

# Environmental Sustainability Evaluation of Apparel Product: A Case Study on Knitted T-Shirt

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**Abstract:** The work reported in this paper presents the assessment of environmental performances of selected local and foreign branded apparel T-Shirt products made by Bangladesh. The study is based on a standard evaluation tool named Higg Index which is basically used widely to measure the environmental sustainability of various apparel and footwear products. The Higg Index is an internal self-assessment tool created by the outdoor apparel industry and Nike's apparel environmental design tool. Higg Index aims to aggregate information on the environmental performance of products from major apparel brands. The Index considers performance across the full life-cycle of a product, including impacts from "input materials, manufacturing, packaging, transportation, use, and end-of-life." Some selected apparel branded T-Shirt products from S. Oliver, PUMA, Esprit, Aarong and Yellow were taken into consideration for this study. The results indicate that T-Shirt of foreign branded products named S. Oliver, PUMA & Esprit gained higher score and local branded product like Aarong & Yellow gained lower score in terms of environmental sustainability based on Higg Index assessment tool. Moreover, many weaknesses and opportunities for improvement of both local and foreign branded T-Shirt products have been identified and suggested which would eventually lead the fashion designer, apparel manufacturer, stakeholder and consumer towards greener apparel products.

**Key Words:** Apparel products, Environmental performance, Higg Index, Sustainability.

## 1. INTRODUCTION

Sustainability is the major concern in the age of modern world. For textile and apparel sector, this has been a burning issue for many related concerned bodies. Over the past few years, increasing awareness of the environmental and social concerns surrounding the fashion industry have led to a rise in the implementation of sustainability initiatives. There has been a growing concern over apparel brands in improving their environmental impact and the social responsibility throughout their supply chains. Environmental sustainability refers to the ability of something to continue without upsetting earth's ecological balance. Sustainable apparel products can be defined as a part of the growing design philosophy and trend of sustainability, the goal of which is to create a system which can be supported indefinitely in terms of environmentalism and social responsibility [1]. Environmental sustainability in business refers to longevity, but in terms of which natural resources the production process might draw upon, how resources are used and replenished, the overall impact of the final production on the environment, and where the product ends up following its disposal. The textile and apparel products impact the environment at every point along the product's lifecycle [2]. However, Rapid growth

in the industrial sector is playing a vital role in the economy of Bangladesh. Despite the growing necessity of environmental practices in the apparel industry, little research has explored methods and standard tools to guide apparel designers, manufacturers, merchandisers and consumers in adapting environmental issues in their work. Many designers do not recognize how their designs impact the environment. The role of the designer must expand dramatically in light of current environmental concerns with the contamination and destruction of the ecosystem. Today's designer, manufacturer, merchandiser and consumer must be well informed on a vast array of topics, from methods of production to governmental regulations to life cycle analysis. They must account for the environmental impacts of the materials used, the resulting waste from the forms they choose, how products are produced and packaged, where they will be made and then sold causing energy use for transportation, and how consumers may use and dispose of the product [3]. Hence, there is a growing need to measure the environmental sustainability of apparel products by standard methods, tools and technique to minimize the environmental impact. The Higg Index by sustainable apparel coalition is such a standard tool by which the environmental sustainability of apparel products could be measured. This study attempts to identify and analyse a number of these issues related to apparel product sustainability taking several local and foreign branded T-shirts into consideration as case study.

## 2. LITERATURE REVIEW

### 2.1 Sustainable Apparel Product

Sustainability is defined as the design of human and industrial systems to ensure that humankind's use of natural resources and cycles do not lead to diminished quality of life due either to losses in future economic opportunities or to adverse impacts on social conditions, human health and the environment" [3]. To achieve sustainable development, designers need to be aware of environmental impacts and incorporate environmental awareness into the design [2]. Product sustainability is the easiest aspect to alter for an apparel brand, as this is where a company has the most and direct control through design and product development [2]. Transforming product sustainability may be achieved via various aspects such as fiber/textile selection, processing methods, use behaviors, and reuse/recycle strategies. Fiber/textile selection is often the first step that designers and product developers will take in reducing the environmental impact of a garment. Environmentally preferred fibres/textiles can significantly reduce the environmental impact, and

increase the resourcefulness of an apparel product throughout the garments life cycle without change to design practice or product development processes [2].

### *2.2 Environmental Impact of Textiles Apparel Products*

The apparel industry has many negative environmental and social impacts that are complex, and occur at different stages of the apparel life cycle. The development of fast fashion has amplified the impacts due to the increased volume of apparel produced and sold at low prices [1]. Apparel has a long and complicated production chain consisting of many phases including resource production and extraction, fibre and yarn manufacturing, textile manufacturing, apparel assembly, packaging, transportation and distribution, consumer use, recycling, and ultimate disposal [4]. The environmental impacts of apparel are varied across the phases, difficult to assess for individual garments, and are subject to type of raw material used, dyeing, and laundering. It wasn't until the 1990s that there was a greater awareness as to the severity of the negative environmental impacts of apparel production [3]. The major environmental impacts associated with the production and use of apparel throughout its life cycle includes wastewater emissions from dyeing, finishing and washing processes, increase in pollution, solid waste production, and significant depletion of resources from consumption of water, fossil fuels and raw materials [2, 8]. Energy is used for laundering, transportation, operations of machines for various processes, production of primary materials especially man-made fibres such as polyester (a petroleum based product), and yarn manufacturing of natural fibres such as cotton. Conventional cotton production has high water consumption, and employs the use of toxic chemicals that may harm human health and the environment [1]. Chemicals are also released in wastewater from processes such as pre-treatments, dyeing, finishing, and laundry. These chemicals are disruptive to both the environment and aquatic-based life [5]. Solid waste is produced during natural fibre yarn, textile and apparel manufacturing, and disposal of apparel products at the end of their life. There are significant issues with clothing waste as the majority of clothing and textile waste ends up in landfills as opposed to being recycled or reused [2].

### *2.3 Sustainable Apparel Coalition and Higg Index Tool*

The SAC is a multi-stakeholder engagement, formed in 2011, by a group of global apparel and footwear companies and non-profit organizations representing nearly one third of the global market share for apparel and footwear. The SAC seeks to build a common approach for measuring and evaluating apparel and footwear product sustainability performance [7]. It aims to develop common measurements and a common environmental understanding of products' impacts across the industry by building on the Outdoor Industry Association (OIA)'s Eco Index™ and Nike's Environmental Design tool. The Eco Index™ is a standardized tool for measuring the environmental impacts of outdoor products such as boots, clothing and tents and evaluates the impacts in six key areas of a product's life cycle: materials, packaging, product manufacturing and assembly, transport and

distribution, use of service, and end of life [7]. Nike's Environmental Design tool measures the environmental impacts of apparel. Measuring performance of apparel products will spotlight priorities for action, and opportunities for technological innovation [7]. The Higg index 1.0 is an "indicator based tool for apparel that enables companies to evaluate material types, products, facilities and processes based on a range of environmental and product design choices" [7]. The scope for the desired outcomes of the SAC Higg Index 1.0 tool includes improvements to reduce water use and improve quality, reduce energy and emissions, minimizing waste, reduce chemicals and toxicity, and increase transparency for social and labour issues [8]. The first version of the Higg Index 1.0 tool was released in June 2012 was based on life cycle thinking and is publicly available for any organization. The Index tool was developed to measure the environmental impacts of apparel products. The tool evaluates material type, products, and facilities and processes. By utilizing practice based, qualitative binary yes/no questions, assessments can be made as to the sustainability performance of product and drive behavior for improvement. The Higg Index RDM-Beta is a prototype aims at educating and providing quick directional guidance to apparel designers during the product creation process about the potential environmental impacts of their design solutions [7]. It is to engage designers in the Higg Index's produce life cycle thinking and how we directionally assess materials sustainability through the MSI. By helping organizations standardize measurement and evaluation of environmental performance, the tool creates a starting point for engagement, education, and collaboration among stakeholders [6]. Through self-assessment, organizations can better understand the environmental impacts that occur throughout the life cycle and the effect of design choices such as material type. However, there are many apparel brands belonging to the SAC such as: H&M, Gap Inc., Nike, adidas, Puma, Patagonia, Mountain Equipment Co-op (MEC), Levi's, Hanesbrand, Marks & Spencer (M&S), Esprit, Columbia, Timberland and Loomstate, S. Oliver etc. These brands are widely using this Higg Index tool to measure the environmental performance of their apparel products towards better sustainability [9].

## **3. MATERIALS AND METHODOLOGY**

To carry out this study, selected knitted men's T-shirt products were taken into consideration as case study. Both foreign and local branded knitted men's 'M' sized short sleeve T-shirt products namely S. Oliver, PUMA, Levi's, Aarong and Yellow were selected to measure their environmental performance. The PUMA, S. Oliver and Esprit branded T-shirt were collected from various organizations namely Viyellatex group ltd. And Yellow and Aarong T-shirt collected from Beximco fashion wear and Aarong. Higg Index provides a value that represents how environmentally responsible an apparel item is in terms of sustainability. For this study, the tool was used to obtain product scores for the above mentioned T-Shirt. This score was obtained by answering questions relating to the materials, packaging, manufacturing, product care and repair service, and product end of life. The data used

during this process includes information readily available to the general consumers, manufacturers and merchandisers including hangtags, care labels, and online product descriptions and throughout the LCA phase of the developed T-Shirt. The product Tec-pack details information was the important sources for various Higg Index required information towards sustainability measurement. Higg Index 1.0 requires that all materials present be entered into a materials input table. This includes a description of all materials used in addition to

information obtained from follow up questions. By utilizing practice based, qualitative binary yes/no questions, assessments can be made as to the sustainability performance of product and drive behavior for improvement. Higg Index 1.0 is a Microsoft office excel and web based tool that has predetermined standard values based on global survey for specific materials that are used in determining a score. Higher the Higg Index score, better the environmental performance of an apparel products.

But in case of local branded Yellow and Aarong T-shirt Higg Index score was lower due to environmentally

**TABLE 1: HIGG INDEX EVALUATION SCORE OF T-SHIRTS**

Scoring summary stages	Section score each out of 100					Section weight %	Total score out of 100				
	S. Oliver	PUMA	Esprit	Yellow	Aarong		S. Oliver	PUMA	Esprit	Yellow	Aarong
Materials selection	71	100	71	66	57	30 %	21	30	21	20	17
Manufacturing -Marker efficiency -Garment finish -Applied graphics and logo -Screen printing size & color	55	53	53	40	24	25 %	14	13	13	10	6
Packaging	90	90	50	40	0	10 %	9	9	5	4	0
Product use & care service	20	90	20	20	20	20 %	4	18	4	4	4
End of life	60	60	60	60	60	15 %	9	9	9	9	9
Total						100 %	57	79	53	47	36

#### 4. RESULTS AND DISCUSSIONS

In this study, the all five selected foreign and local branded knitted T-shirt were assessed using the Higg Index 1.0 to obtain a value that represents a product's environmental impact. A higher score implies a more sustainable product. Upon completion of the excel and web based Higg Index tool, the S. Oliver, PUMA, Esprit, Yellow and Aarong T-shirt received total score 57, 79, 53, 47 and 36 respectively on a scale of 1---100. The superior score of the foreign branded product especially PUMA T-shirt was due to the organic material content, eco-friendly raw materials and process used product end---of---life options and confirmed traceability. On the other hand the local branded T-shirt gained comparatively lower score in most of the areas due not using eco-friendly raw materials, manufacturing processes, high impact finishes, improper or insufficient care and repair instructions, traceability issues etc. This also confirm that by increasing the transparency of a product and offering more information about a product's development, the more this product will represent eco-friendliness and will be superior in terms of sustainability.

##### 4.1 Materials Selection

The materials selected for the knitted T-shirt for both foreign and local branded product were entered into the material inputs table in the Higg Index 1.0. tool. The values obtained by various products are shown in table 1. The foreign brand PUMA, S. Oliver and Esprit obtained higher score. This was due to the eco-friendly raw materials used, i.e. PUMA t-shirt included 100% organic cotton fibre which was third party verified. During processing of fabric, PUMA and others foreign brand used eco-friendly and certified and environmentally low impacted dyes chemicals.

hazardous conventional raw materials, processing, dyes used, no third party verification etc issues. For better environmental sustainability these issued must be addressed for local branded apparel products.

##### 4.2 Manufacturing Stages

The manufacturing stages obviously an important area for better product sustainability. Some major issued have great impact on product environmental sustainability as per Higg Index tool. The PUMA and foreign branded T-shirt used low impact garment finish i.e. process combination enzyme wash or basic rinse that scored higher. But local branded Aarong and Yellow T-shirt used high impact garment finish namely traditional bleach, acid chemical wash etc. and scored lower. Besides, marker efficiency has great impact on product sustainability. Higher the marker efficiency, better the product sustainability and lower marker efficiency indicate its direct impact on supply chain including more wastages of material like fabric, dyes chemicals, process loss, land fill etc. As PUMA, S. Oliver and Esprit brand had more than 92 % marker efficiency, they scored better. But Aarong and Yellow brand had marker efficiency 78 % and 84 % and scored lower in the Higg Index tool. Similarly, a single colored, screen printed logo with small area received a higher score of for foreign branded T-shirt and these issues scored lower for local branded T-shirt. The total points for manufacturing stages are shown in table 1.

##### 4.3 Packaging

Product packaging was included in this assessment. Conventional materials were used for local branded T-shirt, which did not provide any score points. But PUMA and

others T-shirt used only sustainable, third party verified and reduced packaging materials and obtained better score. The packaging score are shown in table 1.

#### 4.4 Product Care and Repair Services

For PUMA S. Oliver and Esprit T-shirt, best class to low impact details care instructions were provided due to the required care of the chosen materials that scored higher i.e. 18 for PUMA. But for Yellow and Aarong T-shirt, there were no in details care instructions that led to lower score in Higg Index i.e. only 4. Proper care instructions should be provided to the product label as most of the water and energy is used by the customer during the care and repair service stages.

#### 4.5 End of Life

The all five T-shirt products received 60 points and a base score 9 for product end of life. The PUMA product is made from 100 % organic cotton and other branded T-shirt made from conventional cotton. These individual material types can be accurately identified by end of use facilities or processes. The material types be recycled via existing infrastructure and processes or materials be used in closed-loop recycling processes were not known. So the EOL stages obtained average score i.e. 60 % and no additional points were given. The overall score for the all five T-shirt were 9 points and as is shown in table 1.

### 5. SUGGESTIONS FOR APPAREL PRODUCTS SUSTAINABILITY IMPROVEMENT

The researcher has identified many technical requirements issues for apparel products sustainability improvement based on Higg Index assessment tool.

#### 5.1 Sourcing Fair Production & Practice Transparency

Sourcing fair production can be performed by selecting manufacturers that are known to operate in a socially responsible manner. For the technical requirement of practicing transparency, the researcher suggests a hangtag including maximum in details information to the products that includes the name and contact information of a hypothetical manufacturer. This would allow a customer to verify socially responsible methods were practiced when the product was produced.

#### 5.2 Sourcing Local Production

Local production is a valuable asset to improve product sustainability. This will also improve the social and economic sustainability of a product.

#### 5.3 Consider Waste Reducing Design Adjustments and Sourcing Clean Production

To reduce waste, the researcher suggested using eco-friendly dyeing method like reduced water dyeing or waterless dyeing method for the fabric processing. An on-product label with instructions to recycle, reuse of the product, thus reducing waste, should be added to the label. Clean production can be achieved by selecting manufacturers that make a commitment to the use of alternative or renewable energies.

#### 5.4 Consider Organic and Natural Fibers

Natural fibers are often viewed as the most environmentally responsible as they come from renewable sources and use less energy and chemicals to produce than manufactured fibers. Eco friendly fibers and production

methods that demand fewer natural resources and use the forces of nature to their benefit should be used.

#### 5.5 Source of CMT Production

In order to replicate the possible effects of sourcing CMT production, the researcher decided to identify only one manufacturing facility instead of two or more in the Higg Index 1.0 to determine if fewer facilities results in a better score.

#### 5.6 Consider Natural and Low Impact Dyes & Chemicals

The designers, manufacturers and merchandiser should introduce natural and environmentally low impact dyes in materials processing to better product sustainability.

### 6. CONCLUSION

The textile and apparel industries are notorious for their excessive contribution of waste and pollution to our environment. The unsustainable practices trends of poorly designing, raw materials selection, processing, manufacturing and disposable of apparel product is a major contributing factor to this problem. The purpose of this study was to evaluate the environmental sustainability of various branded T-shirts and find out different sustainable issues for greener apparel products. Based on Higg Index environmental assessment standard tool, the findings of this study could be helpful for many organizations & customers who attempt to produce and consume sustainable textiles and clothing products. Both the local and foreign branded products should be produced by strictly maintaining sustainability issues. Hence this study is a little approach towards better sustainable practices and eventually would drive the textile and clothing designer, manufacturers, merchandisers and consumers to introduce various sustainable issues in their works. Hence, growing awareness and leading them towards sustainable practices in the textile and clothing business for greener world.

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