

Environmental Risks & Impacts – likelihood and intensity

Environmental risk & harm ¹	Types of harm	Likelihood of harm in specific processes or materials	Factors increasing likelihood	Factors increasing intensity	Sources of risk information
Air pollution The release of non-greenhouse gas pollutants into the atmosphere, leading to poor air quality unhealthy for humans and nature	<ul style="list-style-type: none"> Air pollution continues to exceed the World Health Organization's limits and guidelines in most regions around the world. Poor air quality can result in human health impacts such as respiratory issues and cancer. It can also affect plants, animals and ecosystems 	<ul style="list-style-type: none"> Air pollution can be emitted during the extraction or processing of raw materials including mining, fracking, smelting, farming, burning of crop residues Manufacturing facilities can emit air pollution through <ul style="list-style-type: none"> Processes such as gluing, sanding, grinding dyeing, finishing Burning of fuels resulting in non-Green House Gas (GHG) emissions Air emissions can be emitted in logistics through fumes from trucks, ships, airplanes or other modes of transport 	<ul style="list-style-type: none"> Poor regulation of air emissions at country or regional level can result in raw materials producers or manufacturers emitting high levels of pollution Lack of awareness of alternative practices (e.g. crop residue burning) or lack of access to improved technology (e.g. biofuel boilers) can make emissions more likely Specific materials such as virgin synthetics and rotation crops have a higher likelihood of air pollution emissions 	<ul style="list-style-type: none"> Existing air quality issues in the relevant geography will reduce the ability to absorb specific impacts and increase the cumulative intensity of harm Proximity to human settlements or important ecosystems may also increase the intensity of harm on people or nature 	Berkley Earth The Environmental Performance index
Animal Welfare The care and protection of the health and well-being of animals	<ul style="list-style-type: none"> Poor animal welfare practices can lead to animals suffering fear, distress or mental or physical harm Five kinds of harm can be mitigated through the 'Five Freedoms' <ol style="list-style-type: none"> Freedom from hunger and thirst by providing access to fresh water and diet to maintain full health and vigour. Freedom from discomfort by providing appropriate shelter and comfortable resting area. Freedom from pain, injury, or disease by prevention or rapid treatment. Freedom to express normal behaviour by providing sufficient space, proper facilities, and company of the animals' own kind. 	<ul style="list-style-type: none"> Animal-derived fibres (e.g. wool, down, leather, silk) can have risks of poor practices at the farm/ranch level, in animal transit, at the market, or at the place of slaughter Specific poor practices include animal confinement, live-plucking, force-feeding of ducks and geese, and mulesing of sheep. Use of furs, skins, ivory or other controversial materials are often the result of direct slaughter for the fibre or product 	<ul style="list-style-type: none"> Inadequate animal welfare and protection legislation can lead to systemic poor welfare practices Poor enforcement can also lead to individual sites failing to adhere to animal protection laws Religious and cultural norms in a country can influence animal care and slaughter practices 	<ul style="list-style-type: none"> The scale of animal derived fibre sourcing and the number of animals can influence the intensity of negative animal welfare impacts 	World Animal Protection's Animal Protection Index

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Biodiversity impacts, protected areas and protected species The degradation of important habitats and species can lead to irredeemable loss of biodiversity or damage ecosystem service functions	<ul style="list-style-type: none"> Activities that exploit endangered species or areas can directly destroy important ecosystems Processes taking place within sensitive landscapes can reduce the biodiversity richness of that landscape, for example through grazing impacts. Activities that create pollution or other impacts on protected areas and biodiversity hotspots can indirectly damage these ecosystems 	<ul style="list-style-type: none"> Use of furs, skins, ivory or other controversial materials can be linked to endangered species Cotton and other agricultural fibre production can harm biodiversity through spraying, leeching and intensive cultivation Wool, leather and other animal-based products can damage biodiversity through runoff of pollutants or overgrazing of livestock Wet processes, tanning and other intensive processes can create impacts through wastewater discharge, leeching or through direct use of protected species for dyehouse boilers 	<ul style="list-style-type: none"> Poor enforcement of wildlife trade, controlled species or protected area mechanisms Agricultural policies that do not prioritise biodiversity protection and ecosystem services Industry norms and practices that are likely to harm biodiversity, such as over-cultivation or chemical leeching Lack of integrated landscape mechanisms leading to fragmentation of regulation, enforcement or planning 	<ul style="list-style-type: none"> Presence of protected areas or species in vicinity of production Presence of rich or threatened biodiversity landscapes in vicinity, including key landscape corridors 	The Environmental Performance index UN Biodiversity lab map

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<p>Chemical impacts</p> <p>Use of toxic or other chemicals can create human health problems and damage ecosystem services</p>	<ul style="list-style-type: none"> Chemicals used in textiles and apparel production processes (particularly wet processes, finishing and tanning) can be known carcinogens, reproductive toxicants, hormone disrupters and/or toxic to the environment. This has potentially serious implications for both human and environmental health if chemicals are not carefully controlled Chemicals are used across most pre-spin raw materials, for agricultural production and processing of raw materials into fibres. These chemicals can run off at field level, have serious GHG implications, and can damage soil and water bodies Chemical harms may come from the used phase of products, where toxic chemicals are released through product use or garment care. End of life in landfill can also create leeching of chemicals into soil. 	<ul style="list-style-type: none"> Chemicals are used in virtually every stage of the life cycle of apparel, footwear and equipment. They are used to process, colour or preserve materials, and can also be intentionally added to a material or product to achieve a desired function. For apparel, the bulk of chemical use is typically in the dyeing and finishing processes and at agricultural production and fibre processing stages While only 2.4 percent of the world's cropland is planted with cotton, it consumes 10 percent of all agricultural chemicals and 25 percent of insecticidesⁱ 	<ul style="list-style-type: none"> Lack of government control on banned chemicals; countries not adhering to chemical conventions Lack of government standards, enforcement or incentives for chemical management at farm level or effective wastewater treatment for factories Poor performance by municipal or centralized effluent treatment plants used by factories, over-capacity leading to untreated wastewater Farmers or producer norms around chemical management, such as lack of personal protective gear and training, lack of proper storage and control of runoff, lack of effective wastewater treatment Customer care and end of life norms and infrastructure 	<ul style="list-style-type: none"> Farm or factory runoff into key surface or groundwater bodies, particularly if local actors or settlements are dependent on that water source Discharge into important river or wetland systems Presence of sensitive or rich biodiversity areas or protected areas nearby Proximity to population centres 	<p>The Environmental Performance index</p> <p>SDG12.4.1 data on chemical conventions adopted by countries</p>

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<p>Climate and energy impacts</p> <p>Energy use and GHG emissions lead to climate change and disruption of the earth's natural systems</p>	<ul style="list-style-type: none"> Energy use impact is relative to the fuel or energy source. Renewable energy generation does not produce GHG emissions, grid electricity can have different GHG emissions depending on the energy mix of the country or region. Fossil fuel sources create GHG emissions when burned – higher or lower amounts depending on the fuel source. Biofuels usually release as much GHG as they have captured during cultivation, but there is high variability in the sustainability of biofuel sourcesⁱⁱ. There are additional non-energy sources of GHG emissions, such as land conversion and deforestation impacts, embodied impacts from chemical and resource use, and life cycle impacts from livestock. The most recent data from the IPCC shows we will likely experience catastrophic effects of climate change within our lifetimes. If GHG emissions continue at the current rate, the atmosphere will warm by as much as 1.5 to 4 degrees Celsius by 2040, inundating coastlines, intensifying droughts, storms, heat waves, and poverty. Impacts from energy use run throughout 	<ul style="list-style-type: none"> The majority of GHG emissions from the textiles value chain are from raw materials production, high-heat wet processes and consumer care GHG impacts from raw materials include drilling, smelting (metals), use of petroleum-based fertilizers to grow crops and high GHG emissions from livestock such as sheep and cows Energy is used in all manufacturing stages, and is particularly high in the dyeing and finishing stages. Sites may be burning coal, wood oil, propane, and other fossil fuels for boilers, steam, and generators. The majority of energy used for manufacturing China, Vietnam and other countries is generated from coal fired plants and boilers Transportation of products also produces GHG emissions – varying amounts depending on the mode of transport and fuel source. Consumer washing, drying and ironing of clothing is thought to be a high energy use impact, however detailed data on consumer garment use and care phase is often lacking. 	<ul style="list-style-type: none"> Industry and farming norms within a country, including intensity of production or manufacturing processes, energy efficiency, fuel sources, irrigation pumping, chemical management and resource efficiency Incentives, regulations and enforcement around energy performance Energy pricing and subsidies Accessibility and scale of renewable energy solutions including biofuels for high-heat processes Available transport solutions and time pressures on delivery Prevailing lifestyle and weather conditions in store, DC, office or factory locations Customer care and end of life norms and infrastructure 	<ul style="list-style-type: none"> Grid electricity mix within a specific country or region and the related GHG emission factors Vulnerability to climate impact is also highly variable although emissions in a specific region do not relate specifically to impacts within the same region 	<p>Climate performance index</p> <p>The Environmental Performance index</p> <p>SDG13 progress data</p>

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<p>Deforestation, land conversion and land use</p> <p>The loss of important forest, grasslands, wetlands and other key landscapes creates biodiversity loss and GHG emissions – land use optimization will be key in an increasingly pressurized future</p>	<ul style="list-style-type: none"> The world's forests continue to disappear as they are cleared for cattle ranching and farming, and cut down for paper, packaging, and cellulosic materials (e.g. rayon). The United Nations estimates that current land use change is resulting in approximately 50,000 square miles of deforestation every year. Deforestation contributes to around 10% of GHG emissions each yearⁱⁱⁱ Conversion of other landscapes such as native grasslands, wetlands, peat etc can have catastrophic ecosystem impacts and unlock carbon stores to emit high levels of GHG The world has lost around 30% of its arable land in the past 40 years^{iv} whilst population increases and changes in consumption leads to a rise in food demand. Cultivation for fibres must compete with food crops, forests, settlements and natural landscapes for land use – and land use impacts will become increasingly important 	<ul style="list-style-type: none"> Direct deforestation risks are present in the production of paper, packaging, and cellulosic fabrics (e.g. rayon). More than 150 million trees are logged every year to produce cellulosic fabrics such as rayon/viscose, modal and lyocell.^v 40% of wood harvest goes into paper and packaging products each year^{vi} Natural rubber also has significant risks, becoming a leading cause of deforestation in mainland Southeast Asia.^{vii} Indirect deforestation and land conversion risks are present in leather and wool product value chains through potential clearing or over-exploitation of land for industrial agriculture. Some manufacturers are also using endangered or high value forest stocks directly in boilers, for example in wet processing sites in Cambodia^{viii} All agricultural products are in theory competing with other land use including food production – for example cotton cultivation or Generation 1 biofuels. Land conversion itself is unlikely for cotton, but conversion for commodity-based biofuels is a possibility 	<ul style="list-style-type: none"> Use of unverified forest, pulp or animal products which may be directly or indirectly to deforestation or land conversion Use of materials with a higher potential for land use pressure, such as non-food fibre crops and generation 1 biofuels Degree of landscape planning regulations and management within sourcing country or region; legal controls on deforestation or land conversion activities Regulations around animal husbandry and grazing activities Norms within industry and farming actors in terms of fuel sources, feed stocks, due diligence and prevalence of sourcing from high risk regions 	<ul style="list-style-type: none"> Sourcing from (or proximity to) high conservation value forests, grasslands or other important landscapes, including landscapes with a high level of carbon storage Degree of competition around land use 	<p>The Environmental Performance index</p> <p>Forestwatch map</p> <p>UN Biodiversity lab map</p>

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Marine impacts Negative impacts on marine environments and species including pollution and destruction of ecosystems	<ul style="list-style-type: none"> • All raw material production and factory level processes can lead to pollution of marine habitats if ground, surface or municipal watercourses discharge into the marine habitat, potentially damaging marine life and ecosystems • Shipping can create waste, chemical and sound pollution in marine habitats, as well as potentially posing a physical danger to marine species or bringing in invasive non-native species • Packaging from consumer or retail delivery (and even apparel products themselves) can be deposited into oceans, causing accumulation of waste and damaging ecosystems and species • Micro-fibre shedding from wet processing and consumer garment care are often finding their way into oceans – in some places 85% of the human-made materials discovered on the shorelines were microfibers^{ix} and many aquatic animals are found to have ingested micro-fibres^x 	<ul style="list-style-type: none"> • Highest likelihood of harm are from agricultural or extractive industries and wet processing sites placed near to major rivers or coastlines • Consumer washing of synthetic products is also a major risk of harm through micro-fibre shedding • Transit or consumer packaging can be a risk for marine contamination, as well as some apparel products themselves (such as flip-flops) • Shipping is a major risk for marine habitat harms 	<ul style="list-style-type: none"> • Effectiveness of marine protections from shipping impacts and controls of polluted waste and river flows from on-land sources • Norms of industrial and municipal wastewater treatment, investment in relevant infrastructure • Shipping behaviour, fuels and speed • Packaging volumes, types and disposal routes/infrastructure • Type of fibre and processes used • Norms of consumer care behaviour 	<ul style="list-style-type: none"> • Proximity of textiles processes to marine or large river systems • Vulnerability and richness of marine habitats and species in vicinity of contaminated water supply from farms, factories or consumer care • Bio-accumulation of toxins, chemicals and micro-fibres in existing ecosystems • Presence of key food species for humans or nature • 	UN Biodiversity lab map

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Soil health Negative impacts on soil chemistry, carbon and microbial/biodiversity richness can significantly affect soil productivity, as well as contributing to GHG emissions and biodiversity loss	<ul style="list-style-type: none"> Unsustainable agricultural practices, pollution or saltwater intrusion from climate and groundwater impacts can result in degradation of soil in terms of pollutants, chemical properties (such as nitrogen levels), helpful soil bacteria, other organisms such as worms, and captured carbon Poor soil quality reduces productivity of farm land, and can lead to shortages of food or production and price of raw materials Release or sequestration of soil carbon can lead to positive or negative effects on greenhouse gasses Poor soil biodiversity can affect the whole food chain of the relevant ecosystem e.g. worms for birds 	<ul style="list-style-type: none"> Raw material production, particularly of agricultural products, are the main direct driver of soil health. Other stages can act as a catalyst for soil health impacts, including pollution from wet processes, tanning or extractives 	<ul style="list-style-type: none"> Agricultural practice norms can make healthy soil more or less likely, including: degree of tillage, management of pesticides and fertilisers, rotation or mono-cropping, farrowing of fields, prevention of saltwater effects e.g. from inland aquaculture Land management planning and agricultural performance standards can also make a big difference if enforced, particularly around incentives for better on-farm practices 	<ul style="list-style-type: none"> Existing health and resilience of the soil, including chemical composition and contamination, PH balance, saltwater intrusion, soil carbon, microbial and biodiversity robustness 	The Environmental Performance index

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<p>Waste management and resource use, including hazardous waste</p> <p>Negative impacts on people and ecosystems from improper disposal of waste or hazardous waste in an environment; lost resource optimisation potential from waste generation and embodied impacts</p>	<p>Solid waste is any material or substance that is discarded, which can create pollution and GHG emissions through decomposition, incineration or leeching. Any solid waste produced is also a missed opportunity to optimize resource use within a value chain, and contributes to the impact intensity of remaining products. Examples of solid waste include e.g., cloth, leather, plastic, and paper or pre-consumer packaging waste.</p> <ul style="list-style-type: none"> • Hazardous waste is waste that could cause harm to public health and/or the environment because of its chemical, physical, or biological characteristics (e.g., it is flammable, explosive, toxic, radioactive, or infectious). Hazardous wastes can be liquids, solids, gases, or sludge. • Waste is often classified as pre-consumer or post-consumer waste; pre-consumer waste is usually a by-product from production processes whereas post-consumer waste covers packaging and the end of life destination of the product itself. 	<ul style="list-style-type: none"> • Solid waste is generated throughout the textiles value chain, from raw materials through manufacturing of products to packaging and end of life waste. • Waste is produced in the pre-spin raw materials phase through processing steps such as ginning or from extraction of inputs such as crude oil • Waste is produced throughout the manufacturing part of the value chain through losses such as fabric cutting • Post-consumer solid waste includes packaging and product at the end of their useful life. Impacts can vary according to the destination of the waste products • Hazardous waste is mainly generated during the processing of materials and products. Examples of hazardous waste include sludge from effluent treatment plants, waste from leather tanning processes, empty chemical drums and containers, film and printing frame, expired /unused/used chemicals (waste oil solvents, reactants, etc.), electronic waste, batteries • Extraction of inputs such as oil can also result in toxic waste at the extraction location. 	<ul style="list-style-type: none"> • Degree of solid waste produced in each stages of production, influenced by harvesting or extraction practices, production efficiencies and opportunities/practices around re-use or resale practices for waste materials • Norms around waste disposal, management or recycling practiced by extractives, farmers and production sites • Degree of hazardous waste produced in each stage of production, influenced by farm, mining or factory chemical and product management practices • Degree of hazardous waste controls put in place to prevent contamination, including effective wastewater treatment, chemical leakage/runoff prevention and suitable hazardous waste disposal routes or 3rd party contracts 	<ul style="list-style-type: none"> • Waste infrastructure within a country – degree of collection, processing, recycling and decontamination facilities available • Existing degree of solid waste or hazardous waste in environment of production or consumption regions • Degree of waste or hazardous waste ‘transference’ possible, e.g. through presence in water bodies, particular soil types or other mechanism • Presence of important or threatened ecosystems or vulnerable populations in location of solid or hazardous waste generation, disposal or end destination • Presence of food production systems or drinking water in 	<p>The Environmental Performance index</p> <p>SDG12 progress data</p>
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Water quality and wastewater discharge	<ul style="list-style-type: none"> Industrial and domestic wastewater, runoff from agricultural production and extractive industries can all pollute and contaminates natural systems, rivers, lakes, and groundwater. Pollutants can end up in drinking water, can damage aquatic ecosystems, and can ultimately be passed into the sea to affect marine ecosystems. Pollutants can bio-accumulate in many species and not only kill many species but also pass into the human food chain Eutrophication is the process by which a lake evolves into a bog or marsh and ultimately disappears. During eutrophication the water becomes inundated with nitrogen and phosphorus. Algae and other microscopic plant life grow to the point that they "choke" the lake, causing it to eventually to dry up. Eutrophication is greatly accelerated by human activities. Micro-fibre shedding is a major concern around the washing of synthetic fabrics - 30% of all ocean microplastics come from textiles fibres, and microfibres have been found in 70% of EU drinking water. About 20 percent of industrial water pollution is due to garment manufacturing,^{xi} and textile production ranked third among major industries in China in terms of total wastewater discharge, emitting over 2.5 billion tonnes, primarily from the dyeing and finishing steps of manufacture^{xii} 	<ul style="list-style-type: none"> Ranching and farming water runoff includes pesticides, insecticides, and fertilizers. Approximately 40% of dye chemistries end up in the wastewater.^{xiii} Wastewater from dyeing, finishing, and garment washing usually contains many toxic chemicals as well as creating impacts around conventional parameters of BOD, COD, TSS, PH and temperature Wastewater from consumers washing products can contain chemicals as well as micro-fibres. Non-synthetic micro-fibres degrade and so do not bioaccumulate, however they can release process chemicals into water bodies when they do. 	<ul style="list-style-type: none"> Poor water quality standards and wastewater discharge controls by government, including lack of enforcement or penalties for factories Price of wastewater treatment inputs including energy, chemical and technology inputs Industry norms around wastewater treatment, and price/cost pressure at factory level Poor performance by municipal or centralized effluent treatment plants used by factories, over-capacity leading to untreated wastewater Lack of incentives or controls around farm level water quality management, including prevention of runoff Customer care and end of life norms and infrastructure 	<ul style="list-style-type: none"> Dependency of other water users on polluted water bodies, including industry, farmers and communities/ municipal suppliers Vulnerability of local populations to water quality challenges including use of untreated surface or groundwater sources Vulnerability and richness of biodiversity dependent on contaminated water resources, proximity to important wetland or river protected areas 	The Environmental Performance index Water Risk Filter and WRI Aqueduct tool

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<p>Water use or extraction</p> <p>Over-exploitation of water resources can reduce availability for other water users and the environment and result in long term loss of important water sources</p>	<ul style="list-style-type: none"> Water is a limited resource on the planet. Industrial processes, farming, and ranching are impacting the availability of water that is critical to sustaining natural systems and communities. Climate change is increasing the frequency and magnitude of droughts and higher temperatures are placing more demands for increasingly limited water resources. The world uses 5 trillion litres (1.3 trillion gallons) of water each year for fabric dyeing alone, enough to fill 2 million Olympic-sized swimming pools.^{xiv} Increasing demand for water from farming, ranching, manufacturing, and human consumption is putting more and more strain on limited water resources. 	<ul style="list-style-type: none"> Farming and ranching to create fibres for raw materials often uses high volumes of water. Growing conventional cotton uses an average 20,000 litres of water to grow enough cotton to create one kg of textiles.^{xv} Variation of agricultural water use is high, particularly between rainfed and irrigated cotton. Over-use of water for agriculture can deplete ground and surface water suppliers and increase runoff potential. Dyeing, finishing, and garment laundering all use high volumes of water. It takes an average of 100 to 150 litres of water to dye 1 kg of fabric.^{xvi} Water for wet processes are often withdrawn from groundwater and discharged to surface water, creating a net drain on groundwater stores Consumer washing of garments can use high volumes of water across the lifetime of a product 	<ul style="list-style-type: none"> Poor water extraction/use regulation, poor water infrastructure investment or maintenance, lack of proper water planning Type of water infrastructure and sources available Pricing of water, subsidies or free water provision for farmers, factories or consumers Norms of farming and production practices including on-site water use behaviour Contextual drivers of agricultural water needs, such as temperature, rainfall, soil type and evaporation rates – and the role of climate change in increasing/decreasing these variables Customer care norms and infrastructure 	<ul style="list-style-type: none"> Underlying water availability or depletion per water source Water use needs of other users including industry, farmers and communities/ municipal suppliers Vulnerability of local populations to water access challenges including pricing/treatment Environmental flow requirements for surface water to support local ecosystem Water infrastructure elements such as dams creating river flow issues Vulnerability and richness of biodiversity dependent on water resources, proximity to important wetland or river protected areas 	<p>The Environmental Performance index</p> <p>Water Risk Filter and WRI Aqueduct tool</p> <p>UN assessment of water governance per country</p>

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ⁱ WWF

ⁱⁱ <https://www.chathamhouse.org/publications/papers/view/190783>

ⁱⁱⁱ Rainforest Alliance <https://www.rainforest-alliance.org/articles/relationship-between-deforestation-climate-change>

^{iv} University of Sheffield Grantham Centre for Sustainable Futures

^v Canopy Planet, canopy style: <https://canopyplanet.org/campaigns/canopystyle/>

^{vi} <https://www.worldwildlife.org/industries/pulp-and-paper>

^{vii} <https://outdoorindustry.org/article/the-sustainability-initiative-youve-never-heard-of/>

^{viii} SCALE https://res.cloudinary.com/crowdicity-eu-cld/image/upload/SCALE_Overview_2018_-_edits_NK_-_29_Aug_2018_1_ia1oz4

^{ix} Mark Anthony Browne, Phillip Crump, z Stewart J. Niven, Emma Teuten, Andrew Tonkin, z Tamara Galloway, and Richard Thompson (2011) , Worldwide: Sources and Sinks, Environ. Sci. Technol. 2011, 45, 9175–9179

^x Taylor, M. L., Gwinnett, C., Robinson, L. F., & Woodall, L. C. (2016). Plastic microfibre ingestion by deep-sea organisms. Scientific Reports, 6

^{xi} <https://www.nrdc.org/issues/encourage-textile-manufacturers-reduce-pollution>

^{xii} IPE 2012

^{xiii} <http://www.chinawaterrisk.org/resources/analysis-reviews/can-fashion-be-green/>

^{xiv} <https://www.wri.org/blog/2017/07/apparel-industrys-environmental-impact-6-graphics>

^{xv} Textile & Clothing Sustainability: <https://www.bookdepository.com/Textiles-Clothing-Sustainability-Subramanian-Senthilkannan-Muthu/9789811021848>

^{xvi} Textile & Clothing Sustainability: <https://www.bookdepository.com/Textiles-Clothing-Sustainability-Subramanian-Senthilkannan-Muthu/9789811021848>

^{xvii} <https://www.wri.org/blog/2017/07/apparel-industrys-environmental-impact-6-graphics>

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¹ Harm and Impact are used interchangeably in this document