

Sustainable trimmings for clothing

Abstract

Global environmental concerns, as well as the rapid depletion of non-renewable resources based on fossil fuels, have led to research into the development of sustainable, environmentally friendly, and biodegradable materials for use in a variety of applications. The textile chain is wide and diversified according to the final product. The basic raw material is the fibers/filaments, however, other compounds/materials are necessary for the formation of the part. In this context are the trimmings, elements that are part of the finishing of the pieces and that can be used for decoration or functionality. The materials most used in the production of trim are synthetic. Therefore, this article aims to present a review about sustainable trims, obtained from different materials, which are usually discarded in nature, and which are increasingly being used in the textile and fashion industry, as well as clothing companies that have already adopted sustainable practices and the challenges that arise when adopting sustainable materials.

Keywords: trim, sustainability, fashion, textile, composites, materials

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Jacqueline Rodrigues Moraes, Fernanda Steffens, Rita de Cassia Curto Valle

Postgraduate Program in Textile Engineering, PGETEX, Federal University of Santa Catarina Campus Blumenau, Brazil

Correspondence: Rita de Cassia Curto Valle Postgraduate Program in Textile Engineering, PGETEX, Federal University of Santa Catarina, Campus Blumenau, Rua João Pessoa 2750, Bairro Velha; Blumenau – SC; 89036-256, Brazil, Email rita.valle@ufsc.br

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Introduction

Sustainability is a current issue and presents itself as a solution to repair and minimize various actions originating mainly from the industrialization process that has been attacking the planet, and causing global warming.¹ With regard specifically to global warming, it can be said that the high consumption of oil, used as a raw material for the manufacture of products, is one of its main causes.² The textile and fashion industry produces about 1.2 billion tons of greenhouse gases in the atmosphere every year and about 20 to 35% of the microplastics present in the oceans.³ There is a forecast that by 2050 the fashion sector will be responsible for a quarter of all carbon dioxide emissions on the planet.⁴ Facing problems with environmental issues on the part of the fashion industry is due not only to the use of chemical products and waste disposal⁵ but also to the short cycles of clothing products, due to tendencies and seasonality.⁶ This is an issue that challenges the sustainability aspects of the fashion industry.⁷

On the other hand, the textile and clothing sector is considered one of the largest employers in the manufacturing industry, being largely responsible for generating income and socioeconomic development in various regions of the world. In Brazil, it is the second largest employer with 1.34 million formal employees (IEMI 2022), and more than 8 million indirect employees are added, of which 60% are female workers.⁸

Currently, consumers are increasingly demanding innovative products that have a sustainable and less aggressive appeal to the environment to reduce environmental impacts.⁹ Conscious fashion encompasses an identity, sensitive to changes and paradigms, and is concerned with future generations and with the preservation of the planet.¹⁰ In other words, when using a garment with a sustainable appeal, consumers can communicate a new way of representing their concern for the environment.

The relationship between sustainable products and environmental issues has increased in the mindset of consumers as well as the global legislation.¹¹ Environmental concern has generated interest in the research of new materials that are aligned with the principles of sustainability.¹² Green production practices can help garment industries to gain economic benefits and to have a larger number of target customers to achieve a competitive “edge” over their competitors.¹³

Although the textile sector is mainly known for the manufacture of knits and fabrics, another branch that is very used, but little explored in the textile chain, is trimming. They are elements used as ornamentation and to complement the functionality of the garment. Due to the considerable amount of waste that is generated during the production and after the life cycle of a garment, it is essential to have a broadly sustainable vision in the use of raw materials and their production method. Materials from renewable, recycled, and reused resources are increasingly in evidence as production alternatives, along with the areas of biotechnology and biomanufacturing.¹⁴ Furthermore, eco-materials, ethical production, and eco-efficiency have been popular themes in the textile industry in recent years.¹⁵ The new proposals meet the search for more demanding markets and increase competitiveness and maintenance and growth of companies, without risk to the ecosystem where they are installed.

The main objective of this article is to present sustainable innovations in the development of trims, through a bibliographical survey of different research sources, as well as to present the review of sustainability in the textile industry, the pillars of sustainability, and the most used certifications in the textile sector.

Sustainability in the textile industry

The concept of sustainability consists of developing practices and/or uses that seek to minimize harmful actions to the environment, as well as the ability of companies to meet the needs of the current generation without compromising future generations.¹⁶

In the textile and fashion industry, sustainability stems from productive characteristics such as the use of sustainable, renewable, and durable materials, which have social attributes, including job security, fair wages, and quality of professional life.¹⁷ In terms of textile production, sustainability issues involve how to manage energy, water, use of toxic compounds, and waste throughout the entire production chain (DESORE; NARULA, 2018).

The use of certification seals for sustainable appeals emphasizes the company's commitment to social and environmental causes, which are used as a way of leveraging consumer behavior about the importance of sustainability. The labeling of certifications is a practice that allows industries to communicate to consumers, encourage socially responsible behavior, and boost product evaluation and purchase intention.¹⁸

However, when it comes to sustainable products, there are two aspects: recycled and biodegradable materials. Recycling is a waste management strategy in which ready-made materials are transformed into new ones to be reused.¹⁹ Biodegradable products are decomposed by natural bacterial action, turning into organic matter, water, and CO₂, which do not interfere with the natural cycles that can impact the planet.²⁰

Associating growth and competitiveness (internal and external) to the pillars of sustainability, and adjusting to the demands of the consumer market in terms of quality, beauty, comfort, and price, is a great challenge for companies in the textile sector.

Certifications

The certification of processes and specific characteristics of materials with a sustainable appeal offers the consumer guarantees of compliance, respect and monitoring of an efficient way of leading sustainability solutions in this area.²¹ In Brazil, international sustainability certifications are still little used. However, there are some certified companies, especially with the OEKO-TEX® seal, which is the most recognized worldwide in the textile sector.²² Figure 1 presents the most requested certifications in relation to sustainability in the textile sector.

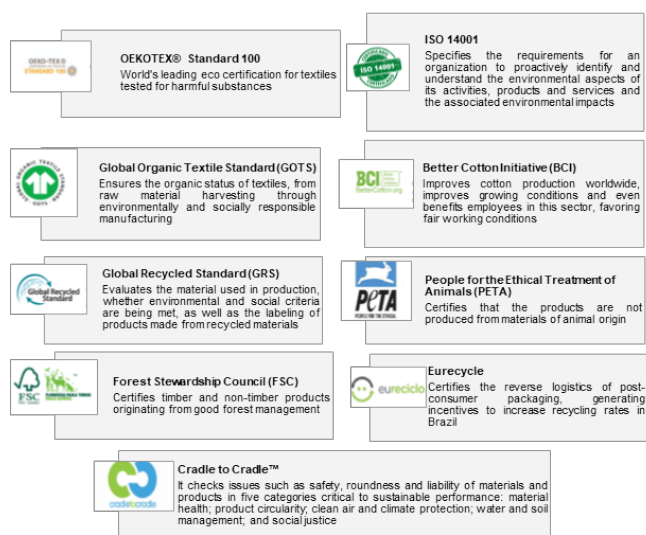


Figure 1 Main sustainability certifications for textile industries.

Source: GRAF; et al, (2022); CUNHA, (2022); BYRD and SU, (2021)

To obtain OEKO-TEX® certification, the standard focuses on an audit for harmful substances (e.g. illegal substances, legally regulated substances, non-legally regulated harmful substances, and parameters for health care) for environmental quality assurance.²³ Certification is also relevant in what affects the purchasing process of textile products, from the consumer's point of view.²⁴ Obtaining certification provides companies with a positive impact on the protection of workers, the environment, more economical use of raw materials and energy resources, and regulation of requirements related to storage, packaging, labeling, and transport of products.²⁵

The ISO 14000 standard deals with environmental management, which indicates what companies must do to minimize the environmental impacts of their activities and continuously improve their environmental performance.²⁶

The Global Organic Textile Standard (GOTS) (2023) aims to define requirements that ensure textiles are organic from harvest to social and environmental manufacturing, and then accurately labeled to provide credibility to end consumers. This standard covers all stages of the supply chain to ensure that textiles are produced with at least 70 % certified organic natural fibers.²⁷

The Better Cotton Initiative (BCI) is considered the leading sustainability initiative in the cotton world. Its mission is to help cotton communities survive and thrive by protecting and restoring the environment. Impact areas consist of climate change mitigation, soil health, pesticide use, smallholder livelihoods, and women's empowerment.²⁸

Cradle to Cradle Certified is another global standardization. According to CELEP; TETIK.; YILMAZ,²⁸ this certification evaluates the safety, circularity, and responsibility of materials and products in five sustainability performance categories, such as material health, product circularity, clean air and climate protection, water and environment management soil, and social justice. Manzini and Vezzoli (2008) state that one should consider that the environmental impact is not determined by a product, and even less by a material that composes it, but by the set of existing processes throughout the entire life cycle.

The Forest Stewardship Council (FSC) forest management certification endorsed that forest management is carried out based on care for biological diversity, consequently benefiting the lives of the population and local workers. There are 10 principles for earning FSC forest management certification, which cover a wide range of issues from maintaining high conservation values to community relations and workers' rights, as well as monitoring environmental and social impacts of forest management.²⁸

According to ATKINS-SAYRE,²⁹ in People for the Ethical Treatment of Animals (PETA), causes include working for the rights of animals, opposing research on animals, their dissection, the use of fur, and the use of animals in attractions such as circuses and rodeos, for example.

Eureciclo's objective is to guarantee the correct destination of materials of the same type (raw material) by the companies that adhere to its service. According to reports from the entity, recycling can only be scaled up with the commitment of all of society, being a shared responsibility among consumers, companies, public authorities, and other civil society organizations. For this, the reverse logistics certifier invests in the important role of environmental education in strengthening sustainable practices, especially in the proper disposal of recyclable materials, through its social networks, webinars and workshops.³⁰

Trimmings and sustainability

Trimmings are component materials for the finishing of a garment and are used to make a garment in addition to the base fabric³¹ They are classified into two types, decorative trimmings, which are those used only to decorate the garment; and the functional trims, which as the name suggests, have a functional purpose in the pieces. Figure 2 shows some of the trims most used in the textile industry according to their respective classification.

According to Jesus,²² trims can also be classified according to their visibility, where there are apparent trims, which are those that remain visible on the piece after finishing the confection, such as buttons, ribbons, rings, appliqués, platelet, and shoelaces. And the

non-apparent ones, which are present inside the piece, perform a certain function, such as support (bulge), fixation (Velcro), adjustment (elastic), specification (labels), and joining parts (zipper).

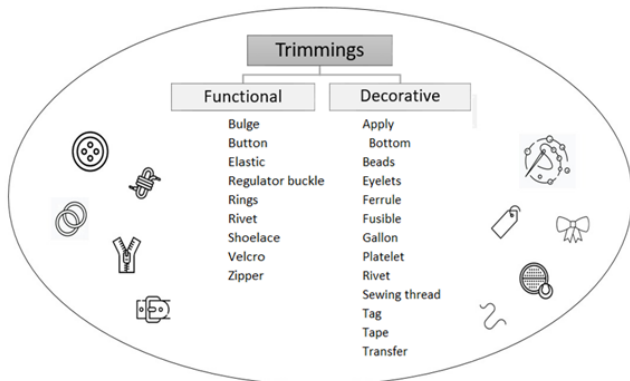


Figure 2 Classification of trims.

Sustainable trim refers to the use of ecologically correct and socially responsible materials and practices. This may include the use of recyclable materials (recyclable polyester materials or fibers or process waste of textile substrates); and renewable, produced from natural materials (vegetable materials such as cotton, flax, and seeds, free of chemical pesticides). Renewable sources, being natural, are biodegradable, that is, they decompose in nature in a short period. In this context, there is still the possibility of using materials obtained from local and organic producers, using natural dyes, reducing waste in the production process, and ensuring fair labor practices in the supply chain.

Recyclable trimmings

With the rampant consumption, many products are discarded daily, which signals that the product has reached the end of its useful life, that is, it no longer performs the function for which it was proposed to perform (STOCK; SELIGER, 2016).

Recycling and reuse processes contribute to the management and conservation of raw materials that would otherwise be discarded, reducing the need for new exploitation of natural resources that would be necessary to produce goods and products.²² To recover materials that have reached the end of their life cycle, there is a process called upcycling, that is, reuse, which transforms and reuses materials, without losing their composition and original physical appearance, but increasing their commercial value.³² Upcycling is a conscious and creative behavior that transforms *new* products through the reuse of materials.³³

Analyzing from the perspective of the trimmings industry produced from poly ethyl terephthalate (PET) bottles, the waste goes through the following stages before returning to the process of developing new products: collection, classification, cleaning, transformation into flakes, can receive additives and undergo specific physical transformation processes into a new polyester raw material (spinning by extrusion, blowing, etc). The raw material from the PET bottle is one of the most common and used recyclable materials. In the textile area, PET is used in the most diverse items, such as in the production of shoelaces, lace, labels, zippers, and other elements of clothing items that require this raw material in the form of yarn for their production. Recycled polyester emits 25 to 75 % fewer greenhouse gases and consumes 25 % less electricity.³⁴ Recycled PET filaments have an emission reduction of 65 % of CO₂ and use 90 %

less water and energy consumption.³⁵ In addition to PET bottle waste, another form of recycling is waste from production processes.

Figure 3 shows trims and the percentage of recyclable materials produced from PET bottles.



Figure 3 Recyclable PET trims.

Source:YKK, 2023

According to the 11th PET Recycling Census in Brazil, in 2019, the country recycled 331 thousand tons, equivalent to 55 % of discarded PET bottles. According to the Brazilian Association of the PET Industry,³⁶ a large part of recycled PET production is directed to textile products, with the textile industry responsible for 22 % of its recycling (PERREIRA, 2023).

The recycled label is made from 88 % PET and the rest from cotton (12 %). This material is a sustainable alternative compared to virgin polyester. The recycled polyester label has a soft touch like microfiber and is flexible in terms of printing possibilities (warm and colored printing and suitable for embossing).³⁷ Another possibility for recycled PET is the yarn for denim clothing.

In addition to trims produced from recycled PET, other residues incorporated into the resin are used, such as recycled paper, rice husks, coffee grounds, corn cob, liquid sugar cane ethanol, recycled polyamide (PA), corozo, recycled paper, and hemp, as illustrated in Figure 4.



Figure 4 Trimmings produced with recyclable materials.

Source: Brasil Buttons; Perfect Brothers; Ecobuttons, 2023

Making recycled paper consumes about 33 % less energy, and 49 % less water and chemicals compared to virgin paper.³⁸ The trim produced from 22 % rice husks uses 50 % less virgin resin in its composition and is made with 35 % recycled PET. In addition, the manufacturing process uses 50 % less water than a conventional process.³⁹

In the production of sealing wax, 94 % of sugar cane is reused to produce the material. For the zipper, the natural raw material used is molasses, a by-product of the sugar manufacturing process and which promotes the reduction of CO₂ emissions associated with the production of petroleum-based polymers using 30 % of material derived from plant origin. For the manufacture of shoelaces and gallons, 100 % recycled PA is used from waste from the textile industry's production processes.⁴⁰

Corozo sliced buttons, a fruit imported from Ecuador and Panama, is produced 100 % naturally with an appearance like the ivory color. Buttons with vegetable fibers from recycled paper present in their composition between 50 and 70 % (ECOBOTÕES, 2023).

The use of alternative materials incorporated into trim goes beyond reuse, making a differentiated product with new attractiveness and sales appeals, since product acceptability studies are carried out with each new proposal. It has already been verified that, for some consumers, recycled products have a superior visual appearance than conventional equivalent items.³⁹

Biodegradable buttons

Biodegradable materials are those whose composition is made of organic elements and can be decomposed by microorganisms, which results in their disappearance and complete degradation in the environment.⁴¹ The biodegradation process is defined as a biochemical transformation promoted by the action of microorganisms under certain conditions of temperature, humidity, light, oxygen, and nutrients.⁴² Its decomposition in the environment occurs in a short period and, after decomposition, it does not generate toxic waste.

The time of biodegradation by microorganisms is a determining factor for the material to be classified as biodegradable or not. Normally, the biodegradability time is weeks or months.⁴³ Figure 5 shows the biodegradable trims that exist on the market, which can be made from different types of materials, which may or may not be wasted. As an example, leftover food, biopolymers, biodegradable polyamide, derived from vegetable oils, paper, seeds, etc.

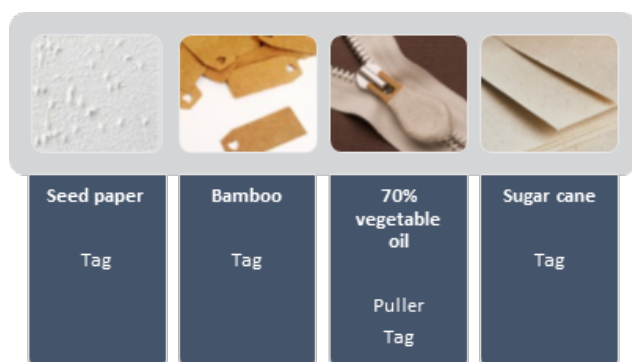


Figure 5 Trimmings produced with biodegradable materials.

Source: Hoyan Ip, Brasil Botões, HACO (2023)

Trimmings from food waste can be certified as free of genetically modified organisms, made with waste from organic product

processes.⁴⁴ Design Hoyan Ip reuses food scraps to create trimmings, “Bio-trimmings”, the stylist’s brand, which features buttons and buckles made from organic materials as a possible replacement for metal or plastic items.

Wooden materials are widely used in buttons, buckles, platelets, and rings, as well as materials produced from coconut shells. Biodegradable PA 5.6 yarn has been used to manufacture shoelaces and lace. This PA decomposes in nature in less than three years, in a chemical process in which bacteria from the soil and the environment feed on the fiber, and it degrades in the environment in about 3 years after being properly discarded in landfills.⁴⁵ Made from a compound known as “nylon salt”, this production of biodegradable PA starts with the evaporation of water with salt to increase its concentration, after which it passes to a condensation process where the material is transformed into chips that later are melted and filtered, finally passing through the drawing process, where the yarn is cold stretched to about 500 % of its initial length.⁴⁶

Organic cotton comes from non-genetically modified plants and without the use of synthetic agricultural chemicals such as fertilizers or pesticides.⁴⁷ For Lavrati et al.,⁴⁸ the production of organic cotton is a system that aims to maintain the health of soils, ecosystems, and, consequently, people. Unlike conventional production techniques, organic cotton is cultivated using organic fertilizers, biological pest control, and crop rotation, and its harvest is usually carried out manually, thus enabling optimization and better use of natural resources.⁴⁹

To produce tags to be inserted in clothing, many brands have invested in seed paper, made from bamboo and sugar cane with a mixture of seeds from some plant or flower. When you plant the tag (paper), a plant is born. Tag produced from bamboo and sugar cane is also considered sustainable since after its disposal it decomposes in nature.⁵⁰

The zipper puller, produced from vegetable oil, has different types of oils in its composition, such as rapeseed, olive, coconut, linseed, and modified sunflower oil, with different amounts of fatty acids.

It should be noted that biodegradability does not necessarily mean sustainability, as the necessary conditions for biodegradation to occur may not be present in all environments, and the process of producing biodegradable materials can still cause an environmental impact. Therefore, to assess the sustainability of a product, it is essential to consider its entire life cycle.⁵¹

Ecologically correct processes

The conventional process of producing trims in the textile industry consists of non-renewable energy sources (gas, coal, or oil), which are limited and create an environmental burden. As the term “green production” has become commonplace, the textile sector has adopted this action in the search for sustainable products and processes. Eco-friendly production practices can help industries achieve economic benefits and have a competitive advantage over their competitors.⁵²

Currently, one of the major concerns of companies in the textile segment is reducing the toxicity of their products by changing or minimizing the use of harmful chemical substances. Consumers need to be confident in buying a garment that will not cause skin irritation, or contain any chemical compound that is potentially carcinogenic or that could affect the central nervous system or the production of hormones, for example. In some countries, there is already a requirement to have the entire composition of articles informed to consumers.⁵³

In conventional production, most metal trims undergo the galvanizing process, a finish with several metallic layers on an object using the fundamental principles of electrolysis, such as oxidation and reduction reactions, done to give the piece a shine, prevent corrosion and consequently increase its durability.⁵⁴ However, this process uses a variety of chemical substances and the use of heavy metals, which are highly toxic to the human body and cause an ecological impact when present in effluents.⁵⁵

In the case, for example, of organic cotton, emissions are 58% lower than in conventional cultivation due to the reduction of agricultural inputs, such as pesticides and chemical fertilizers, and the reduction of mechanized operation.⁵⁶ It is possible to reach up to 70% if the factory energy source is replaced by photovoltaic panels.⁵⁷ Figure 6 shows some trims produced from ecologically correct processes.

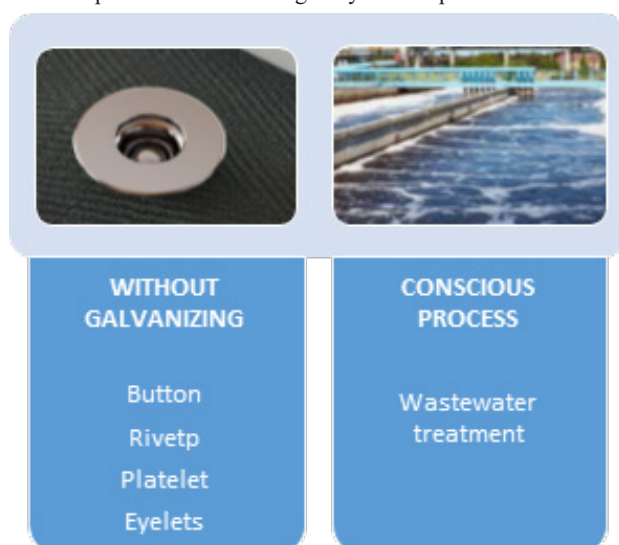


Figure 6 Environmentally correct process supplies.

Source: Authors, 2023.

The production process without galvanization is carried out through a single bath without heavy metals, obtaining metal trims such as buttons, rivets, platelets, and eyelets.

The conscious production process also consists of treating effluents. Because of this, companies have sought alternatives to develop new formulations in their processes and suitable for sustainable certifications that guarantee the minimum consumption of raw materials or inputs with polluting potential. As well as reducing the environmental impacts in its manufacturing processes that can contaminate the environment.

Apparel brands that embrace sustainable practices

Sustainable fashion is a drive to create change in the creation of fashion products and the industry in general to reduce negative effects on the environment. Given the context of sustainability, brands such as Hennes & Mauritz AB, Kering SA and LVMH have committed to sustainability in recent years. A study has shown that 52% of US and UK consumers would prefer that the fashion industry be sustainable, but 45% of consumers are confused as to which brands have made commitments to sustainability and which ones haven't.⁵⁸

A multitude of sportswear designers such as Decathlon, Satva, Stretchery, Deivee, Pact, Etiko and Tentree are pioneers in launching sustainable products, not just the fabric but also the trim that makes up the trimmings.⁵⁹

Accordingly Astorgano,⁶⁰ the brand Adidas hopes to reduce its impact on the environment, support ethical labor standards, and spur improvement in the sector. Adidas shows its dedication to fostering a more sustainable future for athletes and the globe by integrating sustainability ideas into its business activities.⁶¹ By 2025, they hope to have 90% of their products that are sustainable. They characterize products as sustainable when they exhibit environmental advantages over traditional products because of the materials employed, i.e., when they are mostly made of ecologically friendly resources. At least 70% of the weight of the product must be made up of ecologically friendly materials for clothing, at least 50% for accessories and gear, and at least 20% for footwear.

The fight to reduce plastic consumption is ongoing and is a pivotal challenge across all industries. Brands are continuing to review their plastic usage to find suitable, sustainable alternatives. Among Trimco's wide offering of material solutions, Paptic®, an FSC-certified and 100% plastic-free, is an excellent and durable substitute for plastic-based trims and packaging. Made from renewable and biodegradable wood fibres, this material was developed specifically to reduce the use of plastic and can be used to replace any oil-based materials in packaging, especially popular for bags. The hunt for plastic-free alternatives extends to trims like woven labels and care labels. While cotton is the most popular polyester alternative, Trimco continues exploring cellulose-based, compostable options such as SeaCell™.⁶²

To become increasingly competitive, brands have communicated to consumers the design of sustainable fabrics and trims in their packaging, Adidas, for example, uses certificates such as Oeko-Tex to attest to performance.⁶³

Challenges in adopting sustainability

Clothing companies have faced some challenges, such as fast fashion still has a long way to go when it comes to sustainability.⁶⁴ In 2020, 93% of brands were not paying garment workers a living wage. And it is known that fast fashion is quite popular, has a significant impact on the environment and sustainability is a necessary aspect for the survival of fashion brands of the future.⁶⁵ To Liu, liu and Gong⁶⁶ fast fashion is the so-called slow fashion, which promotes sustainable production and consumption of fashion. However, fast fashion companies have also begun to launch sustainable collections to increase the company's legitimacy, perception of socio-environmental responsibility and brand trust in the eyes of customers. Due to production problems and other economic, social, ethical and environmental impacts, companies seek to promote and ensure sustainability in their value chains to improve performance, define sustainability criteria and carry out monitoring and auditing activities.⁶⁷ However, audits are often ineffective, even fictitious, and do not reveal the real unsatisfactory conditions.⁶⁸

Despite this, another challenge to implementing sustainable trims is certification, which is costly and often small companies are not willing to join and often ends up making the product more expensive.⁶⁹

Tilbury et al.⁷⁰ point out that many owners and managers do not give due importance to environmental issues and the need to be environmentally sustainable because they have a lack of knowledge about environmental issues and the sustainability effectiveness. And also due to the lack of knowledge on the part of the owners and managers of many companies about the benefits of sustainability practices, this means that they are often pushed to the background and there is no interest in their adoption, because they are not can visualize immediate financial return on them.⁷¹

Álvarez Jaramillo et al.⁷² argued that, as a result of a literature review, they were 175 barriers to the sustainable development were identified, with the lack of resources, the initial cost in implementing sustainability measures and lack of knowledge, competence and experience - “expertise”, the barriers that arise most frequently. Already Abdelmeguid, Afy-Shararah and Salonitis,⁷³ highlight that the main barriers such as , limited resources, the return time on your investment, as well as the lack of knowledge and awareness, and lack of government support and legislation. As well as the high cost of environmental certification, low levels of support and guidance from governments, industrial barriers and local barriers, with high waste transportation costs and the cost of raw materials.⁷⁴

Despite it is It is important to be aware of sustainable management and the effective adoption of sustainability practices business and that large companies have adopted these practices as part of their strategy.⁷⁵

Sustainable fashion isn't a trend that will disappear in time. It is a movement led by the consumers of the fashion industry that intends to see this planet sustain years of innovation and creativity from the fashion industry. If the consumers and industry stakeholders play their parts properly, the ecological benefits would be tremendous.^{76,77–89}

Conclusion

Faced with the environmental impacts that occur in the textile and fashion industry, consumers have become increasingly aware of purchasing environmentally correct products. This change in behavior leads the industry to rethink more sustainable and attractive processes and products.

The trim segment has grown in this regard, bringing products with a sustainability appeal. The diversity of existing materials and new concepts contributes to the consolidation of this theme and brings alternatives for new products that are created to meet the needs of the fashion market, with its requirement to adapt the material, its shape, and the agreement of the concept of the piece in which it will be inserted.

Despite this, there are still some challenges such as the lack of resources, the initial cost of implementing sustainability measures, the lack of knowledge, the return time on your investment, as well as the lack of knowledge and awareness, and the lack of support. Government and legislation.

Therefore, according to the research carried out, it was possible to observe that, despite the business of trimming being little explored in the academic field, companies in this segment have been moving to bring environmentally sustainable products and processes.

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Conflicts of interest

Author declares that there is no conflict of interest.

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