Footprint of leather Industry on Environment: A Review

Trivendra Singh Ghritlahre1, Sushma Dubey1*

Department of Biotechnology Kalinga University, Naya Raipur Chhattisgarh

Sushma.dubey@kalingauniversity.ac.in

Abstract –

In this review, we are going to discuss the ecological, environmental, and social impact of the leather industry and the potential for sustainability within it. The process of transforming animal hide into leather involves the use of harsh chemicals, which can have significant negative impacts on the environment and ecosystem, both directly and indirectly. While many alternative methods for producing leather have been developed, the impact of leather production has yet to be fully overcome. This is because leather is still in high demand, and the alternatives are not yet able to fully replace traditional leather production methods. However, with increasing knowledge and awareness of the environmental and social impacts of the leather industry, more and more people are becoming concerned about the livelihoods of those impacted by the industry. There is a growing demand for more sustainable and ethical practices within the industry. To address this demand, alternative ways of producing leather are gaining popularity. For example, fruit leather is one potential alternative that is gaining attention due to its environmentally friendly production process. These alternatives have the potential to reduce the impact of the leather industry on the environment and create a more sustainable and ethical industry. Due to nature of material increase in demand with alternate ways has gained popularity like fruit leather.

Keyword: Leather, footprint, ecosystem, environment

Introduction –

Leather is the most important material from the ancient times. Our ancestors hunted animal for food and also for their hide to make leather. The leather was utilized for clothing, tent and as vessels. (Navarro et al., 2020) The improvement in leather produced occurred when tanning was discovered. Initially the leather was tanned with vegetable extracts (Koloka & Moreki, 2011). Further chrome has been utilized for tanning (Pati et al., 2014). Since then, industry evolved and industrialized. Due to industrialization and development of various chemical to be utilized in the production of leather has led to environmental hazards that are damaging the environment and the ecosystem. Beside demand it also gained the attention of everyone on its effect.

To monitor and to understand the process Life Cycle Assessment of leather is used. It helps in understanding how materials and energy flow throughout a system's entire life cycle is beneficial (*ISO 14044:2006(En), Environmental Management — Life Cycle Assessment — Requirements and Guidelines*, n.d.). LCA adopts a systemic, comprehensive approach in which all pertinent processes are investigated. Therefore, it can help to rethink and redesign products and procedures (Civancik-Uslu et al., 2019).

The leather industry uses up resources and emits harmful pollutants into the environment. For example, in the production of leather, to create just 200 kg of usable leather product, which contains 3kg of chromium, a massive one metric ton of raw materials is required. This means that a significant amount of raw materials is going to waste during the process. In fact, around 60% of the raw materials are transformed into waste.

The waste generated in the process comprises of different components. Firstly, 250 kg of non-tanned solid waste is created. Secondly, 200 kg of tanned waste, which also contains 3 kg of chromium, is produced. Lastly, 50,000 kg of wastewater effluent is generated, which contains 5 kg of chromium. It is essential to note that chromium is a highly carcinogenic heavy metal, which can cause severe environmental damage.

Overall, the process of producing leather from raw materials is a highly wasteful one, resulting in a vast amount of waste and hazardous substances. Only 20% of the raw materials are utilized in creating finished leather products, while the rest is transformed into waste that could potentially damage the environment and impact human health.(*Fibres, Textiles and Clothing | ITC*, 2022) (Sivaram & Barik, 2019).

The leather industry is struggling. Through global challenges. In the aspects of sustainability. Profit. And transparency. In supply chain.

The leather industry is struggling through global challenges in the aspects of sustainability profit and transparency in its supply chain. It will be very economic important to produce leather as the marketplace or the society is becoming environmentally conscious (Kılıç et al., 2023).

This review is to provide information to enable leather making company managers so they can analyze the environmental effect and perform the production process in more sustainable way.

Process of leather production -

The process of leather manufacturing can be categorize mainly in three part, (i) preparation stage or beam house stage, (ii) tanning, and (iii) post tanning stage (Suresh et al., 2001) (Sivakumar et al., 2010).

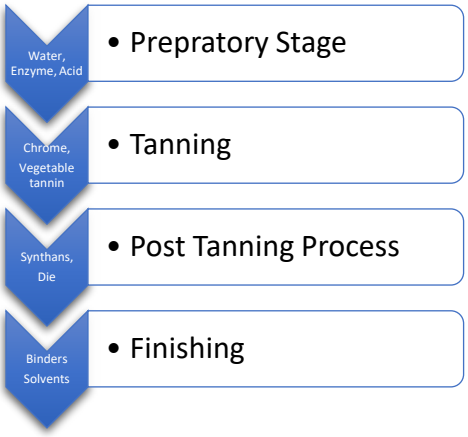

Figure 1. Input of Leather Production

There are several steps involved in producing leather, and they are usually done in tanneries. A general description of the procedure is provided below:

Leather Production Process	1. Pre-Treatment
	2. Soaking
	3. Liming
	4. Fleshing
	5. Deliming
	6. Bating
	7. Tanning
	8. Colouring

Pre-Treatment: The hides or skins are first given a treatment to get rid of any remaining flesh, fat, or hair(Saxena et al., 2018).

Soaking: After that, the hides or skins are soaked in water to become supple and malleable(Saxena et al., 2018).

Liming: The hides or skins are immersed in a lime solution to dissolve the skin's proteins and remove any remaining hair (Nazer et al., 2006).

Fleshing: The process of fleshing involves removing any remaining flesh and fat from the hides or skins after liming(Nasr, 2017).

Deliming: After treating the hides or skins with an acid to remove any remaining hair and flesh, the lime is neutralized(Deng et al., 2015).

Bating: To remove any remaining protein and make the leather supple and malleable, the hides or skins are then treated with an enzyme solution(Fuyi et al., 2020).

Tanning: Tannins, which can be either natural or man-made chemicals, are then applied to the hides or skins to make the leather more resilient to deterioration and durable. Vegetable tanning, chrome tanning, and synthetic tanning are a few methods of tanning.(Suresh et al., 2001)

Colouring: After the leather has been tanned, it is typically stained or dyed to give it colour(*The Characterization of Vegetable Tannins and Colouring Agents in Ancient Egyptian Leather from the Collection of the Metropolitan Museum of Art - Elnaggar - 2017 - Archaeometry - Wiley Online Library*, n.d.).

Finishing: To give the leather its final texture, and appearance different variety of finishing techniques, can be utelized such as buffing, embossing, and coating, are used.(Tamil Selvi et al., 2013)

Solid waste – From the preparation of rawhide to the use of various chemicals and dyes, leather processing is a multi-stage, resource-intensive process. The process of chrome tanning, which involves treating rawhide with chromium salts to create a resilient and adaptable material, is one of the most widely used methods for processing leather.

However, the tanning of chrome produces a lot of solid waste, and improper disposal of this waste can harm the environment. Tanneries typically divide this waste into five categories based on the various materials and chemicals that each category contains in order to manage it.

Tannery hair waste, or rawhide that has had its hair and other organic material removed during the initial preparation process, is the first category. Composting or gasification are two energy-producing options for this waste material.

The remaining trimmings and scraps from the rawhide that were not used in the tanning process are included in the second category, untanned solid waste. This waste can be recycled or used in other ways, like as insulation or mulch.

Solid leather waste with chrome, which is created during the actual tanning process, is the third category. This waste typically consists of leftover chromium salts in the form of leather shavings, trimmings, and other scraps. This waste must be carefully disposed of through incineration or other specialized methods because, if improperly handled, it can release toxic chemicals into the environment.

Tannery sludge, a byproduct of the wastewater treatment process used to remove extra chemicals and contaminants from the tanning process, is the fourth category. This sludge can be used as a soil conditioner or anaerobically digested to produce biogas. It is typically rich in organic matter.

The scraps and trimmings produced during the cutting and finishing phases of leather production are included in the final category of finished leather waste. This waste can be recycled to be used in other products or repurposed for other uses.

(*Materials | Free Full-Text | A Review of Keratin-Based Biomaterials for Biomedical Applications*, n.d.)

Liquid Waste – Due to the high concentrations of toxic chemicals they contain that have the potential to degrade the quality of water, the discharge of tanneries' effluents is a significant environmental concern. Tannery waste contains biodegradable organic material, specifically proteins and carbohydrates, which can cause the dissolved oxygen concentration in aquatic systems to drop(*An Ecotoxicological Approach to Assessing the Impact of Tanning Industry Effluent on River Health | SpringerLink*, n.d.). The discharge of effluents from tanneries is a significant environmental concern due to the high levels of toxic chemicals they contain that can lead to the degradation of water quality. Tannery waste is composed of biodegradable organic matter, specifically proteins and carbohydrates, which can result in the depletion of dissolved oxygen in aquatic systems due to the decomposition of micro-organisms. The decrease in dissolved oxygen levels can have a detrimental impact on aquatic organisms, leading to increased anaerobic activity and the production of harmful gases that can damage the nutrient profiles of aquatic organisms. Moreover, the reduction of dissolved oxygen levels can pose a severe risk to human health as it can lead to the spread of waterborne diseases such as cholera, infective hepatitis, typhoid, dysentery, and gastroenteritis. Therefore, it is crucial to address the issue of tannery waste discharge to protect both the environment and public health(Saha & Azam, 2021) (www.fibre2fashion.com, n.d.).

Air Polution - Our overall health and well-being depend on the air we breathe. Since the 1960s, air pollution has unfortunately grown to be a significant problem on a global scale, affecting both developed and underdeveloped nations. Because of the numerous harmful substances it contains, including particulate matter, heavy metals, carbon monoxide, carbon dioxide, benzene, N2O, PAHs, and NH3, contaminated air poses a serious threat to human health. These pollutants are produced during tanning processes, especially during finishing and post-tanning procedures (*Environmental Pollution: Its Effects on Life and Its Remedies by Mashhood Ahmad Khan, Arsalan Mujahid Ghouri :: SSRN*, n.d.; Hashem et al., 2014).

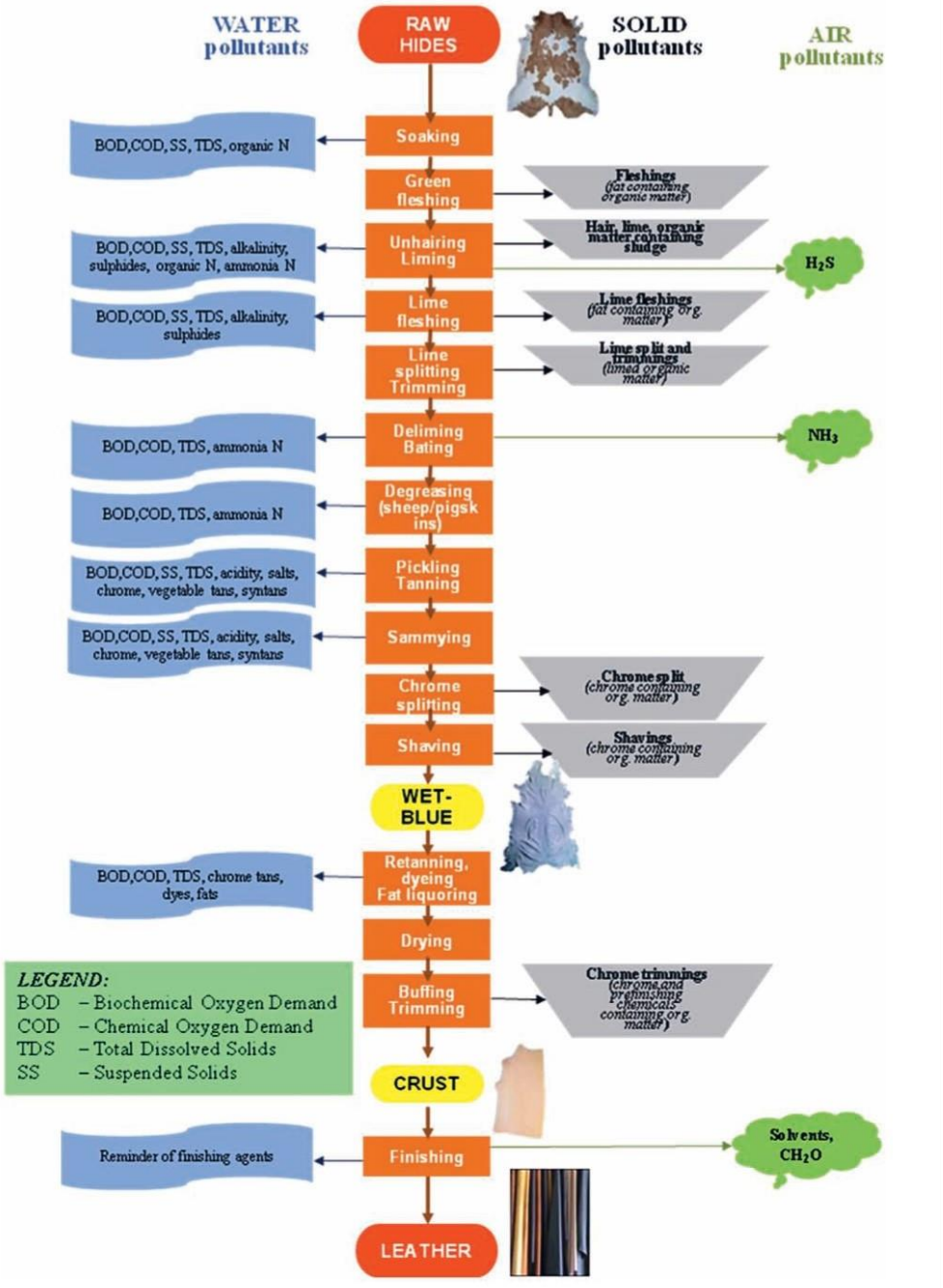

Figure 2.Introduction to treatment of tannery effluents UNIDO 2011

Main sources of leather are animal hides.

Conclusion –

From the above the conclusion can be drawn that leather from animal hide is most demanded industry yet most controversial in terms of fashion and daily use. There is a wide field of research can be seen to develop the leather from the plants and organic matters. Some of the alternet leather source can be

1. Dried fruit (Diamante et al., 2014)
2. Cork leather (Duarte & Bordado, 2015)
3. Mushroom leather (Elkhateeb et al., n.d.)

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