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Sustainability Research in the Leather Industry: a critical review of progress and opportunities for future research.

Abstract

Sustainability research continues to receive significant attention in academia, service and manufacturing industries. In a manufacturing industry like leather, research has played a significant role in accelerating the adoption of sustainable manufacturing practices. As sustainable operations attainment itself is deemed a journey rather than a destination, synthesising present research could assist in forging future research paths in the journey ahead. Hence, this study aims to identify trends and opportunities for future research in sustainability research in the leather industry. This is achieved through a comprehensive literature review of peer-reviewed journal articles related to sustainability in the leather industry. Key findings include a significant increase in triple bottom line related sustainability studies in the leather industry in the past four years compared to the previous 15 years combined. Contrary to prevailing notions, there is more sustainability research in developing/emerging country contexts than in developed country research contexts. While it is not surprising that economic and environmental sustainability-related research dominate, present social sustainability research is found to be mostly skewed towards health and safety themes while other relevant themes such as diversity and inclusion are under-researched. Results from the study can guide researchers on opportunities for future research and facilitate the understanding of industry managers on key areas of sustainability to focus on in the leather industry.

Keywords: Sustainability research, Leather Industry, Triple bottom line, Progress, Opportunities.

1. Introduction.

Synonymously used with sustainability, the famous Brundtland report defines sustainable development as the "development that meets the needs of present generation without compromising the ability of future generations to meet their own needs" (Keeble, 1988, p. 20). To foster better understanding of the above definition in terms of sustainability, Elkington (1997) proposed the triple bottom line of sustainability – People (social), Planet (environment) and Profit (economy) to depict the three key dimensions to be concurrently addressed in a sustainability "journey". After becoming mainstream from the famous Brundtland report in 1987, the importance of sustainability to businesses, individuals and industries became solidified even further with the 17 sustainable development goals (SDGs) defined by the United Nations in 2015.

The subject of sustainability is increasingly discussed in day-to-day conversations, especially in businesses. In manufacturing industries like leather, implementation of sustainable manufacturing practices in production activities takes precedence. Sustainable manufacturing is viewed as a component of the broad sustainability concept and defined as the "the techniques, policies and procedures a firm uses to create manufactured products, that use processes that minimise negative environmental impacts, conserve energy and natural resources, are safe for employees, communities and consumers and are economically sound' (Roberts and Ball, 2014, p. 161). The end results of sustainable manufacturing is documented to include (but not limited to) a reduction in operation costs and improvement in quality (Roberts and Ball, 2014), increased global competitiveness (Smith and Ball, 2012), product safety (Gupta et al., 2018a) and improved health and safety profile of employees. Sustainable manufacturing is becoming a rising issue in several industries, with research in the area becoming increasingly important to increase scientific knowledge and adoption.

In the leather manufacturing industry context, sustainability research has been growing in recent years but has largely been focused on the environmental aspect (Chen et al., 2014; Zuriaga-Agustí et al., 2015) while fewer published research about the social and economic aspects exists (Gupta and Racherla, 2018; Śmiechowski and Lament, 2017). As sustainability is often seen as a journey rather than a destination (Lankoski, 2016; Lozano and Haartman, 2017), the same view could be argued for corresponding research. Hence, it is important to understand where present research is, in order to identify where the next steps in the "journey" (sustainability research) could be. Although several publications relating to sustainability

across different industries exist, the need to conduct industry specific studies has been suggested in the literature, as the dynamics of operations and activities differ significantly from one industry to another (Morais and Silvestre, 2018; Popovic et al., 2018). To the authors' knowledge, in the leather industry context, there is an absence of a recent study that evaluates the progress made so far in triple bottom line research. Hence, this study aims to synthesise already existing knowledge on sustainability research in the leather industry in order to identify trends and opportunities for future research. Explicitly, the following research questions (RQ) will be explored; RQ1: What are the sustainability research trends in the leather industry? RQ2: What are the key themes that have been explored in relation to the triple bottom line research in the leather industry context? RQ3: What are the opportunities that could be explored for future research towards a sustainable leather industry?

Though the paper categorises the identified themes into separate sustainability dimensions, the interconnectedness of the three dimensions should not be disregarded as some of the themes are intertwined. The next section presents an overview of the leather industry and the related sustainability dimensions. This is followed by the presentation of the research methodology, the results and discussion section, which shows the emerging themes and conceptual framework. Opportunities for future research are also identified within this section.

2. Literature Review.

2.1 Overview of the Leather Industry.

Leather and Leather products are one of the most traded in the world, accounting for an international trade value exceeding $80 US billion dollars yearly (ITC, 2020). China is regarded as the highest producer (18%), importer (63%) and exporter (43%) of leather in the world (MVO Nederland, 2013). Joining China in the top producing countries are Italy (10%), Korea (7%), India (7%), Russia (6%) and Brazil (6%). Globally, the product generated from leather in highest quantities is footwear (with leather uppers), accounting for more than 50% of the market share (MVO Nederland, 2013).

Leather as an intermediate "industrial" product (Jaegler, 2016; Joseph and Nithya, 2009), is derived as a renewable by-product from slaughtered animals such as cattle, sheep, pigs, goats etc. Contrary to the belief that animals are largely reared for leather use, the leather industry performs a circular economy function to upcycle the waste (hides and skin) generated from the meat and dairy industries, which belongs to the agricultural industry (Dixit et al., 2015). Thus, leather can be regarded as a sustainable material on its own.

Furthermore, the leather supply chain is a globalised one, consisting of breeders, slaughterhouses, tanneries, manufacturers (Jaegler, 2016; MVO Nederland, 2013) and could include retailers, chemical suppliers and technology/machinery providers, service providers such as logistics companies, marketing, information technology and final consumers. An example of a simple model of the leather supply chain is presented in **Figure 1.**

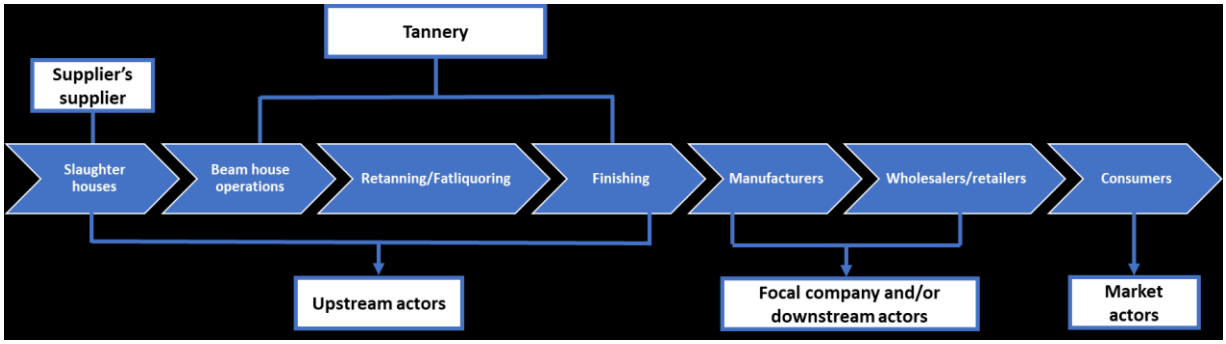

Figure 1: Simple linear leather supply chain (Source: author)

According to MVO Nederland (2013), the leather supply chain is in four key stages (upstream, focal company, downstream and market actors) as shown in the figure above i.e. obtaining raw materials- hides and skins (first stage), tanning and conversion of hides and skins into leather (second stage) and manufacture of different leather products (third stage). The chain starts from the slaughterhouses where hides and skins are collected and salted, after animals have been slaughtered. Collecting these wastes (hides and skin) that serve as the main raw material for leather production reduces landfill dumping, thereby reinforcing the industry as a "circular economy industry" that contributes to sustainable development. From the slaughterhouses, the salted or unsalted hides and skins are transported to the tanneries where they are converted into leather through several processes, from beam house operations to finishing operations (Daniels and Landmann, 2013). These processes can use significant amounts of chemicals, energy and water and can be labour or capital intensive, depending on the level of technology/innovation and intended use of leather.

Processed hides and skins, otherwise known as leather, are then usually sourced by leather goods (belt, bags, clothes etc) manufacturers and retailers, including Original Equipment Manufacturers (OEMs). Although the industry performs a circular economy function, the processing of hides and skins into leather usually generates solid wastes, liquid wastes and gaseous wastes that are capable of constituting negative social, environmental and economic implications. Additionally, given the complexity of the leather supply chain and the amounts

of resources (both human and environmental) used in production processes, the issue of sustainability is quite crucial (Moktadir et al., 2018b).

2.2 A Triple Bottom Line Review of Sustainability in the Leather Industry.

As businesses are gearing efforts towards sustainability, the leather industry is not excluded (Nicoleta et al., 2014). It is currently witnessing an influx of research in the area of sustainability, given the industry is perceived as one of the more polluting industries in the world, characterised by its high use of water and chemicals (Kanagaraj et al., 2015; Sathish et al., 2016).

The inference, proposed by Elkington (1997), that businesses conceive sustainability as environmental sustainability could be suitably applicable to the leather industry. In fact, studies relating to sustainability in the leather industry have been largely inclined towards green chemistry (Krishnamoorthy et al., 2012), pollution control (Kumar Gupta et al., 2018; Zuriaga-Agustí et al., 2015), waste management (Kanagaraj et al., 2015) etc, all of which can be referred to as environmental sustainability practices (Glavič and Lukman, 2007). Conceiving sustainability as environmental sustainability may not necessarily indicate a total neglect of the two other dimensions of sustainability (economic and social sustainability), although the probability of not addressing other related issues could be significant. For example, if an organisation decides to reduce its chemical use during tannery operations, this could lead to cost savings (economic) and reduction in exposure of employees to chemicals (health and safety). However, the chemical use reduction practice may not translate to addressing the issue of child or forced labour. Hu et al. (2011) suggests a sustainable leather industry is one that strikes a balance between the environmental, social and economic conditions. Thus, an understanding of the triple bottom line of sustainability in the leather industry is important.

2.2.1 Environmental Sustainability in the Leather Industry.

Elkington (1997) referred to environmental sustainability as the "planet" aspect of sustainability. Goodland (1995) defined environmental sustainability simply as the "maintenance of natural capital" in such a way that there is a balance between the two services the environment provides: the source and sink services (Andersson and Mackenzie, 2004; Goodland, 1995). Morelli (2011, p. 5) comprehensively defined environmental sustainability as "a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs and preventing it from going beyond the capacity of its supporting systems to

continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity".

In assessing environmental sustainability in the leather industry, Wolf et al. (2013) adopted a "sustainability footprint approach" to depict the possible effects the leather supply chain can have on the environment, as shown in **Figure 2.**

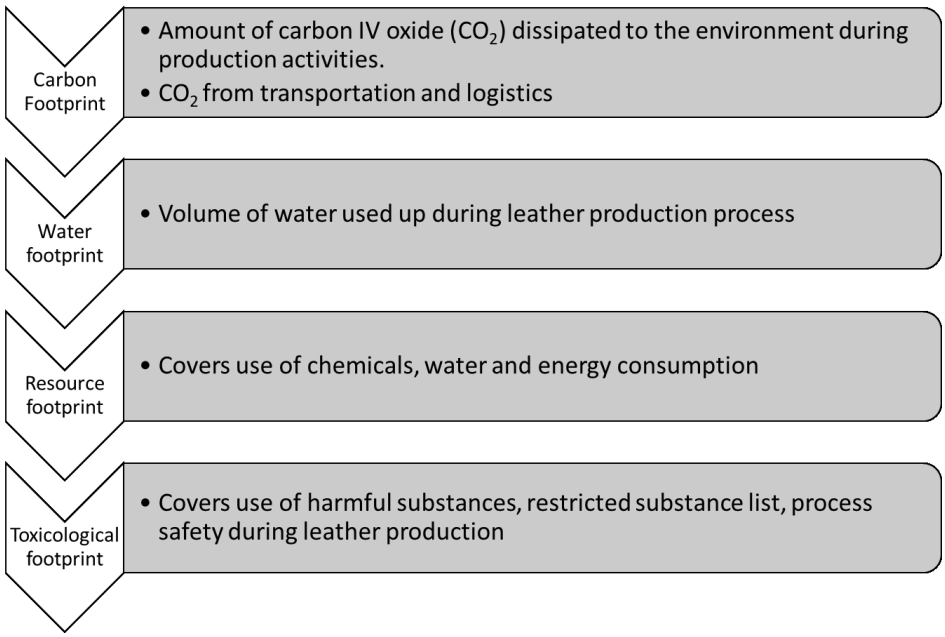

Figure 2: Environmental impact of the leather industry (Wolf et al, 2013)

The issues that arise as a result of these footprints are well documented in the leather industry as they form a basis of discussion among leather experts. Indeed, publications relating to the environment are said to dominate previous research on sustainability in the leather industry (Chen et al., 2014; Marconi et al., 2017). Also, the indicators to assess the environmental sustainability credentials of leather-related companies are also well established. This is reflected in the environmental stewardship tool of the Leather Working Group and in the sustainability reports of different leather companies. Findings from Omoloso et al. (2020) revealed that important indicators for the environment as reported in sustainability reports of leather related companies include energy efficiency, emission reduction of greenhouse gases, efficient water management, waste management and Life Cycle Assessment (LCA) identification. Due to the interconnectedness of the dimensions, environmental endeavours can have multiplier effects on social and economic sustainability and vice versa.

2.2.2 Social Sustainability in the Leather Industry.

The potential release of harmful substances during leather production process can cause serious pollution to surrounding areas of leather processing plants and have debilitating health effects on employees, consumers and community inhabitants, if proper protective measures are not installed (ICT, 2018). Several definitions of the social sustainability concept exist in the literature. While some authors have provided theoretical definitions, some have opted to discuss core themes through which social sustainability can be operationalised (Åhman, 2013). Rasouli and Kumarasuriyar (2016, p. 31) defined social sustainability as the state of a community that is capable of meeting the basic needs of humans as well as satisfy the principles of "social justice and equity, homogeneity, cohesion, integration, diversity, sense of place, social amenity, social security" for future as well as present generations.

By extension to the business and management literature, social equity includes a just and unbiased treatment of employees (Åhman, 2013). Complementary to environmental sustainability which takes a focus on the management of natural resources, social sustainability takes a focus on the "management of social resources, including people's skills and abilities, institutions, relationships and social values" (Sarkis et al., 2010). The leather industry is a labour-intensive sector (ILO, 2018) which can indicate a significant focus on the social aspects of the employees. Important aspects of social sustainability related to the leather industry could include "full compliance to product safety regulation, full compliance to health and safety and employment regulation" and a "commitment to animal welfare principles and practices" (ICT, 2018).

2.2.3 Economic Sustainability in the Leather Industry.

This is also referred to as the "profit" dimension of sustainability". Defined by Atkinson (2007), economic sustainability is the achievement of transferring onto future generations an equal measure of capital which is available for present generations. In relation to business, the economic dimension of sustainability takes into consideration an organisation's effort to improve the value it generates and delivers, at the same time reducing cost of its supply chain related activities (Closs et al., 2011). Additionally, Blanchard (2006) suggested that economic sustainability means the business of staying in business when social and economic aspects are taken into consideration. Using the above interpretation, concepts such as competitiveness, innovation, manufacturing efficiency, lean systems and profitability, important for modern businesses to stay in business in the short and long term could be attributed to economic sustainability concepts.

In the leather industry, important aspects of economic sustainability, as stated by ICT (2018), include commitment to fair trade practices; traceability of raw hides and skins up to the slaughtering facilities; commitment to transparency on the origin of leather production and commitment to observe and promote the correct labelling of leather and leather products, according to the agreed ICT definitions and international standards and laws.

Furthermore, in becoming economically sustainable, organisations are advised to gear considerable efforts towards making maximum profit while ensuring the most efficient use of all resources and raw materials (Singh and Gupta, 2013). It can be argued that social and environmental sustainability practices usually contribute to economic sustainability of a company, industry; and supply chain and vice versa, because a profitable and economically stable company could have a greater chance of committing to sustainability investments relating to the social and environmental aspects.

Discussion of the above dimensions provides a context to the research and guides the next sections of the study.

3. Methodology.

The methodology of this study is based on a narrative and integrative literature review of accessible peer reviewed literature from selected relevant journals. The analysis process followed the approach employed by Gioia et al. (2013) and Garcia-torres et al. (2019). The authors noted the applicability of an integrative literature review design to research that seeks to critique, analyse, and synthesise representative literature on particular subjects or topics with the end goal of deriving frameworks and viewpoints. On the other hand, narrative literature review is useful to provide an overview of key definitions of terms relating to different aspects of sustainability that have been covered on a given subject (Garcia-torres et al., 2019).

As shown in **Figure 3,** peer reviewed journals published since the turn of the century i.e. from 2001 to 2019 were prioritised to ensure a wide scope to the study, since a study of this depth has not been previously carried out in the leather industry context. The study was completed in early 2020 and therefore papers published in 2020 are not included in the analysis. Academic journals were prioritised as they are highly regarded to play a key role in a discipline development (Garcia-torres et al., 2019). Keywords used in search strategy include {“Sustainable and Leather”}, {“Sustainability” AND “Leather”}, {“Green” AND “Leather”} {“CSR” AND “Leather”}, {“Corporate Social Responsibility” AND “Leather”}, {“Social Sustainability” AND “Leather”}, {“Environmental Sustainability” AND “Leather”} and

{“Economic Sustainability” AND “Leather”}. These keywords were entered in publisher websites such as Taylor and Francis, Elsevier, Emerald Insight as well as online search engines such as Google scholar and Web of Science, as guided by previous related studies that have established the significant presence of sustainability related publications from these sources. A complementary snowball approach was also used to find related studies in some of the articles found. This search strategy was used because of the observed dispersed nature of present literature on sustainability in the leather industry. Exclusion criteria was applied to conference papers as well as papers whose emphasis were not related to leather sustainability and papers that were suspected as published in “predatory journals”. Corporate Social Responsibility (CSR) focused papers were included as long as they were used synonymously with sustainability.

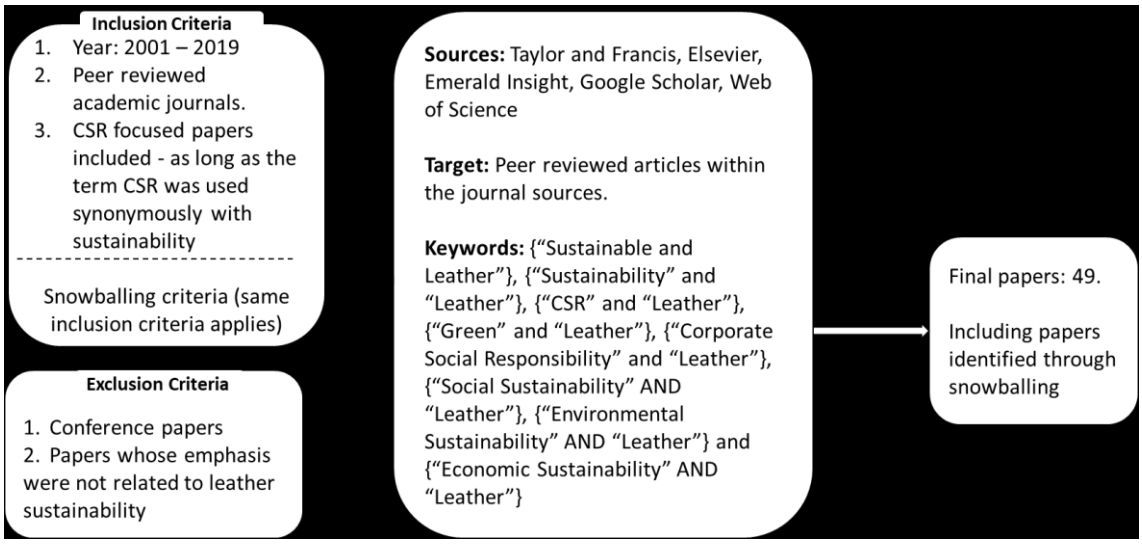

Figure 3: Search strategy and sampling process (Source: author)

After the screening process, 49 papers were reviewed to answer the research questions. The three main sustainability dimensions (environmental, social and economic) that were initially discussed assisted in analysing the relevance of several themes covered in the literature to each dimension. While reading through the articles, an Excel-based sheet was created which had details such as title of article and journal publisher, year of publication, country context of article, key findings, related sustainability dimensions and key theme (s) each articles explored, as shown in **Figure 4.**

	Title of article	Journal name	Year of Publication	Country context	Economic	Social	Environ-mental	Key themes	Key findings	C
1	Sustainability strategies in the Indian leather industry: an empirical analysis	Benchmarking: An international Journal	2018	India	×	×	×	Competitiveness relating to triple bottom line trade-offs	Three different states in India have been leveraging on trade-offs in their focus on the three bottom line to derive competitive advantage over others	

Figure 4: Sample of analysis using Microsoft Excel

Once the exclusion and inclusion principles of each article had been met, the title of the article was placed in the necessary column, followed by the journal name and year of publication. The country context was obtained by reviewing either or all of article title, respective abstracts and the methodology section. Articles with no country contexts were represented as N/A to reflect "non applicability". Guided by the definitions and constituents of social, economic and environmental sustainability defined in the literature review section, the content of each article was reviewed to extract the key themes each paper addressed. A key theme in this regard refers to the key subject or issue addressed in each paper. For example, in Figure 4, the core theme of the article was competitiveness/competitive advantage (an economic theme) which was discussed in relation to the triple bottom line. Each article's abstract and discussion/research findings section were then analysed to obtain the study's key findings, which was integral to the discussion in this present study.

4. Results and Discussion.

This section discusses the distribution of articles based on year of publication, geographical focus, sustainability dimensions addressed, and themes covered in sustainability dimensions.

4.1 Distribution of relevant articles according to Year of Publication.

Figure 5 below shows an increase in publications in the field of sustainable leather industry over the period observed. The sharp increase in publications from 2016 to 2019 could prove the growing attention from researchers and actors in the field of sustainable leather supply chain management (SLSCM), as the industry seeks to continuously improve the sustainability of its operations.

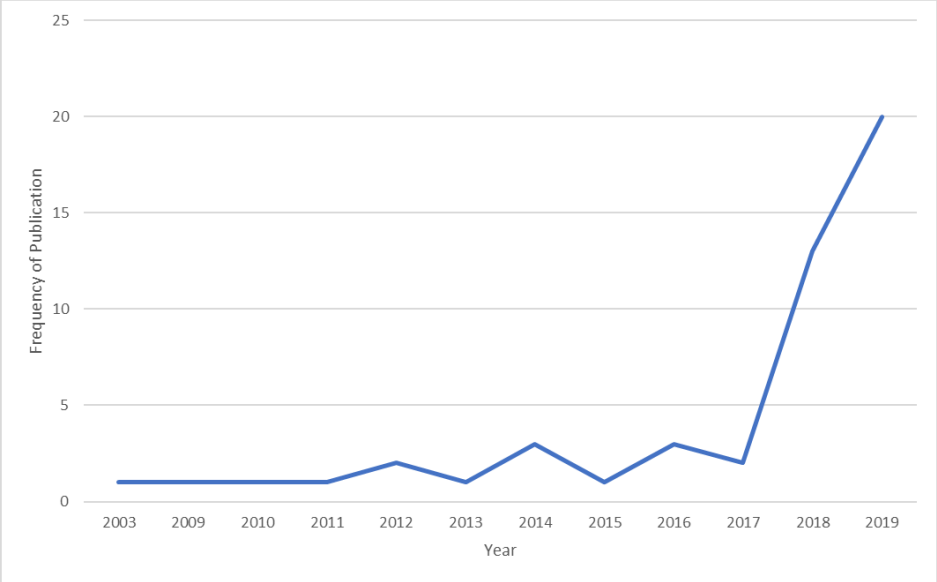

Figure 5: Distribution of relevant articles according to year of publication (Source: author)

Significant increase in the sustainability research in the past 5 years could be due to several reasons. First, the increase in research could be related to the inauguration of the SDGs by the United Nations in 2015 that also tasked businesses, governments and research institutions to work towards the goals. Therefore, it can be opined that the advent of the SDGs may have had a positive multiplier effect on sustainability research in the leather industry. Secondly, animal rights issues, waste management, pollution and circular economy, are some of the recent highly discussed topics in the larger textile industry, of which the leather industry is a subset. Furthermore, there has been a growing awareness of the public, customers, businesses and research community to address these sustainability related issues, which could have led to increase in sustainability studies in the leather industry.

4.2 Distribution of relevant articles according to Journal Distribution.

The distribution of the articles used in the study, which were extracted from 31 different journals are presented in **Table 1**. Journal of Cleaner Production featured as the key journal publishing content relating to sustainability in the leather Industry, with 14 papers, followed by "Sustainability" with four papers. This is followed by two articles each from Sustainable Production and Consumption, and Management of Environmental Quality Journals. One article each from 27 other journals were also reviewed. Hence, the Journal of Cleaner Production could be considered as the core journal in the area of SLSCM, although other journals identified could be equally viable publication channels.

Table 1: Distribution of relevant articles according to journals (Source: author)

Journal	Number of papers
Journal of Cleaner Production	14
Sustainability	4
Sustainable Production and Consumption	2
Management of Environmental Quality	2
Other (one from each 27 journals)	27

The broad presence of publications in a wide and high number of journals also confirms the dispersed nature of present literature on sustainability in the leather industry, thereby contributing to reliability of methodology employed in this study.

4.3 Distribution of relevant articles by Geography.

After analysing the geographical contexts of selected articles, it was identified that developing and emerging countries constitute the focus of several of the studies, as shown in **Figure 6**. Out of 49 articles reviewed, 24 (48%) had research contexts in developing emerging economies including China, India, Pakistan, Bangladesh, South Africa and Sri Lanka. Nine of the publications had research contexts situated in developed countries – either in USA (2 – 4%) or Europe – France, Italy, Poland and Turkey (7 – 14%) while 17 publications had no geographical research contexts. Also, out of 38 articles published between 2016 and 2019, 52% were contextualised on developing/emerging countries while 26% were focused on developed nations such as France, Italy, Poland, and USA.

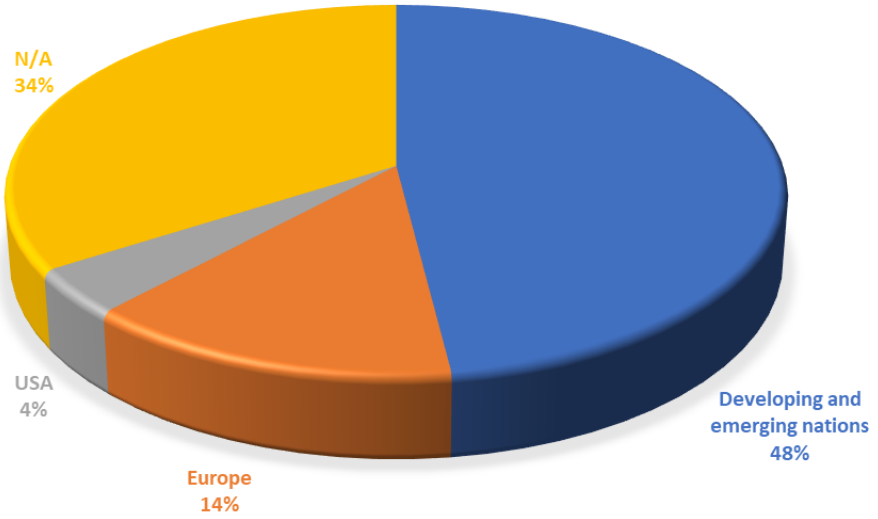

Figure 6: Distribution of articles by geography context (Source: author)

The higher prevalence of leather sustainability research in the "developing and emerging nations" geographical context could be for a number of reasons. First, the general narrative that fewer sustainability research in developing and emerging contexts exists (Morais and Silvestre, 2018), may not apply to the leather industry. Perhaps the narrative holds, this could have been a factor leading researchers to fill the perceived gap, thereby contributing to the increased leather sustainability research projects in developing/emerging country contexts. Secondly, the leather industry contributes significantly to the economic growth of developing/emerging economies. For example, the leather industry ranks second in economic growth contributions in Bangladesh(Islam et al., 2020), which could necessitate adoption of sound sustainability manufacturing techniques and related research. The leather industry also holds significant importance to the economy of countries like China, India, Pakistan, where their western counterparts source leather products from (MVO Nederland, 2013; Wahga et al., 2018).

In order to develop sound sustainable manufacturing practices, research is usually conducted to discover new and innovative techniques, using available resources in particular geographical contexts. In addition to this, the leather industry in certain developing countries/emerging countries are still facing challenges integrating sustainable manufacturing techniques into their operations (Munny et al., 2019). Hence, the possible reasons for skewness in distribution of articles towards developing/emerging country contexts. However, to understand sustainability issues in the global leather industry holistically, further research could focus on developed nations which could lead to comparison of best practices and understanding issues that stakeholders from different countries are facing.

4.4 Distribution of relevant articles according to Focus.

As shown in **Figure 7**, the comprehensive literature review also revealed that 92%, 44% and 38% of the reviewed articles discussed environmental, economic and social sustainability respectively, either individually or with other sustainability dimensions.

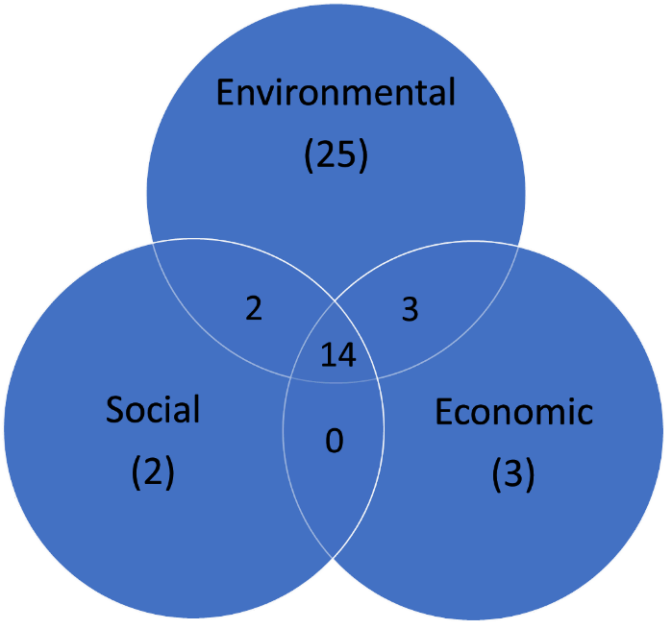

Figure 7: Distribution of relevant articles according to triple bottom line focus (Source: author)

Overall, 14 out of 49 reviewed articles concurrently addressed the three sustainability dimensions in the time period evaluated. Furthermore, out of 38 articles published between 2016 and 2019, 13 focused on the three aspects as compared to one out of 11 articles published between 2001 and 2015. Concentration of articles towards the dominant environment aspect could be due to the nature of leather industry operations itself. The industry is known to use significant amount of environmental resources such as water, chemicals and energy, while generating considerable amount of liquid and solid wastes, which should be managed (Decouple, 2013; Dixit et al., 2015). Hence, several sustainability studies are conducted to discover new techniques to manage waste, recycle/reuse waste and also reduce the use of processing inputs such as water and chemicals. Also, historically, sustainability had been considered just as an environmental concept (Elkington, 1997) and so it is not surprising that there is a significant number of articles available in the environmental domain. However, there may be an indication that researchers are increasingly becoming aware of the need to address the three aspects concurrently, evident in a greater number of papers (13) written on the three main dimensions in the last four years. This suggests some progress in recent years on the holistic understanding of sustainability in the industry.

In the discussion that follow in the next sections, the inter-relatedness of the triple bottom line dimensions becomes significantly apparent. While the discussions in some papers addressed all triple bottom line dimensions either marginally or wholly, as represented in Figure 6, the

core theme of each article was used in grouping them under each category discussed in **Section 5.**

5. Discussion of themes relating to the Triple Bottom Line.

In this section, the result of the analysis of the sampled papers are presented to address the research questions identified earlier. Themes identified are discussed under each sustainability dimension relating to the triple bottom line.

5.1 Themes relating concurrently to all aspects of the Three Dimensions.

Results show that there has been a number of themes discussed in relation to all three dimensions as shown in **Table 2**. This spans the identification of drivers that influence sustainability actions, impact or progress measurement, potential barriers to sustainability implementation and the interrelationship/trade-offs that could exist within the dimensions, emphasising the importance of considering how a lack of/partial focus on one aspect could lead to disproportionate implementation in companies. A breakdown of the key themes generated from analysis is represented below.

Table 2: Themes related to all three sustainability dimensions (Source: author)

Themes	Author(s)
Relationship between triple bottom line performance	Gupta and Racherla (2018)
Sustainability drivers	Moktadir et al.(2018b); Wahga et al.(2018)
Barriers to Sustainable Supply chain	Moktadir et al. (2018a), Uddin et al. (2019); Jaegler (2016)
Sustainability reporting	Śmiechowski and Lament (2017)

First, the inter-relationship between the three dimensions was explored by Gupta and Racherla (2018) based on the focus of governments in three different states in India. The result signifies that negative correlation can emerge between the dimensions, if adequate and proportional focus on the three is not taken into consideration. For example, there was a substantial negative relationship between social and environmental performance, which was reported to be as a result of a higher push for environmental compliance in one of the three Indian states accessed. The nature of push by one of the states towards environmental compliance fits into what is referred to as sustainability drivers.

Indeed, Moktadir et al. (2018b) identified and placed drivers of sustainable practices in the leather industry in Bangladesh in four main categories namely: “knowledge about the circular economy”, “customer awareness”, “leadership and commitment from top management” and finally, “government and support legislation”. Additionally, Wahga et al. (2018) revealed that pressures that drive sustainable entrepreneurial practices in Bangladesh include international customers’ requirements, value of individual owners and managers, educational and awareness raising activities, competitive gains, environmental regulations, maintaining reputation and industry dynamism. Although these drivers were identified in relation to Bangladesh, they could also apply to companies from different parts of the world.

However, achieving a sustainable supply chain in the leather industry could face two types of barriers such as causal – lack of awareness of local customers in green products and lack of commitment from top management and be influenced by lack of reverse logistics practices and outdated machineries (Moktadir et al., 2018a). Similarly, in another study, Uddin et al. (2019) revealed that the high cost of advanced technology is the most important barrier to the implementation of green supply chain management. Additionally key issues identified by Jaegler (2016) related to hide defects (caused by breed of animals, transportation or slaughterhouse conditions and inadequate trainings of actors), lack of specialised training and unbalanced involvement of relevant stakeholders. To overcome some of these challenges, Jaegler (2016) suggested measures such as education, building a public-private partnership, investment in the quality of hides and development of a sustainable model. Although some of these challenges are still posed to companies in the global leather supply chain, significant efforts are being made to address these challenges. Some of these efforts are being presently studied by the authors as part of future research.

Another key theme is sustainability reporting which involves organisations disclosing details of sustainability endeavours and/or performance over a period of time, either quarterly or yearly or bi-annually. After accessing the drivers to which companies publish reports, Śmiechowski and Lament (2017) found out that there was no proven positive correlation between pro-ecological actions of tanneries and sustainability reporting, due to the voluntary nature of reporting. Instead, legal regulations were reported to be the main cause of pro-ecological actions and the level of actions usually depends on factors such as headcount, business format/strategy and time in business. Comparing large and small businesses, it was stated that the latter do not usually prepare sustainability reports due to financial constraints,

but this does not translate to lack of pro-ecological actions. This information could be useful for policy makers and relevant actors when considering actions related to companies' reporting.

To conclude, the variety of themes identified proves the potential depth of factors that organisations should consider in developing holistic sustainability strategies.

5.2 Themes relating to the Social Dimension.

A significant finding related to the social dimension is the narrow nature of present literature, which has largely focused on health and safety, while other aspects have been underexplored as shown in **Table 3**. Due to the nature of the industry that uses vast amount of chemicals and potentially generates significant amount of waste (if left untreated or properly managed), there could be debilitating effects to employees and community in which tanneries are located. Hence, the rationale for the dominance of health and safety focused research could be justified. The review also suggests a positive contextual correlation and relationship between environmental sustainability practices and resulting effect on the health and safety of workers (Decouple, 2013; Garai, 2014; Syed et al., 2010). Also, lack of education on the dangers of working in tanneries without wearing protective equipment is regarded as the most significant health and safety issue in tanneries (Garai, 2014). Thus, relevant education is recommended to address this key issue. Other recommended solutions include developing necessary managerial and technical skills to handle sustainability-related concerns, practical applications of research findings into company's day-to-day operations and raising awareness of potential dangers of tannery waste to workers and environmental management education (Garai, 2014; Syed et al., 2010).

Table 3: Themes relating to social sustainability (Source: author)

Themes	Author(s)
Health and Safety	Syed et al. (2010); Garai (2014); Decouple (2013)
Enablers of Social Sustainability	Munny, et al. (2019)

However, while it is important to note that although the majority of these social sustainability related studies were carried out in emerging/developing economies (such as India, China, Pakistan, Bangladesh), this does not suggest the pre-dominance of poor health and safety practices in these countries. Instead, it presents an opportunity for researchers in this field to explore health and safety issues and practices of tanneries in developed countries, for

comparison and learning purposes. Additionally, other aspects of social sustainability such as practices relating to diversity and equality, fair treatment and respect of employees, work-life balance, could also be explored in other areas of the leather supply chain such as manufacturing/retailing and chemical companies.

5.3 Themes relating to the Environmental Dimension.

In the sustainable leather industry literature, the prevalence of research in the environmental aspect is still evident, as seen in the number of related articles identified in this study. Indeed, dominant discussions on the environmental aspect have been related to waste management and circular economy, pollution prevention and control, and green chemistry. Broadly, the "sustainable manufacturing techniques" theme relates to other themes mentioned in **Table 4** but not specific enough to be placed directly under the other listed themes. Hence, "sustainable manufacturing techniques" in the context of environmental sustainability could refer to practices that aim to prevent and manage pollution, manage waste efficiently, use green chemistry approaches, employ energy efficient methods and ensure a healthy life cycle of leather goods.

Table 4: Themes relating to environmental sustainability (Source: author)

Themes	Author(s)
Pollution management (prevention and control)	Kumar Gupta et al. (2018); Kanagaraj et al.(2015); Basu et al. (2019); Haque et al. (2019)
Life Cycle analysis	Joseph and Nithya (2009)
Green Chemistry	Krishnamoorthy et al. (2012); Sathish et al.(2016); Shirmohammadli et al. (2018); Qiang et al. (2018); Pandi et al. (2019); Mehta et al. (2014); Panda et al. (2016)
Waste Management and/or Circular economy	Selvaraj et al. (2019); Gupta and Gupta (2019); Hu et al. (2011); Kılıç et al. (2018); Raghava Rao et al. (2014); Li et al. (2019)
Sustainable manufacturing techniques	Dwivedi et al. (2019); Bacardit et al. (2015); Islam et al. (2018); Jayanthi et al. (2019); Pacheco et al. (2019)
Energy Efficiency	Moktadir et al. (2019a); Gerek et al. (2019)

Pollution management featured as a key theme in this dimension, with "medium" and "technology-based" strategies emerging towards pollution management (reduction and control). Medium based strategies suggest changes in the processing medium for the conversion of hides and skins to finished leather e.g. replacement of salted skin in a chromium salt tanning agent with a phosphonium based tanning agent, resulting in reduction in dissolved

solid wastes in effluents from 40000 parts per million to 5000 parts per million (Kumar Gupta et al., 2018). On the other hand, technology-based strategy could be interpreted as employing some form of improved technology/technique to improve processing efficiency that could eventually lead to reduced pollution loads of pollutants. For example, Kanagaraj et al. (2015) identified techniques such as enzymatic dehairing, improved biological methods for bio-degradation of dyes and azo-dyes, silica gels, boric acids etc, as suitable and better replacement for salt-based preservation. These techniques were suggested to reduce pollution loads related to toxic substances like chloride levels, biochemical oxygen on demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS) and total dissolved solids (TDS). Further details on these techniques can be found in the referenced articles.

Circular economy (CE) and waste management were also core themes discussed in the literature. These could be positively inter-related with other themes in the above table. Hu et al. (2011) concluded that CE model promotes sustainable production in the leather industry, as it demonstrates huge potential in cost savings and environmental pollution. Similarly, Selvaraj et al. (2019) discovered the potential use of fleshing waste derived nanofibers as a sound absorbing layer in acoustic applications. Also, Gupta et al., (2018) revealed that tannery scraps and wastes could be recycled and upcycled into organic manures, useful for plantations while similar studies also explored waste management themes (Gerek et al., 2019; Kılıç et al., 2018; Li et al., 2019; Raghava Rao et al., 2003). These studies provide examples that demonstrate the practical uses of tannery generated wastes to derive significant value, while ensuring optimum environmental performance of tanneries. Energy efficiency in wastewater treatment to ensure reduction in COD using a technology-based approach was explored by Gerek et al. (2019) while Moktadir et al. (2019a) explored international pressure and scarcity of natural resources as key the drivers to energy efficient supply chains.

Green chemistry represents the final major theme identified. Issues in this area are usually related to efficient use of chemicals, use of environmentally friendly chemicals that do not affect the quality of finished leather products and ensuring adequate chemicals uptake during the processing of hides and skins. It could be argued that authors in this area also proposed a medium and technology-based solutions to support green chemistry for sustainability. For example, Sathish et al. (2016) revealed that an alternative solvent medium (specifically, the application of "supercritical fluids and switchable solvents") has potentials for the development of waterless leather manufacture. Similarly, Krishnamoorthy et al. (2012)'s study employed "unnatural d-amino acids (d-AA)-aldehyde (Ald)" as a substitute for chrome tanning which

resulted in significant reduction in total solids content (TSC) in effluents and improved the biodegradability of organic compounds present in the effluents, compared to chrome tanning. On the other hand, Sathish et al. (2016) suggested a technology-based approach for future research, to explore dry tanning approaches that are capable of transporting the adequate amount of chemicals without any discharge to, using newer equipment engineering packages.

5.4 **Themes relating to the Economic Dimension.**

From a macroeconomic and microeconomic perspective, themes such as organisational efficiency, competitiveness, as well as consumer perceptions and behaviours can be rationalised to be related in the economic sustainability as shown in **Table 5.** However, it is important to note that these themes were not discussed in isolation, in fact, all the themes placed in these dimensions were discussed in relation to environmental sustainability and none in relation to social sustainability. This provides another finding and potentially a gap to explore the relationship between social and economic sustainability in the leather industry.

Table 5: Themes relating to economic sustainability (Source: author)

Themes	Author(s)
Competitiveness	Gupta et al. (2018b); Resta et al. (2018)
Customer perceptions and sustainable behaviours	De Klerk et al. (2019); Dekhili et al. (2019); Jung and Oh (2019)
Innovation for Efficiency	Horvathova et al. (2019); Kusum and Yinghua (2018); De Marchi and Di Maria (2019); Liedtke (2012); Hernandez Pardo et al. (2012).
Supply chain traceability	Marconi et al. (2017); Papetti et al. (2019); Jiang et al. (2018); Moktadir et al. (2019b)

Gupta et al. (2018b) explored how three different states in India have been leveraging on trade-offs in their focus on the triple bottom line to derive competitive advantage over others. These trade-offs were reported to be as a result of different policies and management practices in place in the three different states to push either of social, economic or environmental agenda. Thus, highlighting the potential practical impacts of policies towards the development of the triple bottom line. Resta et al. (2018) reported that business competitiveness (due to reported positive changes in brand value, access to capital, employee retention) of companies surveyed improved as a result of implemented practices relating to sustainable products and practices.

In relation to customer perceptions and sustainable behaviours, De Klerk et al. (2019) suggested that ethical concerns and strong value perceptions of individuals do not usually

translate to environmentally significant behaviours and consumer's purchase intent respectively. Similarly, Dekhili et al. (2019) indicated that sustainability information negatively impacts the perceived quality of luxury products, depending on the country in context using a case of France and Saudi Arabia, where citizens of the latter would lower quality evaluation when social information is provided as opposed to their French counterparts who wouldn't. This information could signify the need for more education to influence consumer behaviours and perception towards sustainable leather goods. This follows Jung and Oh (2019) who noted that the positive determinants of sustainable consumption beliefs are rooted in environmental knowledge and perceived economic effectiveness.

Regarding traceability, Papetti et al. (2019) and Joseph and Nithya (2009) revealed that the greatest environmental impact of the leather supply chain is derived from tanneries. As such, it is recommended that good logistics systems plays a key role, especially upstream (where the supply chain networks can be more fragmented, and suppliers dispersed worldwide) in ensuring better traceability of products (Jiang et al., 2018; Papetti et al., 2019). Furthermore, Moktadir et al. (2019b) suggested that reverse logistics could increase return-on-investment and give a competitive advantage to companies. However, as knowledge and support issues seem to be the most significant issue facing the adoption of reverse logistics practices (Moktadir et al., 2019b), the collaboration of tanneries in the supply chain is suggested to hold potential benefits, including reducing the complexity of networks, transport and associated environmental costs (Jaegler, 2016; Marconi et al., 2017).

Another key area explored by Kusum and Yinghua (2018); De Marchi and Di Maria (2019) and Horvathova et al. (2019) was how innovation leads to efficiency and improved competitiveness and sustainability of the leather industry. For example, Horvathova et al. (2019) demonstrated how the application of industry 4.0 principles to leather cutting could lead to cost savings and increased process efficiency, hence contributing to leather sustainability.

In conclusion, the variety of themes in the articles analysed show a wide spectrum of potential areas that sustainability managers can focus in order to implement sound and holistic sustainability practices. Again, the narrow nature of discussed themes in the social sustainability dimension, compared to economic and environmental sustainability, shows the needs for further research in the social sustainability dimension.

6 Conclusion, Implications and Future Research.

This study synthesises already existing knowledge on sustainability research in the leather industry in order to identify trends, explored triple bottom line themes and opportunities for future research. First, the trends demonstrate that sustainability researchers in the leather industry can potentially find useful information in the field from the predominant Journal of Cleaner Production and other journals named. Although, there is an indication that there is a continued increase in research that address all three dimensions of sustainability over the last 5 years, several of these studies have been carried out in the context of emerging and developing nations. This is contrary to the notion that sustainability studies have been lagging in these world regions. In fact, the impacts and size of the leather industry is significant in countries like China, India and Bangladesh, hence the skewness of sustainability research towards these regions should not emerge as a surprise.

Regarding key themes that have been explored, the study suggests the presence of in-depth research on aspects of environmental sustainability such as green chemistry, efficient energy and water management, as well as waste/effluent management. Core themes relating to economic sustainability include competitiveness, customer perception & sustainable behaviour, innovation for efficiency and supply chain traceability.

However, social sustainability stands out significantly as the most underexplored dimension out of the three dimensions, evident from the narrow themes presently explored. Present literature on social sustainability in the leather industry has chiefly been on health and safety practices (i.e. ways in which health and safety of employees, community, consumers are ensured). Hence, future research can explore practices relating to other aspects of the social dimension, such as diversity and equal opportunities, animal welfare, respect and protection of human rights, employee development and involvement and no use of forced or child labour.

Additionally, in several of the articles reviewed, the relationship between environmental practices and economic bottom line for leather companies were discussed. Also, the relationship between environmental sustainability practices and social sustainability practices (especially health and safety) have been well explored. However, further research can investigate the relationship between social and economic sustainability in leather-related contexts. This type of research can serve to improve the understanding of impacts of social aspects on the economic bottom line of leather-related companies. Additionally, leather

sustainability studies that are contextualised in developed economies can be explored to enable comparison of good leather sustainability practices between different regions around the world.

Furthermore, while the nominal number of published leather sustainability papers since 2001 has increased, future research could evaluate the number of sustainability papers against total leather research articles published within the time period, to obtain the absolute rate at which leather sustainability studies are gaining traction among researchers. Also, improvements could be implemented to extend the body of knowledge in this study. A comprehensive review was applied here due to its appropriateness, although other research analysis techniques can be employed in future research. Lastly, further research could explore research articles that were not written in English, as well as consider other sources of data beyond peer-reviewed journal articles, like books and conference proceedings.

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Conflict of Interest.

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been addressed by the authors.

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