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Towards Sustainable Tanning: Identifying and Prioritizing Barriers to Achieving LWG Certification in Savar Tannery State

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Abstract

The worldwide leather tanning industry is crucial in global trade, making around US$50 billion in sales. However, its fast growth has caused significant environmental issues, prompting a careful reconsideration of the industry's operation. Tanneries, often situated near the water, highlight the difficulty of balancing making money with caring for the environment. Having good plans for managing waste is crucial to deal with these issues. Leather Working Group (LWG) certification is a way to transform the industry. Getting LWG certification allows tanneries to sell their products to the EU and other places that care about the environment. However, there are challenges for tanneries trying to get this certification. This study uses a Multi-Criteria Decision-Making tool to prioritize these challenges systematically. By focusing on these obstacles, the research aims to help the industry move towards more sustainable practices, ensuring it stays competitive globally while taking care of the environment.

Keywords

Leather Tanning, LWG Certification, Sustainable, Barrier, MCDM

1. Introduction

The leather industry in Bangladesh, an agro-based by-product with locally available raw materials, is renowned for its high quality, fine grain, uniform fiber structure, smooth feel, and natural texture. In 2017, the Bangladeshi leather industry accounted for 0.6% of the export market and under 1.0% of gross value added in domestic manufacturing, contributed $1.4 billion to Bangladesh's GDP in 2016-17, and employed 200,000 workers, establishing it as a crucial sector. The sector was widely expected to fetch $5 billion of export earnings by 2021. However, exports fell for two consecutive years to just above $1 billion in 2018–19.

The leather tanning process consists of various steps that require a considerable quantity of pure water and generate bulk amounts of solid and liquid wastes. Annually, during the processing and production stages, leather industries globally generate four million tons of solid waste (hair, dry sludge, buffing dust, fleshing, chrome shaving and splitting, and trimming). When 500 kg of raw animal skin is processed, only 75 kg is converted into leather, and the remaining is discarded as environmental waste. Therefore, despite contributing significantly to economic development, the leather industry is widely criticized for its adverse environmental impact; hence, it needs to be handled optimally. Moreover, this industry generates numerous health hazards, such as dermatitis, ulcers, respiratory diseases, and cancer, as a result of exposure to toxic substances, mainly chromium and chlorinated phenols, used during leather production. Over time, the requirements imposed on leather processing have increased in terms of quality and process optimization, occupational health, environmental conservation, and sustainability.

It is worth pointing out that the relocation of tannery factories from Hazaribagh to Hemayetpur in Savar aimed to improve environmental standards and ensure the compliance of foreign buyers. However, the development activities, including the Central Effluent Treatment Plant (CETP), the installation of automated monitoring devices and water-flow meters in all tanneries to reduce water consumption, technology for dewatering sludge, better raw sewage management, and improving the approach road, among other things, are not complete yet. This points out a challenge to the upcoming sustainability and cleaner production of the leather sector with an increasing number of barriers, including environmental legislation and eco-criteria derived from the exclusive export market. Hence, these shortcomings must be fulfilled for international certification, such as the Leather Working Group (LWG) certification. Leather working group rates (gold, silver or bronze) on leather sectors dependent on how their creation forms influence the environment. They consider waste administration, vitality utilization, water use, detectability, and hazardous substances. It promotes sustainable business forms and ecological needs throughout the leather sectors. Concerning LWG certification, the state of the Bangladeshi tanning sector is getting worse every day due to a lack of compliance. As a result, the company experiences a loss of clients, work orders, and reputation in the global leather market due to not having access to the leather market of Europe, the US, and some developed Asian countries.

The study aims to analyze such barriers and find possible pathways. Therefore, it helps the industry and researchers identify the significant obstacles to achieving LWG certification. Nevertheless, to date, no literature has been found investigating this topic. However, few researchers have worked on finding barriers and challenges to corporate social responsibility, environmentally friendly manufacturing, sustainable supply chain management, green supply chain management, chemical management, and so on from the leather tanning industry perspective. In addition, Industries nowadays focus more on green procurement and sustainability in the supply chain due to increasing consumer awareness and ecological demands from the highly diversified global market. At the same time, Multi-Criteria Decision Analysis (MCDA) could be a potential tool to prioritize the barriers. This study intends to achieve the following research objectives:

RO1: To Identify Barriers to Achieving LWG Certification

RO2: To Prioritize the Identified Barriers Using Multi-Criteria Decision Method (MCDM) Tools

RO3: To Develop Strategic Recommendations for Overcoming Barriers

To achieve the aforementioned ROs, this study proposes an MCDM framework, mainly the Best-Worst Method (BWM). First, through a literature review, an initial list of representative LWG certification criteria has been developed and later validated based on relevant area experts' feedback. Then, the BWM method is used to calculate the weights of the finally selected criteria, and the potential barriers are ranked according to their weights via BWM.

2. Literature Review

The international non-profit organization Leather Working Group (LWG) was founded in 2005. It is a multi-stakeholder group comprising brands, retailers, leather manufacturers, suppliers, and technical experts who have focused on the importance of leather sustainability worldwide. The LWG Environmental Audit aims to improve the leather industry's environmental impact by assessing companies' environmental performance and practical capabilities. Then, based on compliance with the LWG environmental standards, companies obtain a certain level of certification. In addition, LWG aims to engage with members of the leather supply chain and provide them with the necessary knowledge to make informed and sustainable choices in their businesses. Now, on version 7.2.2 of the protocol, the audit assesses the most critical areas of the manufacturing process. Gold, silver, and even bronze ratings improve the company's overall image and create better marketing potential. Certified tanneries gain access to premium international markets, particularly in the European Union and North America, where sustainability is critical for consumers. Despite its benefits, the certification process is complex and demanding, particularly for developing countries like Bangladesh.

Financial constraints are among the most significant barriers, as tanneries often lack the capital required to invest in modern infrastructure, cleaner technologies, and process improvements. High upfront costs for energy-efficient machinery and effluent treatment systems deter many from pursuing certification. Moreover, most tanneries in Bangladesh are small and medium enterprises (SMEs), making it hard for them to consider LWG certification. On the other hand, outdated technology and inadequate infrastructure exacerbate the situation, with many tanneries operating with inefficient equipment and facing challenges like poorly performing centralized effluent treatment plants (CETPs), such as those in Savar Tannery Estate, Bangladesh. They also focus on conventional leather processing, which makes them fall behind in capturing positions in the international market due to competition with China, India, and Vietnam. In addition, supply chain complexities add another layer of difficulty, with fragmented and informal raw material sourcing systems hindering traceability and documentation efforts critical for certification. Regulatory challenges also play a role, with unclear, inconsistent, or poorly enforced policies creating confusion and offering limited incentives for compliance. Finally, behavioral resistance among tannery stakeholders, stemming from focusing on short-term profits and fear of operational disruptions, poses a significant obstacle. Together, these barriers highlight the multifaceted challenges faced by the leather tanning industry in aligning with global sustainability standards.

Prioritizing barriers in achieving Leather Working Group (LWG) certification requires a structured approach, and Multi-Criteria Decision-Making (MCDM) methods are highly effective in this regard. MCDM enables a systematic evaluation of diverse challenges by considering multiple criteria, such as financial, technological, regulatory, and behavioral factors, and weighing their relative importance. The literature review identified various studies focusing on the leather industry. For instance, Bai et al., 2021 conducted a study using the DEMATEL technique to analyze the interactions among the challenges to circular economy practices and found that ‘`lack of financial support from authorities’ was the most pressing challenge that impedes circular economy implementation. Similarly, another study, which adopted the Best - Worst Method (BWM), found that ‘lack of financial support from government’ was the main challenge for CE implementation. Moreover, MCDM methods or techniques have been used for identifying and prioritizing the main key drivers, barriers, and challenges in different sections of the leather industry, including corporate social responsibility, environmentally friendly manufacturing, sustainable supply chain management, green supply chain management, and chemical management. However, very few studies have been found that focus on the crucial certifications, such as LWG, in the leather tanning industry.

3. Methodology and Calculations

3.1 Data Collection

In this study, data were collected through two phases. First, we explored the factors affecting the leather tanning industry toward LWG certification through a literature review and expert feedback. An extensive literature review and analysis were conducted based on a series of latest research studies and several indexing reports published in the field. The screening process of both scientific and gray literature was performed with the aid of several search engines and online databases, e.g., Scopus, Web of Science, Google Scholar, etc., to include a broad spectrum of journals, books, and technical reports with high relevance to different certifications achievement, mainly LWG certification, in the

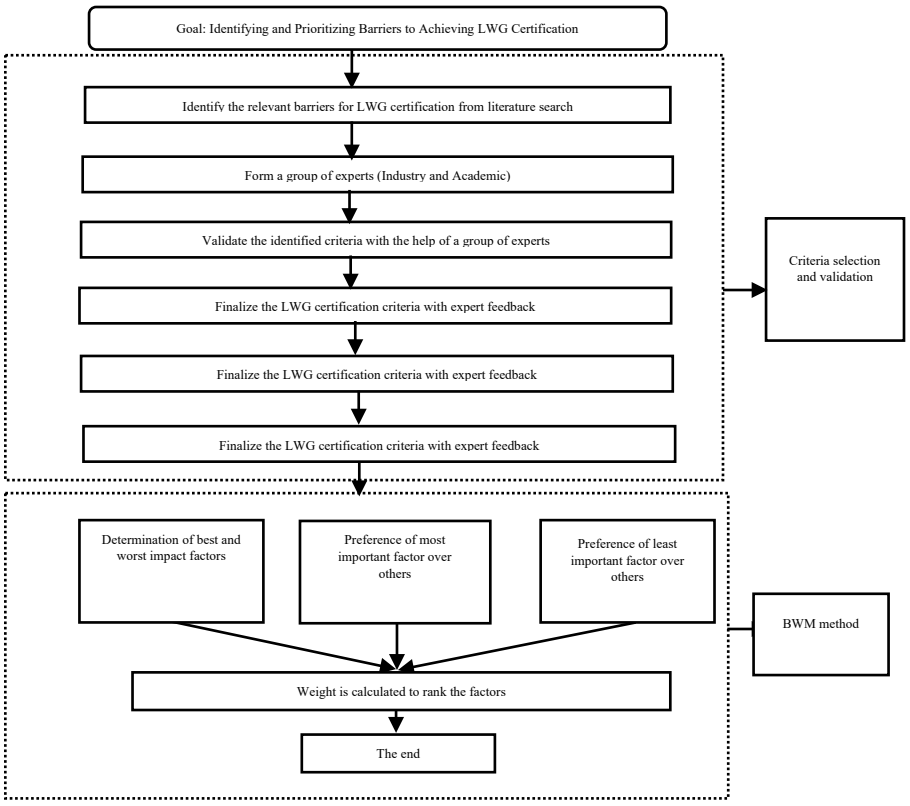

Figure 1. Research Framework

leather industry context. A generic search was performed by typing keywords such as "Sustainable Tanning" OR "Eco-friendly leather production," OR "Green leather manufacturing," OR "Leather Tanning Industry," "Barriers" OR" Obstacles," OR "Challenges," OR "Impediments" OR "Difficulties," "LWG Certification" OR "LWG" OR "Leather sustainability certification" OR "Eco-friendly leather certification" OR "Green leather certification" OR "Tannery sustainability certification" OR "environmental audit", "MCDM Models" OR "Multi-Criteria Decision Making" OR "Integrated MCDM Models" OR "MCDM Frameworks" OR "MCDM Applications" OR "Decision Support Systems." Then, the abstracts and titles of the most relevant articles were examined to select potential references that align with this research's scope and inclusion criteria. The review of gray literature pertinent to sustainability certifications was also considered to extract available information and potential frameworks. However, the exact literature was not found in the literature review. However, few other things were given importance to extract factors, such as sustainable practices, green manufacturing, certifications for sustainability, etc., as these factors obtained from selected areas are entirely related to getting LWG certification. The studies from selected categories that passed the initial filtering process went through a full read and review, and only scientific or technical material with sufficient methodological content and contribution to the field was included in the final inventory of papers and reports analyzed in detail. After reading all the selected articles, 9 factors have been finalized for the BWM analysis to meet our research objectives. After that, in this study, 20 relevant experts were invited through mailing, among which 13 responded (65% response rate). All invited respondents were somehow closely involved in academics and industry.

In phase 2, we collected data for BWM analysis to determine the factors' importance weights. In this study, all selected experts from the previous data collection phase were invited again to participate in the BWM analysis. In BWM, the factors are compared against each other using the best and worst methods.

3.2 Best-worst Method (BWM)

The Best-Worst method ranks the best and worst factors first, then the other variables against them on a 1-to-9 scale. This method simplifies multi-criteria decision-making. Weights are generated for each element by this simple comparison method, which helps the decision-maker prioritize options and make informed decisions—even in complex scenarios. The detailed process is outlined below.

Step 1: Identify Criteria

Define the decision problem clearly and then determine the relevant criteria (factors) that influence the decision.

Step 2: Determine the Best and Worst Criteria:

The most important criteria (B) are selected, and then the least important criteria (W) are selected. These will be used for the pairwise comparison.

Step 3: Perform Pairwise Comparisons:

Using a pairwise comparison method, the decision-maker/expert uses the numbers 1 to 9, where 1 means equally essential, and 9 means significantly more critical, to determine a preference for B over the other criteria. These other figures represent the intermediate assessments. The vector AB = (aB1, aB2, ⋯, aBj, ⋯, aBn) is the outcome of this phase, where aBj represents the preference of criterion B over criterion j.

Step 4: Compare Others to the Worst Criterion:

The 1 to 9 scale is used to assess the preferences for the other criteria over the worst criterion. The outcome of Step 4 is represented by the vector Aw = (a1W, a2W, ⋯, ajW,⋯, anW), where ajW represents the preference for criterion j over criterion W.

Step 5: Liner programming model used to determine the weights W1, W2, W3…… WN

$$\min \max_j \{ \left| \left| w_B - a_{Bj} w_j \right| \right|, \left| \left| w_j - a_{jW} w_W \right| \right| \} \text{---(1)}$$

such that $\sum_{j=1}^{n}$

$w_j = 1$ $w_j \geq 0$, for all j

To determine the weights of the criteria (w1, w2, ⋯, wn)

Consistency ratio = ξ* /Consistency

where ξ* is the result of the objective function 1.

The inventor if the Best worst method Dr. Jafar Rezaei Rezaei, J. [4] has published a solver where the liner programming is done via excel and gives the final output result. In this research the solver excel has been used.

3.3 Calculations

Step 1: Identify Criteria

The criteria are identified from the previous literature, and the list of the criteria is given in the table below. The finalized criterion is identified from the expert feedback.

Name of the Identified Criterion
Non-compliance with the environment
Infrastructural deficiencies
Technology Upgradation
Dysfunctionality of the CETP
Lack of financial resources
Lack of education
Using harmful chemicals
Conventional leather processing
Lack of technical expertise

Step 2: Determine the Best and Worst Criteria

The different tannery associates and industry experts agreed that the best criterion chosen was the dysfunction of the CETP. The least important one was Lack of education.

The Best selected by Expert	Dysfunctionality of the CETP
The Worst selected by Expert	Lack of education

Step 3: Perform Pairwise Comparisons

Best to Others	Infrastructural deficiencies	Technology Upgradation	Dysfunctionality of the CETP	Non-compliance with the environment	Lack of financial resources	Lack of education	Using harmful chemicals	Conventional leather processing	Lack of technical expertise
Dysfunctionality of the CETP	8	7	1	5	8	9	7	8	7

The scores are assigned by the Industry Experts

Step 4: Compare Others to the Worst Criterion

Others to the Worst	Lack of education
Infrastructural deficiencies	3
Technology Upgradation	3
Dysfunctionality of the CETP	8
Non-compliance with the environment	6
Lack of financial resources	5
Lack of education	1
Using harmful chemicals	4
Conventional leather processing	2
Lack of technical expertise	5

The scores are assigned by the Industry Expert.

Step 5: Liner programming model used to determine the weights W1, W2, W3…… WN

The inventor if the Best worst method Dr. Jafar Rezaei has published a solver where the liner programming is done via excel and gives the final output result. In this research the solver excel has been used.

The Weights found are:

	Infrastructural deficiencies	Technology Upgradation	Dysfunctionality of the CETP	Non-compliance with the environment	Lack of financial resources	Lack of education	Using harmful chemicals	Conventional leather processing	Lack of technical expertise
Weights	0.0675 38593	0.0771 86940	0.4202 40137	0.1080 6175	0.0675 38593	0.0375 21441	0.0771 86950	0.0675 38593	0.0771 8699

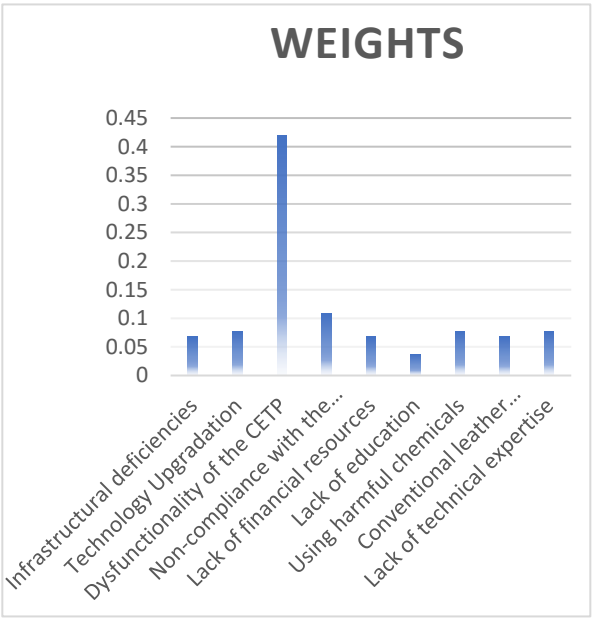

Figure 2. Weights of the Factors

Input-Based CR	0.3611111
Associated Threshold	0.3662

CR<= Associated Threshold is acceptable and the maximum threshold is 0.3662 which is also acceptable.

4. Result and Discussion

The Best-Worst Method (BWM) was used to determine the weights of different criteria identified for evaluating the factors hindering the factor in achieving the LWG certification.

Experts were tasked with determining the best and worst criteria from the identified list. Through thorough deliberation and analysis, the dysfunctionality of the Common Effluent Treatment Plant (CETP) emerged as the most critical criterion. This indicates that ensuring the proper functioning of wastewater treatment facilities is paramount in addressing environmental pollution and safeguarding worker health within tanneries. Conversely, lack of education was identified as the least significant criterion, suggesting that while education and training are essential components of workplace safety, other factors may have a more pronounced impact on overall safety standards.
Next, experts determined the best and worst criteria. Dysfunctionality of the Common Effluent Treatment Plant (CETP) was rated as the most important criterion, while lack of education was considered the least important. Experts determined the most crucial criterion, highlighting the dysfunctionality of the Common Effluent Treatment Plant (CETP) as a top priority for addressing occupational health and safety concerns. This underscores the critical role of effective wastewater treatment in mitigating environmental pollution and safeguarding worker health. On the other hand, lack of education was identified as the least significant criterion, indicating that while education is important, other factors, such as infrastructure and technology, play more prominent roles in enhancing safety standards.

Pairwise comparisons were conducted to assess the relative importance of each criterion concerning one another. Experts assigned scores to indicate the degree of importance of each criterion compared to others. These scores provided valuable insights into the hierarchy of criteria, guiding the subsequent calculation of weights. Pairwise comparisons were then performed to establish the relationships between criteria. Experts assigned scores based on the importance of each criterion relative to others. Using linear programming, weights were calculated for each criterion. These weights represent their relative importance in the evaluation process. The consistency ratio was also calculated to ensure the reliability of the results, which fell within acceptable thresholds.

Overall, the results indicate that the dysfunctionality of the CETP is the most critical factor in addressing tanneries' occupational health and safety challenges. This underscores the importance of ensuring the proper functioning of treatment plants to mitigate environmental and health risks. Additionally, factors such as infrastructural deficiencies and lack of financial resources were also found to be significant considerations in addressing these challenges.
The consistency ratio, within acceptable thresholds, validates the reliability of the derived weights, enhancing confidence in the decision-making process. Overall, the findings highlight the multifaceted nature of tanneries' occupational health and safety challenges, emphasizing the need for holistic approaches that address infrastructure, technology, and regulatory compliance to ensure the well-being of workers and environmental sustainability. The findings provide valuable insights for policymakers, industry stakeholders, and researchers in developing strategies and interventions to improve occupational health and safety standards in tanneries within emerging economies.

5. Conclusion

In conclusion, the Best Worst Method (BWM) proved to be an effective tool for prioritizing criteria related to occupational health and safety challenges in tanneries. This method provided valuable insights into the relative importance of various factors influencing workplace safety through a systematic process of criteria identification, expert consultation, pairwise comparisons, and weight determination.
The findings highlight the critical role of addressing environmental concerns, particularly the proper functioning of wastewater treatment facilities such as the Common Effluent Treatment Plant (CETP), in mitigating ecological pollution and safeguarding worker health. The CETP's dysfunction emerged as the most significant criterion, underscoring the importance of investing in infrastructure and technology to ensure compliance with environmental regulations and industry standards.
Additionally, the results shed light on the multifaceted nature of workplace safety challenges in tanneries, emphasizing the need for holistic approaches considering factors such as infrastructure quality, technology utilization, and workforce education levels. While education and training are essential components of workplace safety, the analysis revealed that other factors may have a more pronounced impact on overall safety standards within tanneries.

6. Recommendations

Several strategic recommendations are proposed to address the challenges hindering tanneries from achieving LWG certification and improving occupational health and safety. The top priorities recommendations are given below:

Enhancing Wastewater Treatment Infrastructure: invest in modernizing and maintaining the Common Effluent Treatment Plant (CETP) to ensure its proper functionality, and regular monitoring and maintenance schedules for CETPs are needed to avoid dysfunctionality and ensure compliance with environmental standards.

Improving Infrastructural Deficiencies: upgradation in tannery infrastructure is required to meet international standards, focusing on workplace safety, ventilation, and waste management systems and promoting the adoption of cleaner and more efficient technologies in tannery operations to reduce environmental and occupational health risks.

Strengthening Regulatory Compliance: strengthen the enforcement of environmental and occupational health regulations, ensuring that tanneries comply with national and international standards and stringent penalties for non-compliance to deter negligence in maintaining safety and environmental standards.

Capacity Building, Training, and Research: training sessions for tannery workers focusing on the operation and maintenance of wastewater treatment facilities, workplace safety, and the use of personal protective equipment (PPE) should be prioritized, raising awareness among tannery staff and management about the importance of sustainable practices and achieving LWG certification and investment in research to explore innovative wastewater treatment technologies, such as membrane filtration and bioreactors, suitable for tannery operations could be a fruitful solution.

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References

Paul, H. L., Antunes, A. P. M., Covington, A. D., Evans, P., and Phillips, P. S., Bangladeshi leather industry: An overview of recent sustainable developments. *Journal of the Society of Leather Technologists and Chemists*, vol. 97, no. 1, pp. 25-32, 2013.

Rahman, M., and Ogunleye, J. A. M. E. S., A Lean, Green and Six Sigma (LG6σ) for SMEs in the leather industry in Bangladesh, *International Journal of Knowledge, Innovation and Entrepreneurship,* vol. 7, no. 2, pp. 42-66, 2019.

Pons, A., Rius, J., Vintró, C., and Lopez, S., Study of the corporate social responsibility in the leather tanning sector, *Journal of Engineered Fibers and Fabrics*, vol. 18, 2023.

Rezaei, J., Best-worst multi-criteria decision-making method. *Omega*, vol. 53, pp. 49-57, 2015.

Razzaque, M. A., Eusuf, A., Uddin, M., and Rahman, J., Exports of Leather and Leather Goods: Performance, Prospects, and Policy Priorities, *In Navigating New Waters: Unleashing Bangladesh's Export Potential for Smooth LDC Graduation*, pp. 229-266, 2020.

Karuppiah, K., Sankaranarayanan, B., and Ali, S. M., Towards sustainability: mapping interrelationships among barriers to circular bio-economy in the Indian leather industry, *Sustainability*, vol. 15, no. 6, pp. 4813, 2023.

Gomez-Padilla, B. E., Esquer-Peralta, J., Munguía-Morales, H. E., Esquer-Miranda, E., and García-Bedoya, D., Tanning leather environmental assessment: a case study in Leon, Mexico, 2023.

Rahman, M. H., An Analysis on the Leather Industry of Bangladesh: Identification of Barriers, Challenges, and Way Outs, *International Journal of Management & Entrepreneurship Research*, vol. 4, no, 3, pp. 154-169, 2022.

Senthil Kumar, P., and Femina Carolin, C., Certifications for sustainability in footwear and leather sectors. *Leather and Footwear Sustainability: manufacturing, supply chain, and product level issues, Singapore, Springer*, pp. 181-197, 2020.

Haq, M. M., Morshed, M. S., Marma, M., and Hamja, A., A Comprehensive Analysis and Ranking of Barriers to implement lean practices in chemical management of Leather Tanning Industries in Bangladesh, *in 6th Industrial Engineering and Operations Management Bangladesh Conference, Dhaka*, 2023.

Hasan, M., Islam, H., Mukter Alam, M., Marma, M., and Sarkar, R., Occupational Exposure of Footwear Roughing Dust During Footwear Manufacturing Process, *Leather & Footwear Journal*, vol. 23, no. 3, 2023.

Hasan, M. N., Barriers and challenges to environmentally friendly manufacturing in developing countries: the views of a young tannery owner in Bangladesh. *Annual Review of Social Partnerships*, vol. 12, 2017.

Islam, M. H., Sarker, M. R., Hossain, M. I., Ali, K., and Noor, K. A., Towards sustainable supply chain management (SSCM): A case of leather industry. Journal of Operations and Strategic Planning, *Journal of Operations and Strategic Planning*, vol. 3, no. 1, pp. 81-98, 2020.

Uddin, S., Ali, S. M., Kabir, G., Suhi, S. A., Enayet, R., and Haque, T., An AHP-ELECTRE framework to evaluate barriers to green supply chain management in the leather industry. *International Journal of Sustainable Development & World Ecology*, vol. 26, no. 8, pp. 732-751, 2019.

Debnath, B., Bari, A. M., Haq, M. M., de Jesus Pacheco, D. A., and Khan, M. A., An integrated stepwise weight assessment ratio analysis and weighted aggregated sum product assessment framework for sustainable supplier selection in the healthcare supply chains. *Supply chain analytics*, vol. 1, pp. 100001, 2023.

Abdulla-Al-Mamun, M., Marma, M., Ali, M. F., and Mottalib, M. A., Recovery and Reuse of Chromium from Tannery Waste Chrome-liquor using Solar Evaporation Process, *Textile & Leather Review*, vol. 6, pp. 652-666, 2023.

Maalouf, M. M., Hamja, A., & Hasle, P. (2017). Investigating the role of organizational routines in the creation of synergies between Occupational Health and Safety (OHS) and productivity. Proceedings of the 24th International Annual EurOMA Conference.

Maalouf, M. M., Hamja, A., & Hasle, P. (n.d.). Enabling the creation of synergies between Occupational Health and Safety and productivity. Proceedings of the 5th International EurOMA Sustainable Operations and Supply Chains Forum.

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