2020)
	EC2	Inflation increases our overall production and labour costs.	(Zhou et al., 2025b)
	EC3	We face difficulties in accessing affordable business loans or credit.	(Zhou et al., 2025b)
	EC4	Demand for our leather products is influenced by national economic conditions.	(Mizrachi & Tal, 2022)
	EC5	Currency fluctuations impact our export pricing and revenue.	(Kumar et al., 2023)
Technological Advancements	TA1	We have adopted new technologies to improve production efficiency.	(Liu et al., 2021)
	TA2	Technological upgrades have helped reduce our environmental impact.	(Orji & Liu, 2020)
	TA3	The cost of adopting modern technology is a barrier for our business.	(Nudurupati et al., 2022)
	TA4	We receive training or support to implement new technologies.	(Zhou et al., 2025b)
	TA5	Staying updated with modern equipment is essential for survival in this industry.	(Tang & Xu, 2023)
	TA6	Government or private agencies offer incentives to support technology adoption.	(Wang et al., 2024)
Socio-Cultural Factors	SC1	There is a growing negative perception toward leather products in society.	(Afeadie, 2022)
	SC2	Ethical concerns (animal welfare, pollution) affect local demand for our products.	(Pecht, 1996)
	SC3	Skilled labour is becoming scarce in the local community.	(Orji & Liu, 2020)
	SC4	Young workers are less willing to work in the leather sector.	(Khaw et al., 2024b)
	SC5	Social media and activism have influenced our business reputation.	(Mizrachi & Tal, 2022)
	SC6	Local community support is essential for our smooth business operations.	(Tang & Xu, 2023)
Global Market Trends	GM1	Demand for Indian leather in international markets has been fluctuating.	(Iacob et al., 2025)
	GM2	International buyers are increasingly asking for sustainability certifications.	(Iacob et al., 2025)
	GM3	Competition from synthetic leather has affected our export potential.	(Kumar et al., 2023)
	GM4	Trade restrictions (e.g., anti-dumping duties) have impacted our exports.	(Kumar et al., 2023)
	GM5	Adapting to global trends is essential to retain international clients.	(Korabayev & Korabayev, 2023)

Table 2: Demographic Profile of the Respondents

Demographic Variables	Categories	Frequency	Percentage
Age	Below 25	33	7.0
	25-35	46	9.7
	36-45	148	31.2
	46-55	164	34.6
	Above 55	83	17.5
Gender	Male	286	60.3
	Female	188	39.7
Designation/Role	Owner	40	8.4
	Manager	139	29.3
	Supervisor	70	14.8
	Environmental Officer	145	30.6
	Supplier	80	16.9
Type of Firm	Tannery	28	5.9
	Export Unit	54	11.4
	Leather Goods Manufacturer	240	50.6
	Supplier (Chemicals/Equipment)	152	32.1
Years of Experience	Less than 5 years	22	4.6

	5–10 years	163	34.4
	11–20 years	150	31.6
	More than 20 years	139	29.3
Annual Turnover of the Firm	Below ₹25 lakh	29	6.1
	₹25 lakh – ₹1 crore	42	8.9
	₹1 crore – ₹5 crore	255	53.8
	Above ₹5 crore	148	31.2
Primary Market	Domestic	166	35.0
	International	267	56.3
	Both	41	8.6
Number of Employees	Less than 20	24	5.1
	20-50	115	24.3
	51-100	182	38.4
	More than 100	153	32.3
City of Operation	Kanpur	236	49.8
	Unnao	238	50.2

The demographic profile of the respondents in this study reflects a comprehensive representation of stakeholders across the leather industry in Kanpur and Unnao. Respondents were diverse in age, with the majority falling between 36–45 years (31.2%) and 46–55 years (34.6%), indicating a predominance of mid-career professionals with significant industry experience. A smaller proportion of respondents were under the age of 35 (16.7%), while 17.5% were over 55 years old. In terms of gender distribution, 60.3% of the participants were male and 39.7% were female, suggesting a relatively balanced, though still male-dominated, workforce in this sector.

The roles of the respondents within their organizations were varied, ensuring a multi-dimensional perspective. Managers constituted 29.3% of the sample, followed closely by environmental officers (30.6%), indicating a strong representation of individuals directly involved in sustainability and compliance. Supervisors made up 14.8%, suppliers 16.9%, and business owners 8.4% of the participants. Regarding the type of firms represented, more than half (50.6%) were from leather goods manufacturing units, followed by suppliers of chemicals and equipment (32.1%), export units (11.4%), and tanneries (5.9%).

When considering industry experience, a significant portion of respondents had between 5 to 10 years (34.4%) or 11 to 20 years (31.6%) of experience, while 29.3% reported over 20 years, and only 4.6% had less than five years. This indicates a knowledgeable respondent base with long-term exposure to the industry. In terms of financial size, 53.8% of the firms had an annual turnover between ₹10 to and ₹50 million, followed by 31.2% reporting above ₹50 million, 8.9% between ₹2.5 million and ₹10 million, and 6.1% below ₹2.5 million.

Market orientation varied among the respondents, with a majority (56.3%) engaged primarily in international markets, 35% operating in the domestic market, and 8.6% serving both. Firm size, as measured by the number of employees, showed that 38.4% employed between 51 and 100 people, 32.3% had more than 100 employees, 24.3% employed 20 to 50, and only 5.1% had fewer than 20 employees. Lastly, the geographic distribution was evenly split between Kanpur (49.8%) and Unnao (50.2%), ensuring balanced regional representation within the study.

Table 3: Construct loadings, Composite Reliability, AVE, Cronbach Alpha, and VIF

Construct	Item Code	Construct Loadings	Composite Reliability	AVE	Cronbach Alpha	VIF
Business Sustainability	BS1	0.882	0.926	0.716	0.9	2.144
	BS2	0.876				2.968
	BS3	0.872				2.863
	BS4	0.774				1.863
	BS5	0.822				2.152
Government Policies & Regulations	GP1	0.823	0.919	0.654	0.895	2.03
	GP2	0.776				2.181
	GP3	0.809				2.276
	GP4	0.793				2.195
	GP5	0.818				2.419
	GP6	0.83				2.563
Environmental Regulations	ER1	0.797	0.909	0.626	0.882	1.993
	ER2	0.794				1.939
	ER3	0.832				1.94
	ER4	0.759				1.883
	ER5	0.805				2.024
	ER6	0.758				1.872
Economic Conditions	EC1	0.877	0.914	0.681	0.883	2.742
	EC2	0.882				2.091
	EC3	0.871				2.98
	EC4	0.741				2.199
	EC5	0.741				2.182
Technological Advancements	TA1	0.793	0.88	0.551	0.852	1.957
	TA2	0.782				1.969
	TA3	0.725				2.29
	TA4	0.72				2.392
	TA5	0.681				1.968
	TA6	0.748				2.529
Socio-Cultural Factors	SC1	0.741	0.914	0.642	0.892	2.391
	SC2	0.743				2.319
	SC3	0.721				2.181
	SC4	0.84				2.645
	SC5	0.889				2.284
	SC6	0.857				2.66
Global Market Trends	GM1	0.769	0.88	0.595	0.832	1.54
	GM2	0.777				1.961
	GM3	0.772				2.047
	GM4	0.844				2.181
	GM5	0.685				1.349

4. Data analysis and results

To ensure the psychometric robustness of the measurement model, all latent constructs in the study were evaluated for internal consistency, convergent validity, and multicollinearity. The assessment was carried out using standardized procedures recommended for structural equation modelling, particularly in the context of Partial Least Squares Structural Equation Modelling (PLS-SEM), which was the methodological framework adopted for this study(Hair et al., 2012).

Each construct was operationalized using multiple reflective indicators, and their reliability was first assessed through standardized factor loadings. All individual item loadings exceeded the recommended minimum threshold of 0.70, indicating satisfactory indicator reliability (Chin, 1998). This confirms that each item was sufficiently correlated with its respective latent variable and contributed meaningfully to the construct it was intended to measure.

Internal consistency was further assessed using composite reliability (CR), which is considered a more accurate measure than Cronbach's alpha in PLS-SEM due to its sensitivity to different item loadings(Mohan, Kushwaha, Venkatesan et al., 2025). As shown in Table 3, all constructs demonstrated CR values above the acceptable benchmark of 0.70, with several exceeding 0.90. This indicates a high level of internal consistency among the items for each construct. Complementarily, Cronbach's alpha values also surpassed the 0.70 threshold, providing additional support for the reliability of the constructs.

Convergent validity, which indicates the extent to which a construct converges to explain the variance of its indicators, was assessed using the average variance extracted (AVE). All constructs exhibited AVE values above the 0.50 threshold, suggesting that more than 50% of the variance in the indicators was captured by the latent constructs (Fornell & Larcker, 1981). This supports the assumption that the constructs used in the model are well-defined and measured by their respective indicators.

To evaluate multicollinearity, the variance inflation factor (VIF) was examined for all measurement items. VIF values ranged between 1.34 and 2.98, well below the conventional cutoff value of 5, which indicates that multicollinearity was not a concern in the model(Hair et al., 2012). This reinforces the structural independence of the measurement items and ensures that the path coefficients are not distorted by high inter-item correlations.

Table 4: HTMT Criterion

	BS	EC	ER	GM	GP	SC	TA
BS							
EC	0.519						
ER	0.185	0.284					
GM	0.327	0.67	0.347				
GP	0.528	0.698	0.3	0.712			
SC	0.325	0.669	0.386	0.792	0.667		
TA	0.285	0.704	0.369	0.619	0.588	0.81	

To assess the discriminant validity of the constructs used in this study, the Heterotrait–Monotrait Ratio of Correlations (HTMT) criterion was applied. Discriminant validity refers to the extent to which a construct is truly distinct from other constructs, both conceptually and statistically (Fornell & Larcker, 1981). The HTMT approach has emerged as a more robust and reliable alternative to traditional techniques, particularly within the context of PLS-SEM (Henseler, Ringle, & Sarstedt, 2015).

HTMT evaluates the ratio of between-construct correlations (heterotrait-heteromethod) to within-construct correlations (monotrait-heteromethod). Values of HTMT below 0.85 are generally considered acceptable, although a more conservative threshold of 0.90 is also used depending on the model complexity and research context (Hair et al., 2017). Values exceeding these thresholds may suggest a lack of discriminant validity, indicating that constructs may overlap conceptually or statistically.

As shown in Table 4, the HTMT values for all pairs of constructs were below the recommended thresholds. These include inter-construct relationships such as Business Sustainability (BS) and Economic Conditions (EC) at 0.519, BS and Government Policies (GP) at 0.528, and Government Policies with Global Market Trends (GM) at 0.712. All other pairwise comparisons similarly fall within the acceptable range, suggesting that each latent variable in the model represents a distinct theoretical concept.

The application of the HTMT criterion thus supports the discriminant validity of the model, reinforcing the appropriateness of the constructs for structural modeling. This step was crucial in confirming that the latent constructs used in the analysis were not only internally consistent but also externally distinguishable from one another, ensuring the conceptual clarity of the measurement framework.

Table 5: Fornell–Larker Criterion

	BS	EC	ER	GM	GP	SC	TA
BS	0.846						
EC	0.472	0.825					
ER	0.172	0.245	0.791				
GM	0.3	0.578	0.305	0.771			
GP	0.483	0.619	0.265	0.627	0.808		
SC	0.313	0.599	0.344	0.744	0.627	0.801	
TA	0.285	0.675	0.31	0.594	0.549	0.777	0.743

In addition to HTMT, the Fornell–Larcker criterion was used to further assess discriminant validity among the constructs in the measurement model. This classical method evaluates whether each construct shares more variance with its own indicators than with those of other constructs, thereby confirming that constructs are empirically distinct from one another (Fornell & Larcker, 1981).

The Fornell–Larcker test involves comparing the square root of the Average Variance Extracted (AVE) for each construct with the bivariate correlations between that construct and all other constructs in the model. The square root of the AVE should be greater than any of the inter-construct correlations for that construct. This condition suggests that the latent variable explains more variance in its indicators than it shares with other variables (Hair et al., 2017).

Table 5 presents the Fornell–Larcker matrix. Diagonal elements represent the square roots of the AVEs for each construct, while the off-diagonal values represent the correlations between constructs. For example, the square root of AVE for Business Sustainability (BS) is 0.846, which is greater than its correlations with Economic Conditions (0.472), Government Policies (0.483), Global Market Trends (0.300), and other variables. Similarly, for Economic Conditions (EC), the square root of AVE is 0.825, which exceeds its correlations with other constructs.

All constructs in the matrix exhibit this expected pattern, satisfying the Fornell–Larcker criterion and providing further support for discriminant validity. When used in conjunction with the HTMT criterion, this analysis confirms that the measurement model is well specified and that the constructs used in this study are both theoretically and empirically distinct.

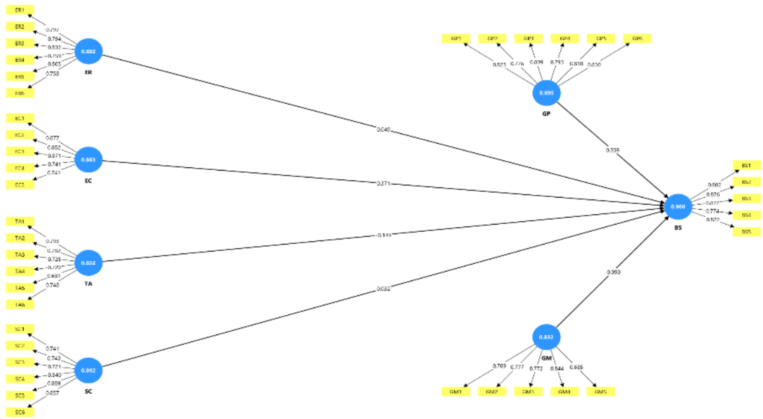

Fig. 1: SEM Model.

Figure 1 presents the structural model developed to examine the hypothesized relationships between macro-environmental factors and business sustainability in the leather industry. The model includes six independent constructs: Economic Conditions (EC), Environmental Regulations (ER), Global Market Trends (GM), Government Policies and Regulations (GP), Socio-Cultural Factors (SC), and Technological Advancements (TA), which are proposed to influence the dependent construct, Business Sustainability (BS).
Each construct is represented by multiple indicators derived from existing literature and refined through a pilot study, with observed variables linked to their respective latent variables. The standardized path coefficients between the independent variables and BS are shown along the connecting lines, indicating the strength and direction of each hypothesized relationship. These coefficients serve as the basis for hypothesis testing in the structural assessment phase.
The measurement model was validated before estimating the structural paths, ensuring that each construct demonstrated sufficient reliability and validity. The structural model was then tested using SmartPLS 4.0, a variance-based structural equation modelling tool suitable for complex models with reflective indicators. The model estimation involved the use of bootstrapping to determine the significance of the path coefficients.
This structural framework allows for an integrated evaluation of how external macro-environmental variables interact with internal business sustainability outcomes, specifically in the context of firms operating in the Kanpur and Unnao leather clusters.

Table 6: Model Fit

	Saturated model	Estimated model
SRMR	0.082	0.082
d_ULS	5.262	5.262
d_G	1.229	1.229
Chi-square	3252.129	3252.129
NFI	0.752	0.752

The adequacy of the structural model was assessed using several model fit indices commonly applied in partial least squares structural equation modelling (PLS-SEM). Table 6 presents the model fit values for both the saturated model, which accounts for all possible paths among constructs, and the estimated model, which includes only the paths specified in the structural framework. These indices provide insights into how well the model reproduces the observed data.
The standardized root mean square residual (SRMR) is a key indicator of model fit in PLS-SEM. It reflects the average difference between observed and predicted correlations, where lower values indicate a better fit. An SRMR value below 0.10 is generally acceptable, while values below 0.08 are considered good (Hu and Bentler, 1999; Henseler et al., 2014). In this study, both the saturated and estimated models yielded an SRMR value of 0.082, indicating a consistent and acceptable model fit.
The model was further assessed using the d_ULS (squared Euclidean distance) and d_G (geodesic distance), which evaluate the discrepancy between the empirical and model-implied correlation matrices. These measures do not have fixed cutoff values but are used comparatively between the saturated and estimated models (Dijkstra and Henseler, 2015). In this case, both d_ULS and d_G values were identical for the two models, at 5.262 and 1.229, respectively, suggesting consistency in the model's specification.
Additionally, the chi-square statistic was reported for completeness. Although chi-square is more commonly used in covariance-based SEM, it may also be used in PLS-SEM for reference purposes. For both model configurations, the chi-square value was 3252.129, indicating equivalence in model structure.
The normed fit index (NFI) was used to compare the estimated model to a null model. Values closer to 1 indicate a better fit, with 0.70 considered acceptable in exploratory research contexts (Bentler and Bonett, 1980; Hair et al., 2019). The NFI for this study was 0.752, which supports the overall acceptability of the model configuration.
Together, these indices indicate that the structural model is properly specified and demonstrates an acceptable level of fit to the observed data, providing a reliable foundation for subsequent structural path analysis.

Table 7: Hypothesis Test

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
EC -> BS	0.371	0.37	0.07	5.32	0
ER -> BS	0.049	0.054	0.039	1.24	0.215
GM -> BS	-0.09	-0.086	0.063	1.427	0.154
GP -> BS	0.359	0.358	0.061	5.84	0
SC -> BS	0.032	0.027	0.074	0.436	0.663
TA -> BS	-0.149	-0.143	0.063	2.355	0.019

The structural model was evaluated through path analysis to test the hypothesized relationships between macro-environmental factors and business sustainability. Table 7 presents the results of the hypothesis testing, including the original path coefficients (O), sample means (M), standard deviations (STDEV), t-statistics, and associated p-values. The analysis was conducted using the bootstrapping method with 5,000 resamples, as recommended for significance testing in PLS-SEM (Hair et al., 2017).

The path coefficient from economic conditions (EC) to business sustainability (BS) is 0.371, with a t-statistic of 5.32 and a p-value of 0.000, indicating statistical significance. This suggests a strong relationship between economic variables such as inflation, raw material costs, and credit access, and the sustainability performance of leather firms.

The relationship between environmental regulations (ER) and business sustainability is represented by a path coefficient of 0.049, with a t-statistic of 1.24 and a p-value of 0.215. This indicates that, within this model, the effect of environmental compliance pressures on sustainability is not statistically significant at conventional levels.

Global market trends (GM) show a path coefficient of -0.090, with a t-statistic of 1.427 and a p-value of 0.154, suggesting that the influence of international market dynamics—such as certification demands, synthetic competition, and trade barriers—on sustainability is not significant in this context.

Government policies and regulations (GP) exhibit a positive path coefficient of 0.359, with a t-statistic of 5.84 and a p-value of 0.000. This result supports the role of favourable policy support, subsidies, and institutional clarity in enhancing the sustainability of firms.

The path coefficient from socio-cultural factors (SC) to business sustainability is 0.032, with a t-statistic of 0.436 and a p-value of 0.663, indicating no statistically significant relationship in this model. This suggests that societal attitudes and labour market trends may not exert a strong direct effect on sustainability outcomes in this industry setting.

Technological advancements (TA) demonstrate a negative path coefficient of -0.149, with a t-statistic of 2.355 and a p-value of 0.019. While negative in direction, this relationship is statistically significant, implying a potentially complex or challenging role of technology in the current operational environment of leather firms, possibly due to high costs, training gaps, or implementation barriers.

These path coefficients represent standardized values, allowing for the comparison of relative effects among the independent variables. This result appears contradictory to conventional logic but is specific to this study. The direct effect of environmental regulations, global market trends, and socio-cultural factors was statistically insignificant. These results are specific to this study and may not be generalized.

5. Conclusion

This study examined the influence of macro-environmental factors on business sustainability in the leather industry of Kanpur and Unnao, Uttar Pradesh. Using a structured quantitative approach and structural equation modelling, six independent variables were assessed for their impact on business sustainability: economic conditions, environmental regulations, global market trends, government policies and regulations, socio-cultural factors, and technological advancements.

The findings revealed that economic conditions and government policies have a statistically significant positive influence on business sustainability, highlighting the importance of stable financial environments and supportive policy frameworks. Interestingly, technological advancements showed a significant but negative effect, suggesting that while innovation is recognized as essential, its implementation may currently be constrained by financial or skill-related barriers. Other variables environmental regulations, global market trends, and socio-cultural factors, did not exhibit significant direct effects within the context of this study.

Overall, the results emphasize the contextual complexity faced by leather manufacturers, particularly those operating in tightly regulated, cost-sensitive, and export-dependent environments. The study adds to the growing body of literature on sustainability in traditional manufacturing sectors and offers region-specific insights for policymakers, business leaders, and researchers.

6. Implications

The study has several practical and theoretical implications. For industry practitioners, the findings underscore the critical role of economic stability and proactive government intervention in ensuring sustainable operations. Policymakers should consider targeted support in the form of subsidies, tax incentives, and training programs to promote cleaner technologies, especially for small and medium enterprises that face adoption challenges. Because of the challenges of manufacturing activities, the public, industry, and academia are becoming more aware of sustainable manufacturing (SM), which incorporates environmentally friendly manufacturing processes while emphasizing overall triple bottom line (TBL) performance in manufacturing. (Yip, Zhou, and To, 2023). According to Elkington (1998), the TBL approach could lead an organisation to perform economic prosperity, environmental quality, and social justice simultaneously(Hourneaux, De Silva, and Dolores, 2018)

The significant yet negative effect of technological advancements suggests that while businesses acknowledge the importance of modernization, they may be hindered by high costs, insufficient training, or a lack of access to innovation networks. This points to a need for capacity-building initiatives, public-private partnerships, and accessible financing schemes to bridge the technology-sustainability gap.

From a theoretical standpoint, this study contributes to sustainability literature by integrating macro-environmental variables within a single analytical framework and validating their collective impact on business sustainability in the Indian leather context. It reinforces the utility of PLS-SEM in studying complex, multi-dimensional relationships across sectors where formal documentation and data are often limited.

7. Future research and limitations

Although this study offers valuable insights, it also has several limitations that can be addressed in future research. First, the study was geographically limited to Kanpur and Unnao, two key leather manufacturing hubs in India. While these regions are highly representative, future research could expand the geographic scope to include other leather clusters or cross-country comparisons to improve generalizability.

Second, the study relied on cross-sectional data, which captures a snapshot in time but may not fully reflect the dynamic and evolving nature of macro-environmental influences. Longitudinal studies would be valuable to assess how shifts in economic, regulatory, and technological environments affect business sustainability over time.

Third, the model primarily focused on direct effects and did not explore potential mediating or moderating variables. Future studies could examine how organizational capabilities, leadership orientation, or environmental strategy mediate the relationships between external pressures and sustainability outcomes.

Lastly, while this study used established and contextually adapted scales, some construct indicators may benefit from further refinement or the inclusion of qualitative insights. A mixed-methods approach combining quantitative analysis with case studies or interviews could enrich the understanding of firm-level responses to external challenges.

Despite these limitations, this research provides a strong empirical foundation for understanding how external environmental forces shape sustainability outcomes in one of India's most vital and environmentally sensitive manufacturing sectors.

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Annexure A

Fig. A1: Open Drain Filled with Solid Waste Near Tannery Cluster.

Fig. A2: Polluted Roadside Water Channel Affecting Livestock and Pedestrians.

Fig. A3: Industrial Discharge Entering Local Water Body.

Fig. A4: Accumulation of Plastic and Organic Waste at Riverbanks.