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Taming Fashion

Part two: A review of the negative effects of fur, wool, down and leather

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Taming fashion: A review of the negative effects of fur, wool, down and leather is the second part of the FOUR PAWS Taming Fashion series.

Read Taming Fashion: why reducing the use of animals is essential to achieving a truly sustainable fashion industry, part one of the series, for an overview of why the fashion industry must decrease its reliance on animal derived materials (ADMs). The report highlights how the industry's use of ADMs contributes to global environmental degradation and poses significant animal welfare risk. Fortunately, there are several solutions that fashion brands can implement now to reduce their impact on both the environment and animals. These solutions are outlined in both reports.

Executive Summary

In the second part of the Taming Fashion series by FOUR PAWS, we present a comprehensive assessment of the animal welfare and environmental impacts associated with four widely used Animal Derived Materials (ADMs): fur, wool, down and leather. We also highlight the various innovative materials that are both currently available and in development that provide more environmentally friendly and animal-free alternatives to ADMs. Our analysis of these materials draws on multiple sources, including insights into production processes, industry life cycle assessment (LCA) data, and expert evaluations of animal welfare.

While we should acknowledge LCA weaknesses and the need for independent environmental data, we must prioritise creating a sustainable planet and protecting all sentient beings. Taking immediate action based on available information is crucial.

What we found

Key animal welfare concerns

- Fur farming is inherently cruel, and no fur animal welfare certification can provide animals on fur farms with a life worth living.
- Sheep in wool supply chains are regularly subjected to mutilations such as mulesing and castration without adequate pain relief as well as stressful shearing practices, and long-distant transport.
- Geese and ducks continue to be at risk of live plucking and force-feeding in down supply chains. Many also suffer for extended periods during poorly managed slaughter systems.
- Cattle in intensive production systems, which are used for leather supply chains, are likely to experience negative states of welfare throughout their lives and rarely have their basic needs fulfilled.
- Even ADMs that adhere to recognised animal welfare certifications continue to carry a significant risk, as existing standards are largely geared towards the removal of specific cruel practices, rather than ensuring suitable levels of animal welfare as determined by experts.

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Key environmental concerns

- Wool and leather have a significant global warming impact, primarily due to being sourced from ruminant animals who emit large quantities of methane during digestion[1].
- Grazing large numbers of animals, such as sheep and cattle, contributes to major global land use change[2], deforestation and biodiversity loss[3], using 83% of the world's agricultural land[4].
- The carbon footprint of producing feed for these farmed animals is significant[5] and chemical fertilisers used in the production of animal feed contribute to eutrophication[6].
- Intensive animal farming requires significant amounts of water and can cause mass accumulation of faeces that can pollute local water bodies.

Resource intensive and environmentally damaging finishing processes

- Significant levels of heavy metals are used to process fur and leather including chemicals such as chromium and formaldehyde[7,8].
- Down is often processed using harsh chemicals, requires water-intensive methods to clean feathers, and involves extensive drying, all of which use significant amounts of water and electricity.
- Wool scouring, a resource-intensive step of wool processing, requires significant amounts of water and detergents to remove wool grease, a substance which is not readily biodegradable, and the combination can be harmful when disposed of.
- Wool and leather are typically treated with synthetic substances to prevent biodegradation, enhance durability, or, in the case of wool, to make it machine washable.

The current scale and nature of animal farming is both unsustainable for our planet and causes unnecessary animal suffering. Fortunately, material innovators have the capability to develop fabrics that are both animal-free and better for the environment than their animal-derived counterparts. We must support these innovators in their efforts to transform the fashion industry for the better and we can do this by reducing the excessive production of apparel and paying attention to the materials used.

Simply put, we must use fewer resources overall, especially ADMs, and transition to low-impact animal-free material choices and more sustainable, higher welfare supply chains.

Introduction

In the first part of this report series, we outlined the need for the fashion industry as a whole to address its use of ADMs due to their negative impact on people, the planet, and animals. In this second part, we take an in-depth look at some of the most widely used ADMs in fashion: fur, wool, down and leather. For each of these materials, we examine the key animal welfare and environmental issues present in their production, as well as specific industry practices that present unique concerns. We also highlight the various animal-free and environment-conscious alternatives to ADMs that are both readily available and in development, enabling ethical companies to prioritise their use.

Since most ADMs originate from the animal agriculture industry, there is often an attempt to categorise them as mere by-products. However, in reality, they hold significant economic value, leading to increased income or reduced expenses for growers or abattoirs. Unfortunately, a substantial portion of the animal agriculture industry relies on intensive farming systems, characterised by large-scale operations that are detrimental to the environment. Additionally, the animals within these systems are often subjected to inhumane treatment and confined in unsuitable environments that restrict their natural behaviors.

Fur, wool, down and leather are mostly produced in these large-scale and resource-intensive operations. The intensive farming of undomesticated animals for their fur is of particular concern as species farmed for their fur are wholly unsuited to life in confinement. Fur is also one of the few materials produced from animals farmed solely for their skins, and therefore warrants even closer attention to convey the enormity of unnecessary suffering inflicted in its production.

The harsh reality of animals' lives within these production systems, coupled with the significant environmental impact of producing ADMs, should provide ample reason for brands to minimise their utilisation of such materials and embrace change by transitioning towards innovative alternatives. Moreover, there are additional benefits to consider, such as protecting workers from the distress caused by traumatic experiences in abattoirs and on farms, enhancing the business's reputation, and fostering increased engagement from employees.

Fur

Of all ADMs, fur is the material most likely to cause collateral damage, not just in terms of inherent animal welfare risk, but also in terms of environmental impact and, as such, should always be avoided.

Key animal welfare concerns

Prior to the COVID-19 pandemic, an estimated 48 million mink, 16 million foxes, and 14 million raccoon dogs were killed to supply the global fur trade in 2019[9]. Following large-scale mink culls, global mink production has fallen sharply and was expected to be around 20 million in 2021[10]. Fur from farmed animals performs extremely poorly on animal welfare indicators and the suffering of animals trapped in the wild for their fur is also severe and extensive. The use of traps also poses a serious risk to animals other than those they were intended to catch and contribute to biodiversity loss[11,12].

Fur-farmed animals

Animal welfare conditions on fur farms across the world are extremely poor and result in prolonged and severe animal suffering, usually for the duration of the animals' lifetime:


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- Species such as mink, raccoon dog and fox are undomesticated and entirely unsuited to captivity. In the wild, they are wide-roaming predators, whereas on fur farms they are kept in tiny, dirty, wire mesh cages which prevent movement and the expression of their natural behaviours. This causes physical, psychological, behavioural problems[13], and increased cub mortality[14].
- Multiple undercover investigations on fur farms have documented inhumane handling methods for fur-farmed animals including beating, strangling, and dragging animals[15], as well as injuries that have been left untreated[16,17].
- Animals display abnormal behaviours such as stereotypies, fur chewing, or self-injury due to stress and frustration[18].
- Fur-farmed animals are generally slaughtered when they are a couple of months old using inhumane methods such as gassing for mink and electrocution for raccoon dogs and foxes, both of which inflict severe pain and distress[19,20].
- Foxes are selectively bred to maximise pelt size, resulting in pathological obesity, causing welfare problems such as foot deformities and abnormal locomotion[21].

Trapping of wild animals

- Millions of wild animals, including coyotes, foxes, bobcats, lynx and beavers are killed every year for the fur industry[22].
- Methods used to restrain and kill wild animals have significant welfare implications and the ability to cause severe suffering and pain. Wire neck snares and leg-hold traps, for example, rarely cause immediate death and result in immense pain and stress[23], the duration and severity of which depend on the time taken to retrieve the animal from the trap and the manner of their death[24]. Also, trapped animals can die of exhaustion, predation, starvation, drowning, shock, injury, or blood loss[25].
- Those animals who are alive when found are often brutally killed through drowning, suffocation, beating or have their chests crushed by trappers[26].
- The traps used to catch animals for the fur industry are indiscriminate and pose a serious risk to animals other than those they were intended to catch. Traps may also have a more severe impact on non-target animals[27], and are also a serious hazard to humans.

"These cruel traps don't distinguish between targeted animals and protected animals, endangered species or pets, and are a safety hazard to people. It's past time to remove this antiquated and inhumane practice from federal wildlife refuges."

– Corey Booker, US Senator[28]

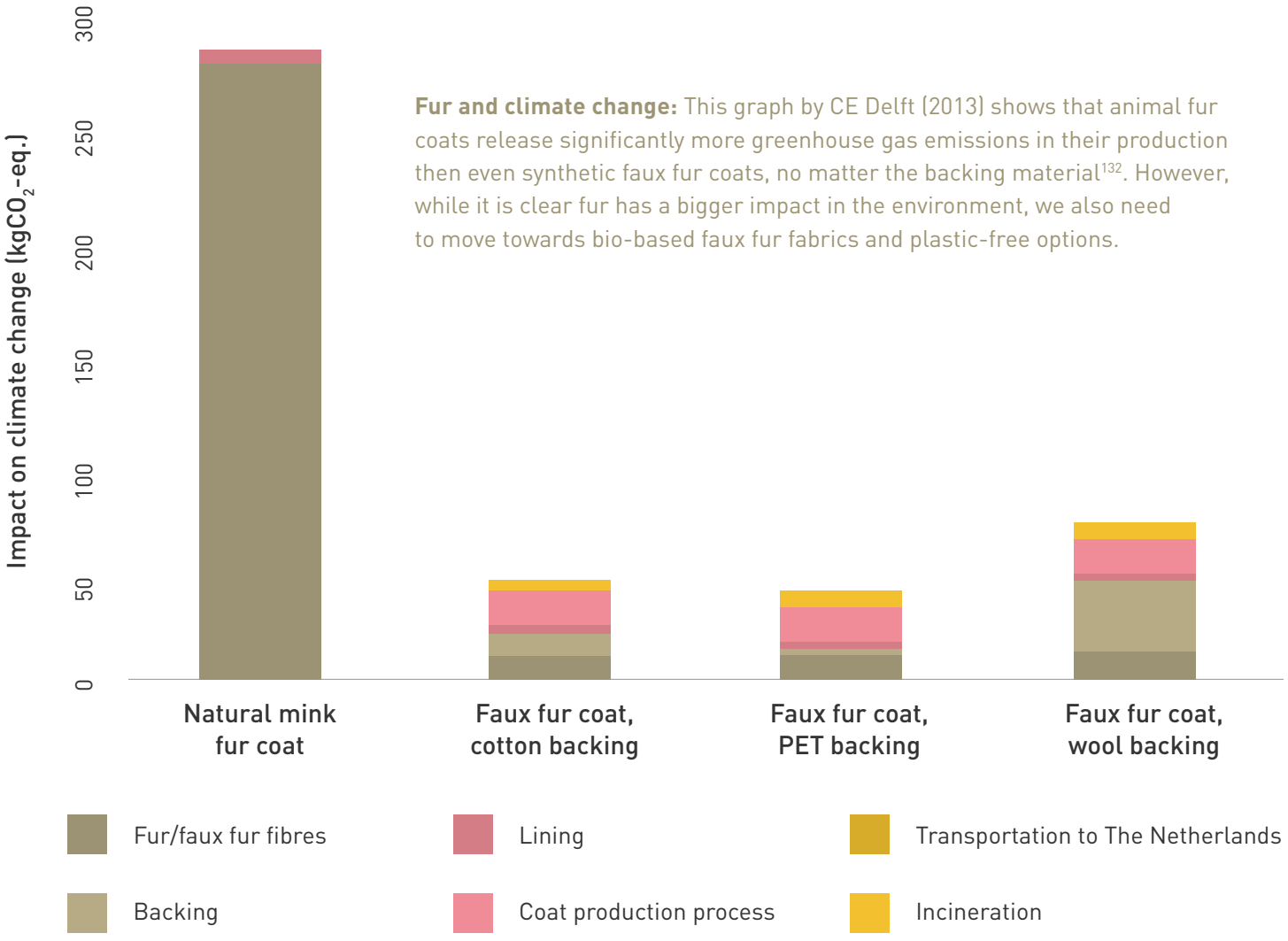
Key environmental concerns

Fur farming

- Like other intensive farming systems, the raising and killing of thousands of animals on fur farms has a severe ecological footprint, requiring high levels of energy consumption, as well as land use, water, feed, and other resources[29].
- Intensively farmed carnivorous animals such as mink require protein-rich diets to produce high-quality pelts and are often fed diets partially composed of fish, poultry and offal[30].
- Mink produce huge quantities of manure which may contain harmful pollutants and heavy metals that can find their way into local water systems[31], and can cause intense pollution and environmental problems[32].
- Extensive processing is required to prevent fur pelts from decaying. This requires consumption of significant quantities of water and the use of toxic substances such as formaldehyde[33].

- Fur farms typically use open-sided housing, which presents a biosecurity hazard as it facilitates contact with wild/feral animals, and fur-farmed animals are known to frequently escape into the surrounding environment[34].
- Fur farming poses a great threat to biodiversity. One third of the 18 'worst' alien mammal species in Europe[35] have been deliberately and/or accidentally introduced by the fur industry including the muskrat, coypu, American mink, raccoon, American beaver, and raccoon dog[36]. The American mink, the most important species in the global fur industry, can have significant adverse impacts once established and is now widespread throughout the EU[37].
- The environmental impact of fur is substantially greater than the environmental impact of other textiles and faux fur[38]. From raw material production to eventual disposal, the environmental footprint of a mink coat is many times higher than that of a synthetic fur coat[39].

"The climate change impact of 1 kg of mink fur is five times higher than that of wool. This is largely due both to the resource-intensive animal feed and to the nitrous oxide emissions from mink manure[40]."



Fur and climate change: This graph by CE Delft (2013) shows that animal fur coats release significantly more greenhouse gas emissions in their production then even synthetic faux fur coats, no matter the backing material[132]. However, while it is clear fur has a bigger impact in the environment, we also need to move towards bio-based faux fur fabrics and plastic-free options.

Trapping of wild animals

- Trapping is unsustainable in terms of its impact on wildlife populations and the environment[41].
- The indiscriminate nature of traps can sometimes result in non-target animals being caught, including endangered species, contributing to biodiversity loss[42].
- Historically, the fur industry has had a devastating impact on biodiversity and has led to the extinction of some species. Even though species are now killed on a scale that does not pose an immediate threat to the survival of the species, the trade in legal fur may also facilitate the trade in illegal fur[43].

Alternatives to fur

A substantial range of animal fur alternatives are readily available on the market. These alternatives are usually made from either acrylic or polyester or recycled non-ADMs. However, in addition to petroleum-based products, new materials are entering the market, such as BioFluff, made from natural plant fibres combined with biotechnology and 100% bio-degradable[44]. Other more 'out of the box' fur replacements are becoming increasingly popular, for example the use of recycled denim, made from frayed, repurposed denim which may not have the exact likeness, but can be used as a replacement, nevertheless. See Taming Fashion – Part One for a list of faux fur innovations.

Pre-loved faux fur © FOUR PAWS | Where Pigs Fly

Bottom line

Despite being touted by the fur industry as being of natural origin and therefore sustainable, the intensive nature of fur farming and its environmental impact outweigh any of its perceived natural benefits. The lives of animals on fur farms are typically characterised by severe deprivation, despite the various welfare assurance schemes implemented by the fur industry. These attempts will always fall short and fail to adequately address the fundamental failures of the industry. Additionally, fur farming continues to pose a significant threat to human health.

Wool

Raising sheep for wool production has multiple implications for animal welfare and the environment. Most sheep used for wool production are considered 'dual-purpose', i.e. can be slaughtered for meat when their wool production is no longer efficient or profitable, or producer income can be significantly supplemented by meat sales[75]. The environmental risk associated with wool is due to it almost always being a product of global commodity supply chains and because sheep, being ruminant animals that are often fed supplementary feed, produce high levels of methane, a key contributor to global warming[76]. Land use exacerbates the impacts of wool production, as does the fact that it also requires significant resource-intensive processing before it can be used as fabric.

Key animal welfare concerns

Although certifications for sheep wool have existed for longer than most other animal-based wools, there remain serious animal welfare issues associated with its production. The following factors contribute to the overall poor welfare conditions and mental state of sheep farmed for wool production:

- Many sheep are subjected to routine mutilation through mulesing (cutting away skin from a lamb's hindquarters using shears or by freezing the skin), tail docking, and castration without adequate pain relief[77].
- Sheep can be subjected to inhumane slaughter methods. In Australia, a lamb can be killed by a blow to the forehead and sheep can be bled out by neck cutting "when there is no firearm, captive bolt, or lethal injection reasonably available"[78].
- Sheep often experience pain and stress caused during shearing, a process that is particularly stressful for animals who are unfamiliar with human contact[79]. While shearing many breeds of sheep is now a necessity, this is due to humans selectively breeding sheep to continuously grow wool[80].

> "What makes Australia even more significant in the fashion supply chain, is that it is the world's leading producer of fine apparel (Merino) wool, growing 90% of the world's supply of wool that goes into making premium wool apparel."
>
> – Woolmark[81]

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"High mortalities from hypothermia have occurred in sheep up to four weeks after shearing, especially for sheep who have been shorn in summer and are conditioned to hot weather[82]."

- Feedlots are increasingly being used to increase sheep slaughter weight and increase profits; however, as grazing animals, this level of close confinement can be highly stressful for sheep[83,84].
- There is often inadequate provision of shelter and severe skin lesions due to sunburn are commonly observed[85].
- Sheep can be forced to endure long-distance live transport, a cause of significant suffering and even death, and many are sold overseas for meat once they are no longer profitable for wool[86,87].

"Mulesing is practiced in Australia which has a 22% market share of the global clean wool market and therefore the risk of sourcing wool produced with mulesing practices remains high if no traceability system is in place to ensure that the wool is mulesing-free."

– Textiles Exchange[88]

Key environmental concerns

Sheep farming

- GHG emissions associated with wool vary but, according to some figures, emissions for a kilogram of wool from a farm producing both meat and wool can be equal to 24.9 kg of CO_2 emissions[89]. As sheep are ruminant animals, they also emit considerable levels of methane during digestion (enteric fermentation)[90].
- Land clearing for sheep grazing is a particularly problematic aspect of the wool industry in countries such as Australia, which is often rated as having one of the highest rates of land clearing globally, and primarily for animal-based agriculture[91].
- Sheep farming produces significant amounts of manure which can cause eutrophication. This is particularly prevalent around sheep holding yards[92].
- Sheep farming can cause land degradation due to over-grazing[93], which in turn also negatively impacts biodiversity.
- Sheep are also a target for native predators, such as the Dingo, a native wild dog in Australia, and have been hunted to dwindling numbers over the past 200 years[94].

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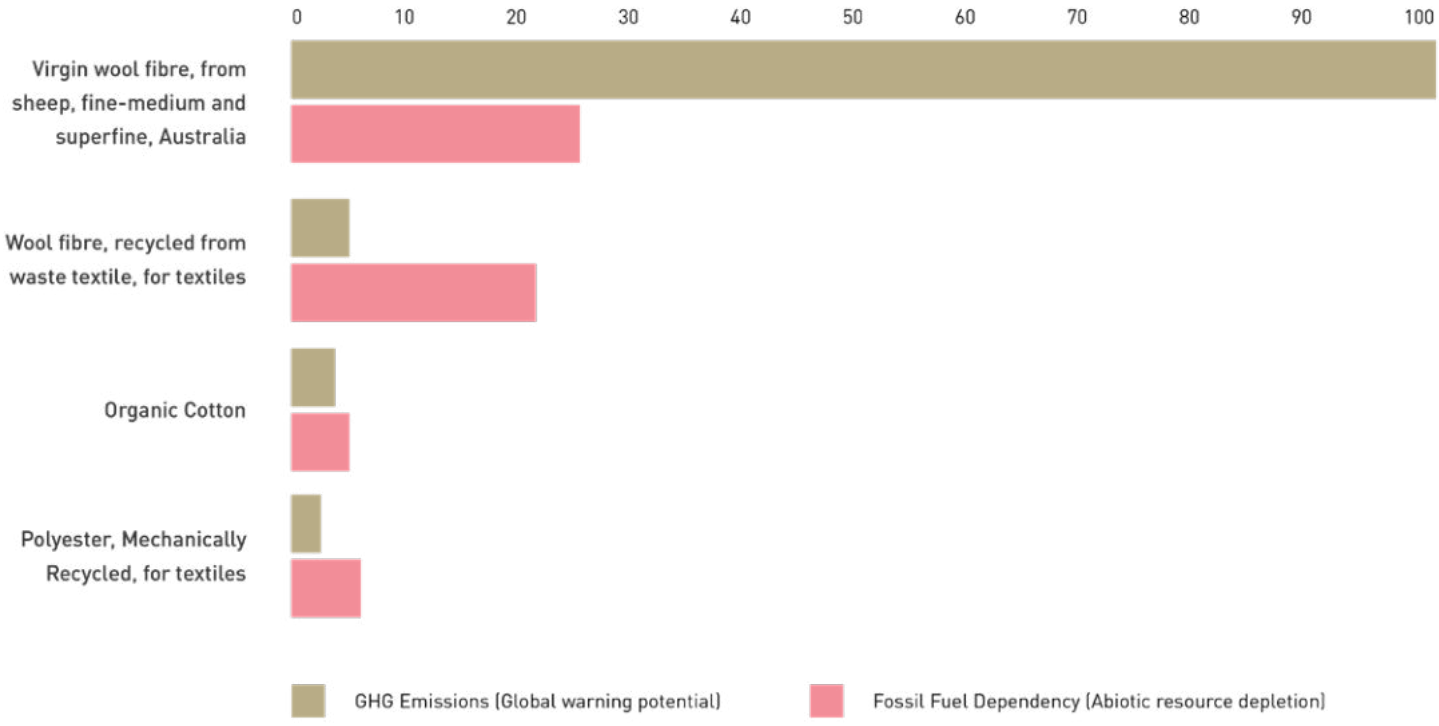
Wool processing

- Wool processing or 'scouring' requires intensive water usage and produces significant liquid waste[95]. It also involves chemical detergents such as alkylphenol ethoxylates which are human endocrine disruptors and can be toxic to aquatic life, when not managed well[96].
- The most common industrial method used to produce machine-washable wool, also known as 'super wash wool', is the chlorine-Hercosett process, a polluting process whereby wool is dipped in a chlorine bath causing the release of adsorbable organic halides (AOX), and then covered in plastic (nylon-based polymer)[97].
- Despite brands' desire to use wool, studies have found that of the wool products reviewed around half were blended with synthetic fibres derived from fossil fuels[98].

While wool has some superior qualities compared to polyester and cotton, the clear discrepancy in climate change impact between these fibres cannot be ignored. Although not all contributors of this report agreed on whether cotton should be included in the graphic, due to the differing qualities of the fibre compared to wool, it was ultimately deemed helpful to compare them since similar products are made from both fibres. Ultimately however, brands should consider a more comprehensive range of aspects, beyond criteria heavily linked to climate change, to get a more complete picture of the impacts of each material.



Wool and climate change: Considering the various environmental impacts present in the production of wool, when it comes to material selection, it is worthwhile noting the environmental performance of other materials with similar qualities. For example, according to the MSI, recycled wool, polyester, and organic cotton all perform significantly better against climate outcomes such as GWP and fossil fuel dependency than wool[99].

Alternatives to wool

There are currently a range of wool alternatives for fashion companies to choose from, from plant-based fibres such as hemp, Tencel, blends from Calotropis fibers and organic cotton, to newer and more complex next-gen materials such as Spiber's wool like fabrics made from a combination of cellulose with microbial fermentation[100]. See Taming Fashion – Part One for a broader list of wool alternatives.

> **"We feed sugar to microbes and they fermentate and produce polymers."**
>
> – Spiber [101]

Until very recently, the main alternatives were petro-chemical-based (typically acrylics or polyester), and these fibre families indeed still represent the bulk of commercialised 'wool-like' products. However, the first plant-based and innovative tech-based wool solutions are now becoming increasingly available. While a lack of economies of scale still hampers availability and price, some of these technologies are being used to develop 'hair-like' fibres of various degrees of fineness, including that of cashmere, mohair, and alpaca, and these technologies represent an interesting offer. Wool-like materials are currently being developed using soybean protein fibre, made from leftover soybean pulp from tofu or soybean production, and tree-free lyocell fibre, made by converting waste products into microbial cellulose[102]. The science behind these techniques is increasingly efficient.

Bottom line

Wool production is linked to negative environmental impacts of intensive farming practices and sheep are ultimately subjected to the same welfare issues often present in the meat and slaughter industry. It is rare for sheep kept for wool production to be kept more than half their natural lifespan[103], and there are various concerns for sheep health and wellbeing throughout their lives. Wool processing is also resource intensive and can cause severe negative implications for the environment.

Down

The global production of duck and goose down is inherently connected to the poultry meat farming industry, which continues to experience significant growth. It is worth noting that nearly 80% of duck down and feathers are produced in China[104], a region with limited legislated welfare protections[105]. Poultry farming, in general, is characterised by highly intensive practices that not only raise concerns about animal welfare but also result in a substantial environmental footprint due to the implementation of intensified growth methods[106].

Key animal welfare concerns

- Down is high risk from an animal welfare perspective, despite the existence of at least two widely recognised down standards: the Responsible Down Standard and Downpass.
- Live plucking of ducks and geese has been repeatedly exposed and results in bleeding and tearing of skin, causing pain, discomfort, stress and in some cases even death[107].

"Breeding ducks and geese are at higher risk of live plucking because they are often kept for up to 4 to 5 years and can be subject to live plucking more frequently than animals kept for meat. Some can be plucked up to 16 times during their lifetime[108]."

- Poor housing is common, including over-stocking, and no access to water for birds to bathe in – a behaviour critical for the mental welfare of ducks and geese[109].
- Birds can be subjected to painful mutilations such as bill trimming, which involves removing a portion of the bill with a hot blade to prevent ducks from feather pecking (often a result of overstocking density)[110].
- Some down comes from ducks and geese slaughtered for foie gras production who are subjected to cruel practices such as force-feeding[111].
- Birds used in down production are still slaughtered for meat, which can subject birds to numerous negative welfare consequences such as consciousness during bleeding, heat stress, cold stress, prolonged thirst, prolonged hunger, restriction of movements, pain, fear, distress and respiratory distress[112].
- Ducks are usually electrically stunned via the head before slaughter in a stun bath, but investigations have revealed that ducks often lift their heads, missing the stun bath and are consequently slaughtered whilst fully conscious[113]. Other legally acceptable methods of killing ducks are decapitation, transection of the spinal cord, and cervical dislocation[114].

Key environmental concerns

Duck and goose farming

- The main environmental impacts of down relate to industrial poultry farming practices. These impacts include issues concerning air quality, such as odour and dust that contain skin fragments, faeces, microorganisms, and other pollutants[115].
- Additionally, there are concerns related to farm catchment soil and water protection, as well as hazards associated with the disposal of waste and dead birds[116].

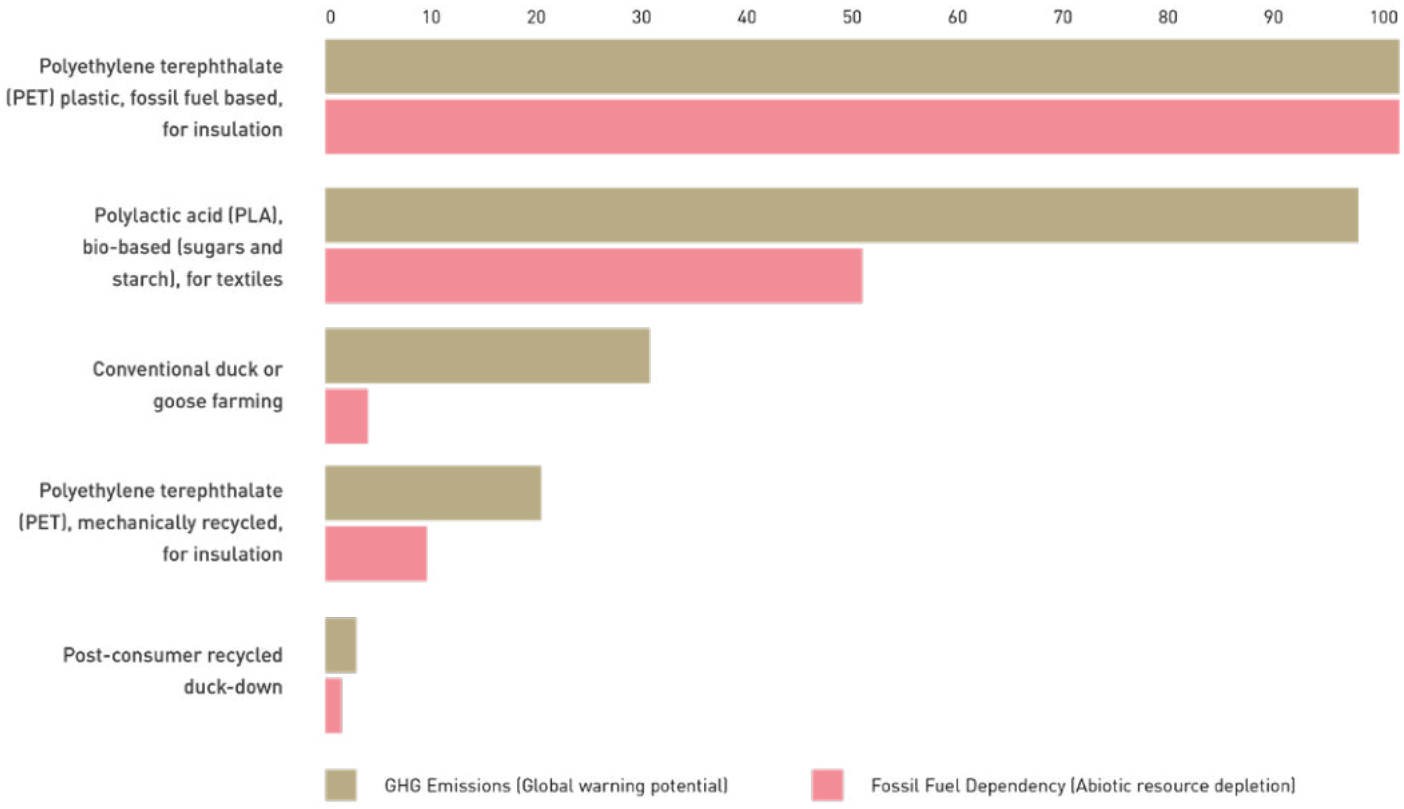
- Intensive poultry farming has become one of the most significant emissions of agricultural surface pollution[117], with high levels of nutrient run-off from manure[118] which can leach into waterways and cause eutrophication[119].
- Cleared land is required to intensively house large quantities of ducks and geese, requiring infrastructure such as electricity, gas, water and road/transport services[120].

"Poultry production and waste by-products are linked to NH_3, N_2O and CH_4 emissions, and have an impact on global greenhouse gas emissions, as well as animal and human health[121]."

Down processing

- The down production process requires feather sorting (removing feather and down from coarse feather and down), to the refining process and pre-washing stage as well as the disposal of waste products via incineration and landfill[122].
- The cleaning and drying phases of down are resource intensive. Feathers are rinsed three to five times and a large amount of water is needed to remove all residue[123]. The drying phase requires both heating and cooling so that moisture is completely removed before down is packaged[124].
- Down can become more allergenic over time and is therefore subjected to several kinds of chemical treatments which can pose a major risk to human health[125] and which produce wastewater that can have negative impacts on ecosystems.

Down and climate change: According to the MSI, recycled PET and post-consumer recycled duck down perform significantly better against climate related outcomes such as GWP and fossil fuel dependency than virgin down[126]. While a key focus of our review is the climate impacts of ADMs, in the case of down, MSI data also indicates that eutrophication and chemistry dimensions perform relatively poorly[127].



Alternatives to down

Most insulation alternatives available on the market today are developed using virgin or recycled petro-chemical ingredients (typically polyester), although some more recently developed alternatives are using completely or more bio-based components. It is only recently that plant-based options have come into development, such as flower down and wild kapok fibre[128,129]. Additional down alternatives are likely to be developed in the future. See Taming Fashion – Part One for a broader list of down alternatives.

Bottom line

Ducks and geese used for down production can be subjected to the same negative welfare outcomes as many other animals in intensive farming and slaughter systems, including inappropriate species environment, painful husbandry practices, and often ineffective stunning and slaughter methods. From environmentally damaging farming practices to resource-intensive and polluting down processing, the production of down also has various negative implications for the environment. It is time for brands to significantly reduce the use of down and instead transition to alternative cleaner and lower impact supply chains.

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Leather

There are major sustainability challenges throughout the entire leather supply chain from farm of origin to finished leather. Leather sustainability certifications can be problematic, and traceability can be challenging for brands, particularly when investigating lower tiers of the supply chain and the source farms of cattle[45].

> "While the Leather Working Group (LWG) claims that it will address deforestation in the future, they currently only rate tanneries on their ability to trace leather back to slaughterhouses, not back to farms, nor do they provide any information on whether or not the slaughterhouses are linked to deforestation."
>
> – Stand.earth Research Group[46]

Relying on Leather Working Group (LWG) certification will not guarantee deforestation-free leather supply chains, nor adequate animal welfare.

Even within certified supply chains, the welfare of cattle can be heavily compromised as they are at risk of being subjected to systemic suffering, pain, and distress at almost all stages of production. They are likely to experience negative states of welfare throughout their entire lives in production systems and often do not have their basic needs met.

The most notable environmental impacts of leather are largely due to the detrimental impacts of cattle farming including deforestation, water and land overuse, as well as significant GHG emissions. The leather tanning process is also highly toxic and has severe negative implications for workers, nearby waterways, and public health.

> "It (animal welfare) exists prior to the leather-making process and is therefore not included in the LWG Audit Standards."
>
> – Leather Working Group[47]

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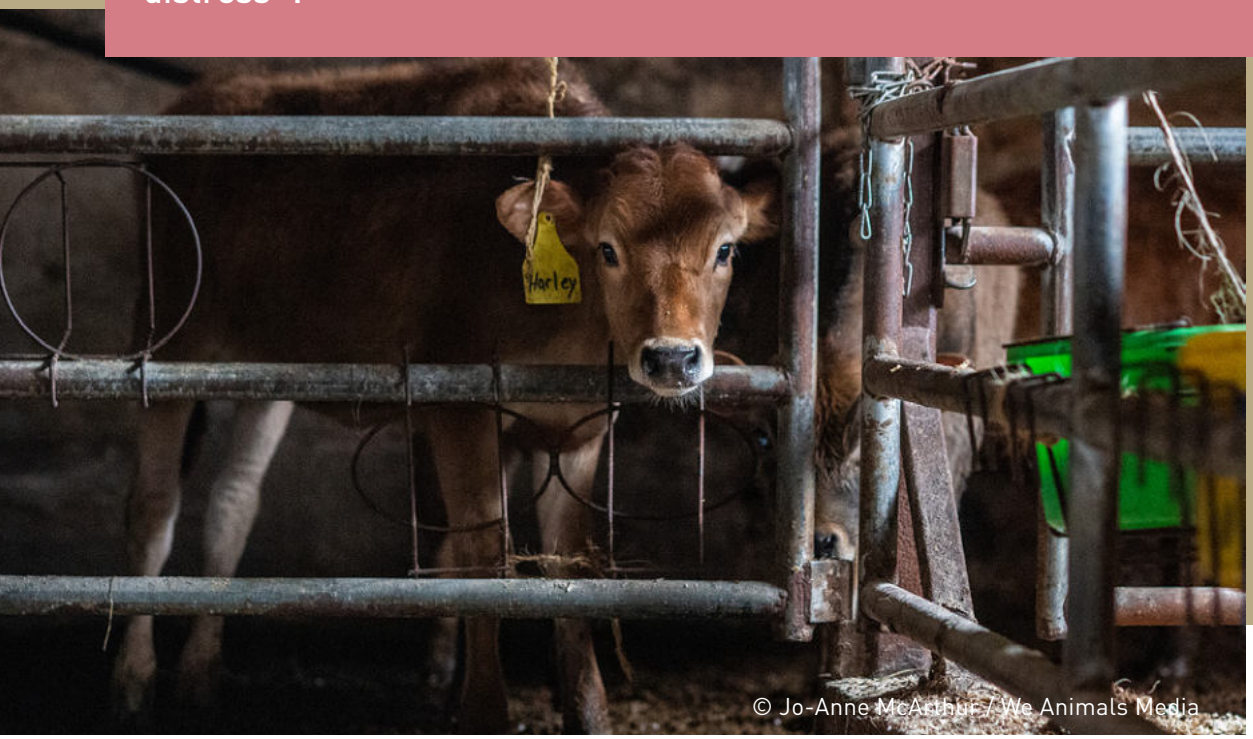
Key animal welfare concerns

- Over 1.5 billion cows are farmed globally for meat, dairy and leather. They are increasingly being put into feedlots, and in the U.S. alone feedlots marketed 25,132 million fed cattle in 2020[48], while Australia keeps 50% of all cattle in feedlots[49].
- There are severe welfare risks for the welfare of cattle throughout all stages of slaughter including temperature stress, fatigue, prolonged thirst and hunger, impeded or restricted movement, injury, social stress, extreme pain, fear, and general distress[50].
- Cattle are often forced to endure extensive transport to slaughter, spending several hours or even days, in severely cramped and distressing conditions with little or no access to food or water, and often without rest[51].
- The separation from bonded relatives, particularly mother and child, and the regular disruption of group dynamics, as well as isolation of animals, disregards their social needs. This deprivation of a normal social life can cause lifelong suffering[52,53,54].
- Cattle are subjected to inhumane branding, and painful mutilations, such as dehorning or castration, usually without any pain relief[55,56].
- Many cattle are housed in feedlots without shelter and experience ongoing welfare implications such as muddy, unhygienic conditions and heat stress[57].
- Cattle are often subjected to overuse of antibiotics[58], highly concentrated diets that can be detrimental to their health, and prevented from accessing outdoor areas or pasture.

"Inadequate pre-slaughter stunning is not uncommon[59] and ineffectively stunned animals may be conscious while their necks are cut, causing suffering and distress[60]."



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Key environmental concerns

Cattle farming

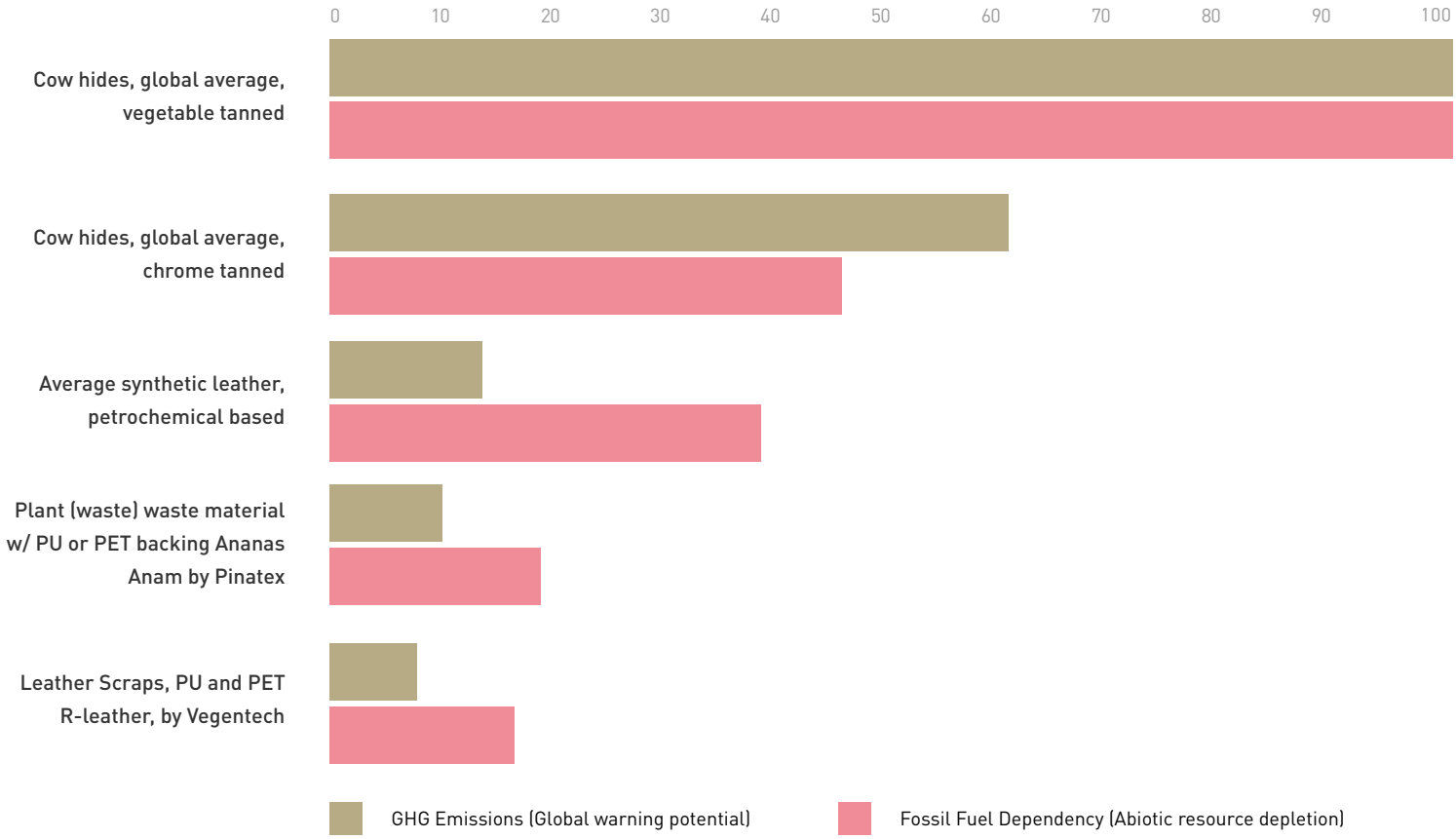
- As ruminant animals, cattle emit significant levels of methane into the atmosphere via digestion through a process called enteric fermentation, making them considerable contributors to GHG emissions[61].
- Land clearing is widely recognised as a highly damaging aspect of the cattle industry, especially in sensitive geographies such as the Amazon biome in Brazil, where the cattle industry is the biggest driver of deforestation[62].
- The beef industry has also been linked to an astounding 94% of land clearing in Australia's Great Barrier Reef catchments, areas in desperate need of healthy natural ecosystems to better protect the reef[63].
- Cattle farming requires significant water use[64], and manure accumulation from farms can cause high levels of eutrophication in local water systems[65].
- Fossil fuels are heavily used throughout most cattle farming production systems, including to run slaughter equipment and to transport animal carcasses and skin.

Tanning

- Tanneries use astonishing amounts of water. The annual water footprint of tanneries in just Bangladesh, a country known for producing high-quality fine-grain leather[66], and the eighth largest footwear producer, is staggering[67]. Average blue water usage (surface and groundwater) is around 7.45 billion litres, and grey water usage (volume of freshwater that is required to dilute pollutants enough to maintain water quality) is 1.55 trillion litres[68].
- Leather tanning is chemical-intensive and produces high-volume effluents with high pollution load. It is estimated that only 20% of chemicals used in the tanning process are absorbed by the leather, and the rest is released as effluent[69]. A high percentage of leather production is still reliant on chromium tanning[70].

"Vegetable-tanned leather is often marketed as a more environmentally friendly product than chromium-tanned leather; however, the Higg MSI analysis, along with various other studies, do not support this claim."[71]

Considering the significant environmental impacts caused by leather production, when it comes to material selection, it is worthwhile noting the environmental performance of other materials with similar qualities. According to Higg's MSI, there is a long list of alternatives that appear to perform significantly better against climate outcomes such as Global Warming Potential and fossil fuel dependency than animal-based leather.



Leather and climate change: This graph using data drawn from Higg Material Sustainability Index Methodology and Data Version 3.5 (MSI) (last updated: December 2022) indicates the global warming and fossil fuel dependency in leather supply chains in comparison to alternative materials of similar functional attributes.

The average Global Warming Potential (GWP) score of materials relates to the greenhouse gases emitted during raw material production, and in the case of leather, also includes initial tanning processes to prevent decay. Fossil fuel dependency relates to the energy from fossil fuel usage during raw material production and basic processing of the hide. This includes the use of fossil fuels used in farm tractors and transport, through to the use of fossil fuel based energy during processing, and energy sources used to power various equipment.

In addition to what the MSI has depicted, the United Nations Leather Panel shared a study which calculated bovine skin leather emissions to be 110 kg of CO_2e per square meter, versus artificial leather being 15.8 kg (but this calculation also includes incineration)[72]. This indicates that bovine skin leather could be nearly seven times more climate impactful. While FOUR PAWS is also concerned about fossil fuel-based materials, it is worthwhile noting the different calculations both indicating animal-based leather performs particularly poorly when it comes to greenhouse gas emissions.

Alternatives to leather

The range of leather alternatives available to fashion companies is especially growing. Most alternatives currently available in the mainstream market, polyurethane (PU) for example, are petrochemical based and, as such, draw from non-renewable resources. While both animal-based leather and PU typically require harsh and harmful chemicals to be used in their production processes, next-gen leather alternatives have the potential to perform far better.

An exciting new material MIRUM® developed by biotech company Natural Fiber Welding, for example, claims to be a fully recyclable, plastic-free, high-performance material based on agricultural waste and coated with plant-based oil resin[73].

Encouragingly, it is in the context of leather alternatives that the highest number of, and the most interesting, novel alternative technologies are being developed, piloted, and scaled-up. Mycelium-based solutions are particularly popular and advanced and appear to have reached a technological maturity stage compatible with the demands and requirements of global fashion brands, as well as innovation in precision fermentation using microbes. Furthermore, when it comes to plant-based, several suppliers offer the opportunity to use a previously discarded material (plant waste) as a basic ingredient material, diverting waste from landfill.

"MIRUM® emits up to 10x less greenhouse gasses than synthetic leather-like materials & conventional chrome-tanned leather."

– Natural Fibre Welding[74]

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Bottom line

The demand for, and use of, leather actively supports and fuels the expansion of the cattle farming industry, thereby perpetuating the detrimental consequences it has on animal welfare, the environment, workers, and communities affected by water pollution.

Given the significant environmental harm caused by leather production, it is imperative we especially reduce use of leather. Furthermore, considering the substantial challenges associated with traceability in leather supply chains, and the inherent difficulties in ensuring animal welfare, coupled with the abundance of alternative materials available, all companies should prioritise making a commitment to reduce their reliance on animal-derived leather as an urgent priority.

Data use and limitations

Consumers seek concise information about the impacts of the clothing they wear. Yet generating simple yet meaningful pieces of consumer-facing information requires extensive calculations, and how this is done has been increasingly under scrutiny.

Life Cycle Assessments (LCAs) are one of the main scientific environmental impact assessment methods available for fashion brands to use. However, the reliability of LCA results depends on the quality of the data and its application. Considering the controversy surrounding this topic, we chose to conduct a literature for our report. This approach provides a broader perspective while considering the interconnectedness between food and fashion industries, as well as referencing current data.

The data displayed in the per domesticated material sections within this report were based on the MSI material type averages or proprietary data. The graphics include only a few materials to highlight the range and provide some insight, but are by no means an exhaustive list. We focused on indicators heavily linked to climate change due to the climate emergency; however, other impact categories should also be considered.

Due to publicly available data limitations, these graphs do not necessarily show the best or worst in class, and there may be many examples of next-gen materials that could outperform what is shown. Similarly, some specific ADM supply chains may perform better than those displayed. The data does not represent information on end of life or durability, nor does it address consumption trends, and is not necessarily the most up to date[130]. Furthermore, the graphs do not highlight land use change impacts (e.g. deforestation) required to farm animals, plants or extract other materials, and these are not factored in to MSI calculations. In saying this, the Higg BRM claims to enable biodiversity and deforestation measurement, and brands are encouraged to encompass these aspects into their measurement[131].

While the MSI data has limitations, it does remain one of the most comprehensive data sources available. In saying this, there are also several data sources which could also be considered when developing a robust picture of the impact of materials, for example Arbor, Doconomy, Datia or Textile Exchange tools. These databases will often give differing results per material, and hence the need to consider impacts from multiple sources appropriate to your needs.

Focusing now on next-gen material measurement, there are some white spaces within this movement that also need to be addressed. These include:

- Updated inventory or lack of datasets for bio-based and lab-grown materials
- Data vetting and transparency
- Lack of consistency in evaluation and reporting
- Benchmarking and interpretation of LCAs

Fortunately, organisations such as the Material Innovation Initiative (MII) are recognising these needs. MII has recently launched the Environmental Data Coalition, which aims to bring together key stakeholders to identify and discuss the issues that persist in LCA analysis within the next-gen material industry. This initiative aims to promote collaboration, transparency and sharing data. In addition, the European Commission's Product Environmental Footprint standard will hopefully also go a long way to harmonise impact measurements and enable companies to make LCAs according to unified standards.

However, in addition to these areas, numerous aspects remain unquantified across all material types. These include overharvesting of renewables, biodiversity loss, animal welfare, economic disparity, and more. Therefore, while LCAs are essential tools, we must actively consider all ethical aspects when it comes to raw material extraction and product development.

Conclusion

This report has shone a light on the often-ignored negative impacts of ADMs in fashion. Our overview of the individual impact of each of the four most widely used ADMs provides a strong case for fashion brands to make robust commitments to reduce the use of ADMs in their supply chains, and to rethink their material sourcing to include more innovative, animal-free, and environmentally preferred materials.

It is a sad indictment of the fashion industry that despite the clear suffering of billions of sentient animals in their supply chains, consideration for their welfare is often an afterthought, if acknowledged at all. We have outlined the myriad ways in which animals are subjected to inhumane treatment in the production of ADMs and shown that most animals in these supply chains are at risk of experiencing negative affective states, rarely have their basic needs fulfilled, and in many cases, the level of welfare they experience is so poor that they do not have a life worth living. Even ADMs from supply chains that adhere to recognised animal welfare certifications, while helpful, still cannot guarantee a high standard of animal welfare.

We have also shown that the production of ADMs poses a significant threat to the environment, and that the assumption that ADMs are 'natural' and therefore more environmentally friendly simply does not stack up in line with the evidence.

Brands can no longer rely on the idea that ADMs are simply by-products and that their use in fashion is without significant impact. The fashion industry's unfortunate preference for ADMs continues to uphold harmful intensive farming industries, and in turn, contributes to their substantial negative impact on animal welfare and the environment.

Fortunately, there are many steps ethical brands can take to reduce their reliance on ADMs, as outlined in the first part of this report series. From replacing

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ADMs with more sustainable animal-free alternatives such as recycled non-ADMs, or if continuing to use ADMs, refining processes to encourage higher levels of welfare within animal-based supply chains, to embracing next-gen materials, there are so many actions brands can take right now to reduce the negative impacts of their material sourcing.

We also encourage further investment and knowledge sharing around LCA data for materials. Although more input is needed to improve the data currently available, we must act now with the information that is available to us.

We hope this report helps to both drive and inspire fashion brands to make more ethical decisions in their material selections. With such significant numbers of animals being subjected to inhumane treatment and practices, and with the various negative implications for the environment from their use so abundant, it is imperative that brands publicly commit to reduce their use of ADMs and by a set timeframe.

Contributors

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Limitations

This report has been developed to support companies in making a broader assessment of the environmental and animal welfare impacts of animal-derived materials in their supply chain. While comprehensive data, which considered all CSR risks and builds a more comprehensive picture is currently lacking, we have drawn on the data available to us. It is also important to note that the differences between materials in terms of quality and performance are not included in this report.

The conclusions drawn for the environmental component of this report rely on a variety of data, including from the Higg Material Sustainability Index (Higg MSI) which itself has several limitations. For example, the Higg MSI does not measure end of life impact of materials, nor does it account for biodiversity loss or land use changes. As these factors are not typically included in Life Cycle Assessments (LCAs) or Higg MSI data, the environmental impact risks may be even higher than those highlighted in this report. We chose to consider the Higg Index, as despite the controversy, for high-level sustainability analysis, it remains accessible, provides broad-level data, and enables users to gain a sense of how materials compare.

It is expected that some of the information presented in this report will change over time as tools for measuring the impact of materials are improved and as data for new and innovative materials is made available. These documents may therefore be reviewed and re-issued periodically. Information included in this report should be considered in conjunction with other data sources, considering the purpose for which insights are intended.

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Animal Welfare.
Worldwide.

About FOUR PAWS

FOUR PAWS is the global animal welfare organisation for animals under direct human influence, which reveals suffering, rescues animals in need and protects them. Founded in 1988 in Vienna by Heli Dungler and friends, the organisation advocates for a world where humans treat animals with respect, empathy and understanding. The sustainable campaigns and projects of FOUR PAWS focus on companion animals including stray dogs and cats, farm animals and wild animals – such as bears, big cats and orangutans – kept in inappropriate conditions as well as in disaster and conflict zones. With offices in Australia, Austria, Belgium, Bulgaria, France, Germany, Kosovo, the Netherlands, Switzerland, South Africa, Thailand, Ukraine, the UK, the USA and Vietnam as well as sanctuaries for rescued animals in eleven countries, FOUR PAWS provides rapid help and long-term solutions.

FOUR PAWS has achieved many lasting improvements for animals used within the textiles industry, including:

- Launching the Wear It Kind animal-friendly fashion programme which encourages and advises brands on how to develop and implement meaningful animal welfare policies and has been supported by over one million people internationally.
- Continued support of the highly successful Fur Free Retailer programme, a global initiative run by Fur Free Alliance member organisations which over 1,500 brands and retailers have joined to stand united in their commitment against the use of fur.
- Exposing the cruelty of mulesing in the wool industry – over 350 brands have since expressed their opposition to the use of wool from mulesed sheep.
- Working with the European bedding and global outdoor clothing industries to lead a successful transition away from using down from live-plucked and force-fed ducks and geese.

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