"The Green Portfolio" Product lifecycle assessment of the sustainable collection

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***Abstract*- The globe is becoming more environmentally concerned, especially with apparel. During the past ten years, sustainable fashion has been steadily growing, and it now appears that it will take off. This calls for numerous adjustments in the sector, ranging from sustainable raw materials, packaging to consumer spending. In this essay, current changes in the mass-market fashion sector are discussed, along with potential and challenges for integrating lifecycle thinking into mass-market design processes. A quantitative method for evaluating the apparel products environmental impact is life-cycle analysis. Although life-cycle thinking is rarely taken into account in the quick-paced, price-driven mass market's design processes, this article investigates its potential and offers suggestions for how it may be applied.**

***Keywords*: Garment lifecycle assessment, sustainability, sustainable supply chain management.**

1. INTRODUCTION

For the fashion industry to move towards a more socially and environmentally responsible industry, change to existing processes would need to occur at all market levels. This study is predicated on the idea that the mass market is where change is most urgently required because of the higher volume usage and thus greater environmental effect. The product life cycle in the mass market starts in the design room and concludes on the sales floor. This life cycle would be expanded by a design process redirected for sustainability, which would evaluate the effects of each stage of the life of a fashion garment, from the ethical production of fibre and textiles to the socially responsible manufacture of the garment.

To understand this approach better, a comparison has been made for an apparel brand where the PLCA score has been given to the products made from conventional raw materials/ procedures and sustainable raw materials/ procedures.

1.1. Product lifecycle assessment

Life-cycle assessment is a quantitative tool that assesses the environmental impacts of materials and products. The scope of research into sustainable fashion is demonstrated using the garment life-cycle evaluation (Figure-1). The designer can prepare for the effects the product will have on input (the impact of raw material extraction during pre-production) and output by using life cycle thinking (the emissions and waste generated by the product during production, use and disposal). (Payne, 2011)

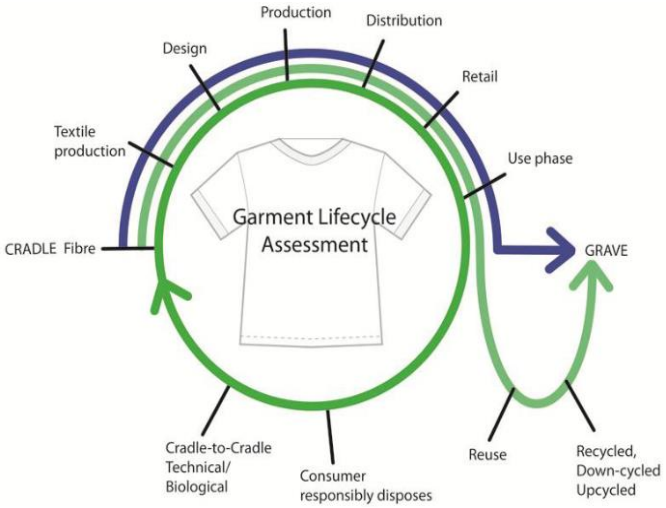

Figure-1: Garment life cycle assessment
(Illustration by Alice Payne)

2. METHODOLOGY

A systematic review looking to evaluate the different stages of the garment lifecycle. These stages are: fiber selection, textile production, design process, manufacturing, distribution, and retail.

Major sources of the database are: industry visits, research gate, google scholar, fibre to fashion, science direct. Few research papers and articles studies were identified, reviewed and few are included in this study.

3. DIFFERENT STAGES OF PRODUCT LIFE CYCLE

3.1. The fiber selection

Fibre selection is the stage where the garment's life cycle starts. The selection of fabrics for fashion design can be challenging when designing for sustainability. For instance, producing polyester only utilises a small amount of the water needed to cultivate organic cotton, despite the fact that polyester comes from a petrochemical, non-renewable source. Although bamboo is a sustainable and renewable resource, the process of turning it into fibre is energy and environmentally intensive. What results is a difficult set of compromises that a designer must work out. The three fibres that are most frequently utilised in the mass market in Australia are cotton, polyester, and regenerated cellulosic fibres like viscose. The businesses should work to get away from conventional cotton and polyester monocultures, which have substantial environmental impacts. This can be accomplished by looking into a wide range of fibre choices.

3.2. Textile production

Textile manufacture comes next in the garment life cycle. Poor working conditions and toxic waste discharged into the environment have been closely examined during the spinning, weaving, dyeing, and finishing stages of textile production. Although waterless dyeing methods and naturally colored cotton are key developments, their costings, and volume currently make them unaffordable for the mass market.

Nonetheless, there are ways for manufacturers to make a difference by choosing raw materials that have less of an adverse influence on the environment and society.

3.3. Garment design

When designing for sustainability, the design step of the clothing life cycle is crucial. The choices taken at this step could affect how much of an impact the garment will have on the environment. A designer might decide, for instance, to design with zero waste, working with the patternmaker to reduce textile waste when the garment is cut. Whether designing for the mainstream market or the upper end, a designer may decide to create "classic" clothing that can buck seasonal trends and be worn for a longer period of time.

3.4. Manufacturing

The next stage of the garment's life cycle is manufacturing. Designing for sustainability entails investigating issues like whether the lives of workers are sustained during production or are they being exploited. Local manufacturing allows for closer monitoring of working conditions. As a result of violations of human rights in the production of fibre and textiles as well as in the manufacturing of clothing, there are growing calls for transparency in the fashion supply chain. It is challenging to evaluate the designer's contribution to this. A designer frequently strives to target costing in the mass market where prices are the focal points.

3.5. Distribution

As it is the company's best advantage to cut its freight costs, sustainability and the economic motivation of the mass market do not conflict in the field of distribution. The cost of transportation, both economically and environmentally, will always be a problem for the fashion business.

Another alternative can be the usage of E-vehicles to reduce the carbon footprint.

3.6. Retail

The product is then placed on the store floor from this point. It is uncommon to think of the retail experience as a factor in the design process. Yet, in terms of designing for sustainability, the retail sector presents a chance to interact with customers in novel ways, for as by putting in place a system for forecasting demand. The benefit of a forecasting system for sustainability is that it can predict the appropriate option with the right quantity at the right time, hence lowering the volume of products made while still meeting consumer demand. Organisations can lower their deadstock with this method.

3.7. Reuse and cradle-to-cradle alternatives

The process of fashion design needs to take the end-of-life of a product into account more. Every year, over millions of textile products, many of which might be recycled or reused, end up in landfills. Designers can take the disposal phase of the life cycle into account, too, by creating clothing that can be recycled or deconstructed after use. To properly dispose of clothing at the end of its useful life, businesses can collect it. Used clothing can be donated to the disadvantaged section of society, so it is important to design them to last longer and be made of higher-quality materials.

The mass market faces a significant difficulty because it is pushed by low cost and quick turnaround, which always results in a loss of product quality. Reuse and recycling are still more environmentally friendly options than continuously using virgin materials to create new items, even though the product journey may eventually end in a grave of landfill or cremation.

4. LIFE CYCLE MODELS

There are generally four product life cycle models (figure-2).

4.1. Cradle-to-grave

Cradle-to-grave analysis refers to the examination of a product's effects over the course of its five stages of development. Grave is where the product is disposed of, with the cradle being the beginning of the product with the sourcing of the raw ingredients. Although it is stated that step 3 involves transportation, all steps can actually involve it. (EcoChain, 2023)

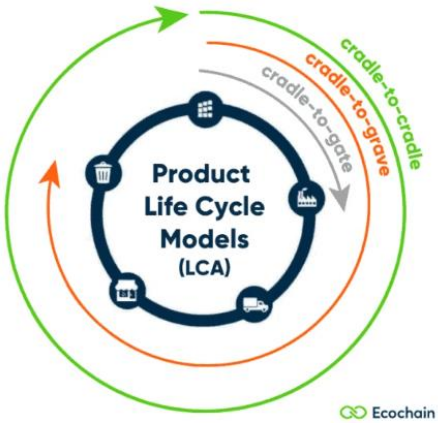

Figure-2: PLCA models (Illustration by Ecochain)

4.2. Cradle-to-gate

Cradle-to-gate evaluations don't begin until a product has left the plant and is being delivered to the customer. This entails skipping the usage and disposal stages. An LCA's complexity can
be reduced through cradle-to-gate analysis, which can also lead to the creation of insights more quickly, regarding internal processes. Environmental product declarations (EPD) frequently involve cradle-to-gate evaluations.

4.3. Cradle-to-cradle

The phrase "cradle-to-cradle" is frequently used in relation to the Circular Economy. A version of "cradle to grave," it "closes the loop" by replacing the trash step with a recycling procedure that makes it useable for another product. For this reason, it is also known as closed-loop recycling. (Ecochain, 2022)

4.4. Gate-to-gate

Gate-to-gate is occasionally used in product life cycles where there are numerous procedures that provide value in the middle. Only one value-added step in the production chain is evaluated to reduce evaluation complexity. These evaluations might be combined to finish a higher-level Life Cycle Assessment.

5. PLCA PARAMETERS

The product lifecycle consists of five phases:

- Raw Material Extraction
- Manufacturing & Processing
- Transportation (can occur between all the phases)
- Usage & Retail
- Waste Disposal (Brusseau, 2019)

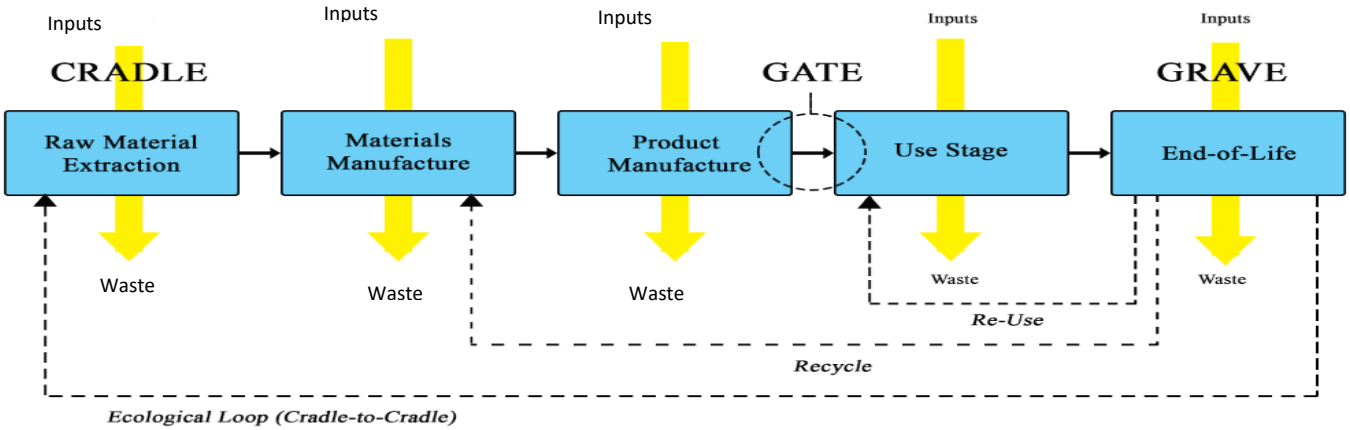

Figure-3: PLCA models and parameters

6. 'The green portfolio'- Range planning

The sustainable collection has been planned for the brand ABC with 35 options. The products are the part of spring summer-24 (SS'24) tradeshow.

The core products of the brand were considered for the sustainable collection.

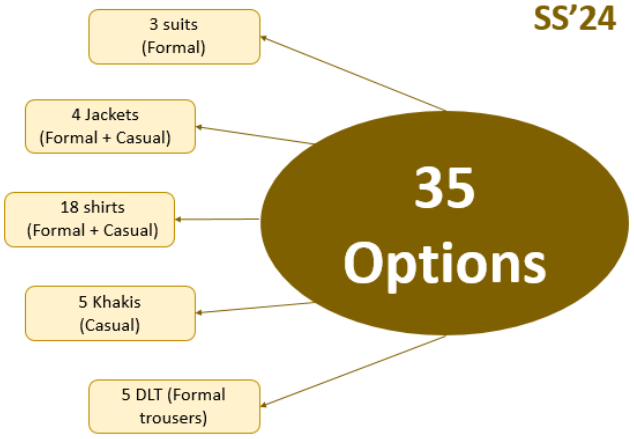

Figure-4: Product classification for the sustainable range

Key focal points were considered while planning the raw material procurement for the sustainable collection

a) *Selected organic or recycled materials:* Opted for materials made from organic fibers like organic cotton or recycled fibers such as recycled polyester or nylon. These materials are sustainable options as they reduce waste and have a lower environmental impact.

b) *Looked for certifications:* There are various certifications available that ensure that the raw materials are sustainable. For instance, look for materials certified by organizations like the Global Organic Textile Standard (GOTS) or the Bluesign System.

c) *Supported local producers:* Choosing materials produced locally can reduce the carbon footprint of the production process. Local sourcing also supports the local economy and promotes sustainable agriculture.

d) *Considered the entire supply chain:* Apart from the raw material itself, consider the entire supply chain involved in producing the material. Factors such as the energy used in production and transportation should be taken into account when evaluating the sustainability of a material.

e) *Looked for sustainable chemicals (considered RSL):* The chemicals used in textile production can have a significant environmental impact. Emphasized over using natural or low-impact chemicals that have minimal environmental impact.

f) *Considered sustainable trims and accessories:* Consumers are becoming increasingly aware of the environmental and social impact of the products they purchase. Sustainable trims can help to meet this demand for sustainable products and differentiate a brand from competitors.

By adopting these strategies, the apparel brands can procure sustainable raw materials and contribute to a more sustainable garment collection which includes widely sustainable products.

7. THE SUSTAINABLE MATERIALS

Figure 5 includes all the available sustainable fibres at the selected fabric vendors, whereas the fabric vendor selection has been done on the basis of the sustainability certifications they have (Figure 6).

Figure-5: Sustainable fiber types used for the sustainable collection

Figure-6: Sustainability certifications

7.1. Sustainable fabric alternatives

ROC product blends	Sustainable fabric blend	Construction	Count	GSM	Weave	Price/mtr (INR)	Sustainable alternative fibres	Price/mtr with sustainable fibres
P/V/LY	RP/EV/P/LY	37/16/41/6	2/44-1/170	230	2/2 twill	275	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	302.5
P/V/L	RP/P/EV/L	30/32/33/5	2/30-2/30	210	plain	250	R-Elan (polyester), liva reviva (viscose), Linen	275
P/V/EL	RP/EV/P/EL	33/23/41/2	2/30-1/170	195	plain	225	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	247.5
P/V/Sp	RP/P/EV/S	30/34/34/2	2/40-2/40	247	2/2 twill	230	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	253
P/V/EL	RP/EV/P/V/EL	29/33/34/1/2	2/30-2/30	239	plain	235	R-Elan (polyester), liva reviva (viscose)	258.5
P/V/EL	RP/EV/P/EL	33/23/41/2	2/30-1/170	195	plain	225	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	247.5
P/V/Sp	RP/P/EV/S	30/34/34/2	2/40-2/40	247	2/2 twill	250	R-Elan (polyester), liva reviva (viscose)	275
P/V/LY	RP/EV/P/LY	37/16/41/6	2/44-1/170	230	2/2 twill	275	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	302.5
P/V/L/EL	RP/EV/L/EL	26/67/6/1	2/40-2/40	250	Fancy dobby	290	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	319
P/V/LY	RP/EV/P/LY	30/32/33/5	2/30-2/30	280	Plain	295	R-Elan (polyester), liva reviva (viscose),Lycra ecomade	324.5

Table 1: Sustainable fabric alternatives for suits, jackets and formal trousers

Fabric	Count	Construction	Blend	Fabric variance	Price/mtr (INR)	Sustainable alternative blend	Price/mtr with sustainable fibres
Cotton-spandex	30*20+20K.SPX(70D)	161*70	98%COTTON 2%SPX	Dobby	230	BCI cotton+ Lycra ecomade	276
cotton/polyester/elastane	2/30 C x1/55 NM	102 x 82	C/P/ELA 67/31/02	Yarn dyed	281	67% Recycled Cotton 31% Recycled Poly 2%Lycra ecomade	337
Cotton/ spandex	50*20 spdx	230 X 94	97% cotton 3% spandex	Satin	256	97% BCI cotton 3% creora	307
100% cotton	30*20 spdx (40 D)	182 X 78	98% cotton 2% spandex	Dobby	240	98% BCI cotton 2% lycra ecomade	288
Cotton/ spandex	2/50 X 2/50	140 X 84	100% cotton	Dobby	305	organic cotton	366
Cotton/ spandex	40*30spdx(40 D)+10 spdx	166 X 80	97% cotton 3% spandex	Dobby	253	97% BCI cotton 3% creora	304
Cotton/nylon/spandex	60S/C+(50D/N+40D)		56%Cotton 36%nylon 8%SPANDEX	Knit	318	56%Organic cotton 36%nylon 8%Lycra free fit	398
cotton/Spandex	16x16+70d	76 x 134	98% cotton 2%spandex	Corduroy	360	98% BCI cotton 2% Lycra freefit	450
Cotton/nylon/elastane	40 X 195D + 20 SPDX	114x76	74%CO 20%NY 6%EA	Dobby	286	74% BCI CO 20%NY 6%Lycra ecomade	343

Table 2: Sustainable fabric alternatives for khaki trousers

Fabric	Count	Construction	Blend	Weave	Price/mtr (INR)	Sustainable alternative blend	Price/mtr with sustainable fibres
Cotton Linen Solid	30 Ne X 40 lea	76X44	CottonLinen 76/44	Plain	260	BCI/organic cotton, Linen	312
100% Linen solids + Checks+ Stripes	60 lea X 60 lea	60 X 52	100% linen	Plain	500	Linen	500
Pique Solids	2/50 X 2/50	160 X 100	100% cotton	Plain	650	Organic cotton	780
CVT Solid stylised + Print	60 Ne X 40spx	198 X 74	97% co 3% EA	Plain	240	Bamboo, Lycra Ecomade	288
Cotton linen print	30X 44 lea + 20 Ne	76X 52	70% co 30% linen	Plain	280	Recycled cotton, linen	336
Super white dobby		50X 50	100% cotton	dobby	270	Ecovero/ organic cotton	324
Oxford solid + Check + Print+ Stripe	40X 16 spx	113X 52	100% cotton	oxford	180		216
Temptech Dobby	50x50--2/80		Poly cot	dobby	470	60.54% org, 39.46% RTCP co (37.5 biodegradable polyester)	564
50/60's twill check+ Stripes	50 X 50	147 X 96	100% cotton		250	Organic cotton	300
Vigo stripe mid tones + Check	50X50	142 X 102	100% cotton	2/1 twill	240	Recycled cotton	288
ELPP solids + Checks+print	40 X 2/30	120X 48	Linen	oxford	200	Recycled linen/ linen	240
Hemp	36 Nml hemp X 36 Nml hemp	61 X 52	Hemp	Plain	410	Hemp	492

Table 3: Sustainable fabric alternatives for casual shirts

Fabric	Count	Construction	Blend	Weave	Price/mtr (INR)	Sustainable alternative blend	Price/mtr with sustainable fibres
NL Desire (print)	60 X 60	210 X 104	100% cotton	Plain	225	Refibra	270
quint dobby	50 X 50	180x102	100% cotton	Dobby	260	Organic cotton	312
ELPP (Solid+ stripe+ print+ check)otto	50 X 50	144 X 102	100% cotton	z twill	195	organic cotton	234
Cotton Knit (Solid) ko1		65/66 CM 120/2 + spx 30 DXCM 120/2 + SPX 30D	cotton elastane		715	Organic cotton, Sorona	858
Solid satin (Stretch and non stretch)		210 X 104-non stretch,223 X 90 stretch	cotton elastane	Satin	300	Organic cotton, Lycra Ecomade	360
Non Iron premium dobby shirt	57/58 CPT + CM 80/2 X CM 100/2	180 X 110	100% cotton	Dobby	300	BCI, Sorona	360
Cross tone shirts	50 x 50	152 X 96	100% cotton	Plain	248	Refibra	297.6
Striped shirt	36 NML X 20/ 1 LSR	65X 52	70% linen 30% sorona	Plain	500	70% linen 30% sorona	600
Hemp	36 Nml hemp X 36 Nml hemp	61 X 52	Hemp	Plain	410	Hemp	492
Supima checks			100% cotton		340	Organic cotton	408

Table 4: Sustainable fabric alternatives for formal shirts

7.2. Sustainable trims and accessories

Figure-7: Sustainable buttons

Figure-8: Sustainable trims and accessories

In current scenario, many brands are claiming themselves as sustainable brand by implementing only sustainable fabric types to their collections. Sustainable trims and packaging materials can help a clothing brand differentiate itself from its competitors. With more consumers looking for sustainable options, a brand that uses eco-friendly materials can stand out in a crowded marketplace.

Sustainable fiber tags can be an effective way for consumers to make more informed choices about the products they buy and their impact on the environment. They can also encourage fashion brands and textile manufacturers to prioritize sustainable and environmentally friendly materials in their production processes. Refer figure 8. These tags help the consumers by providing better transparency and visibility of the manufacturing processes.

Figure-8: Sustainable fibre tags

8. PLCA Score of an apparel brand ABC- Sustainable v/s Conventional collections

The below mentioned table is the comparative analysis of a conventional collection and the sustainable collection of an apparel brand ABC. The scores are given to both the collections on the basis of the focus area and related parameters mentioned in the table itself.

Product Lifecycle Assessment (Conventional v/s Sustainable products)

S. No.	Focus area	Parameters	Condition	Score weightage	Obtained score (Conventional collection)	Obtained score (Sustainable collection)	Justification
1	Fabric vendor assessment	Environmental management systems Company have an environmental management system (EMS) covering waste generation, energy usage, water usage, and carbon emissions	100% suppliers	3	1	3	Measure AQI, having smoke sensors for hazardous gases within the facilities
			> 50% suppliers	2			
			< 50% suppliers	1			
2	Fabric vendor assessment	Environmentally certified raw materials	> 80% suppliers	3	1	3	Liva reviva by ABFRL (For sustainable viscose fabric), RElan by Reliance (For recycled polyester fabric), Self-certification by WFB (For recycled linen fabric), GRS certification for recycled fabrics)
			50-80% suppliers	2			
			< 50% suppliers	1			
3	Fabric vendor assessment	Environmentally certified products	> 80% suppliers	3	1	3	GRS, Oeko tex standard 100, Fair trade, BCI cotton, GOTS, ISO certifications
			50-80% suppliers	2			
			< 50% suppliers	1			
4	Fabric vendor assessment	ZDHC certified	> 80% suppliers	3	1	3	Zero discharge of hazardous chemicals
			50-80% suppliers	2			
			< 50% suppliers	1			
5	Fabric vendor assessment	Sustainability certification for the facility	> 80% suppliers	3	1	3	STEP, Higgs
			50-80% suppliers	2			
			< 50% suppliers	1			
6	Fabric vendor assessment	Monitoring energy usage	100% suppliers	3	3	3	By comparing the records
			< 50% suppliers	0			
7	Fabric vendor assessment	Renewable energy usage	100% suppliers	3	1	2	Usage of solar energy
			> 50% suppliers	2			
			< 50% suppliers	1			
8	Fabric vendor assessment	Monitoring green house gases	Yes	3	0	3	Have sensors to the chimneys to detect pollutants in the emitting air through exhaust
			No	0			
	Fabric vendor assessment	Water conservation practices	100% suppliers	3	2	3	Rain water harvesting and reusing treated water
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	Supply chain water management and monitoring	100% suppliers	3	2	3	Water usage is measured
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	Have their own ETP	100% suppliers	3	3	3	Effluent treatment plant to ensure that the discharged waste water is not harmful for nature
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	BOD, COD, and TOC is measured before disposal	100% suppliers	3	3	3	BOD (biochemical oxygen demand), COD (chemical oxygen demand), TOC (total organic carbon)
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	Monitoring and reporting non hazardous waste	100% suppliers	3	1	2	Records are maintained
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	Hazardous waste authentic disposal	100% suppliers	3	2	3	Hand over to government certified disposal area with record maintenance
			> 50% suppliers	2			
			< 50% suppliers	1			
	Fabric vendor assessment	Monitoring total waste recycled	100%	3	1	2	Documentations and reports are maintained.
			> 50%	2			
			< 50%	1			
	Fabric vendor assessment	Supply chain chemical management	100% suppliers	3	1	3	Have chemical management system (CMS)
			> 50% suppliers	2			
			< 50% suppliers	1			
	Environmental concern	The products or processes are structured to restore or preserve the environment in any way	Yes	3	0	3	Through an innovative deveopment/ manufacturing of multitude garments which is designed to significantly reduce environmental impact compared to typical practices for the industry
			No	0			
	Environmental concern	Green building certification	Yes	3	0	0	Future scope
			No	0			
	Environmental concern	Audits for facility's environmental management system	Yes	3	3	3	Internal audits
			No	0			
	Environmental concern	Have you ever conducted a formal assessment to measure the environmental footprint of your value chain (including supply chain, product usage, and end-of-life).	Yes	3	0	3	This format can be used for the tentative assessment. A standard certification (B corp, Higg index, etc.) can be implemented for further assessments.
			No	0			
	Environmental concern	Does your company monitor, record, or report its energy usage?	Yes	3	3	3	By comparing the annual consumption
			No	0			

Product Lifecycle Assessment (Conventional v/s Sustainable products)							
No.	Focus area	Parameters	Condition	Score weightage	Obtained score (Conventional collection)	Obtained score (Sustainable collection)	Justification
2	Environmental concern	Does company uses energy produced from renewable resources	Yes	3	0	0	Planning for solar energy utilisation
			No	0			
3	Environmental concern	Has your company adopted any of the techniques for minimizing the transportation-related environmental impact of its distribution and supply chain?	Yes	3	3	3	E- vehicles are used for internal transportaion troughout the facility
			No	0			
4	Environmental concern	Does water conservation methods have been implemented at the majority of your corporate offices or plant facilities	Yes	3	0	0	Not yet
			No	0			
5	Waste management	Does your company have any of the following recycle/reduce/reuse programs in the facilities?	Yes	3	0	3	The unwanted fabric cut pieces are sent to shredding units and for reusability purpose for various small industries. The bigger fabric yardages of previous season are sent to local market.
			No	0			
6	Waste management	Does your company track and manage waste in your supply chain?	Yes	3	3	3	Records are maintained for waste disposal
			No	0			
7	Waste management	Does your company follows any practice to reduce waste to landfill after the usage of your product and/or its packaging?	Yes	3	0	3	Planning take back programme
			No	0			
8	Chemical management	Does your company track and manage toxins or hazardous waste in your supply chain?	Yes	3	0	3	Looking for vendor's sustainability cetificates.
			No	0			
9	Packaging	Does your company minimize the environmental impact of the packaging of your products?	Yes	3	0	3	By introducing recycled polybags
			No	0			
11	Packaging	Has your company adopted and implemented a preferred and restricted packaging materials list? (e.g. virgin fibers must be from FSC-certified forests, no fibers from old growth or endangered forests, minimum	Yes	3	0	3	Recyclable packaging material
			No	0			
12	Environmental awareness	Does your company educate its customers about the environmentally preferred packaging materials it has used or its initiatives to reduce packaging?	Yes	3	0	3	Mentioned details for packaging materials
			No	0			
13	Environmental conern	Does your company assess the environmental impacts of its products during customer use and at end of use?	Yes	3	0	3	Maintaining PLCA to evaluate sustainability at each stage
			No	0			
14	Environmental conern	Does your company provide customers with a product take-back program/offering?	Yes	3	0	3	Suggested the plan
			No	0			
15	Product	Does your company assess the environmental impacts of the products it sells?	Yes	3	0	3	Maintaining PLCA to evaluate sustainability at each stage
			No	0			
16	Product	Does your company track the percentage of products it sells that have sustainability attributes?	Yes	3	0	3	The percent share has been counted for sustainable collection
			No	0			
17	Product	Does your company have a means of communicating the environmental attributes or certifications of its products to customers?	Yes	3	0	3	Sustainable tags explaining sustainability at each level
			No	0			
18	Product	Does your company have an integrated scorecard that helps factor both business and sustainability criteria into purchasing decisions from supliers?	Yes	3	0	3	The brand will provide sustainable fibre tags with products
			No	0			
19	Product	Does your company assess the environmental impacts of the materials used to create its products?	Yes	3	0	3	Maintaining PLCA to evaluate sustainability at each stage
			No	0			
20	Manufacturing	RFT (Right first time)	More than 90%	3	2	2	80-85%
			80-90%	2			
			Less than 80%	1			
21	Manufacturing	Cut to ship ratio	equal to 1	3	1	1	95-98%
			Less than 1	1			
22	Manufacturing	Marker efficiency	More than 90%	3	2	2	(Shirt- Checks: 84-85%, Solid: 87-88%), (Khakis- Checks: 82-85%, Solid: 86-89%), (DLT trousers: 86-89%)
			80-90%	2			
			Less than 80%	1			
23	Manufacturing	Cut pieces/ remnants disposal (waste management)	Yes	3	3	3	the cutting waste is send for shredding (recycling) and bigger panels are sent to other small industries for reuse purpose
			No	0			
Final score				129	44	113	

Table 1: Comparative analysis of a conventional collection and the sustainable collection of a brand ABC

9. Result

The difference in scores between a conventional collection and a sustainable collection can be evaluated from table-1.
The table is self-explainable encountering the difference in scores of both the collections and how they are impacting the environment.
The table comprises of 43 questions each with a maximum score of 3, hence the maximum score for this evaluation is 129. The collection made up of conventional raw materials and procedures gets a score of 44, whereas the sustainable collection gets a score of 113, which is undoubtedly better.
This comparative analysis gave an eye-opening insight into the through-and-through apparel product life cycle and its impact on the environment.

10. Discussion

After implementing the sustainable approach to each step, 'the green portfolio'-the sustainable range has been planned. To check the effective impact of the sustainable collection, a PLCA has been done for the conventional and sustainable collections of the same brand. The focus areas for the comparative analysis were raw material procurement, sustainable certifications, garment manufacturing & processing, transportation, product usage & retail, and waste management.
Depending on the effect, the type of clothing, and the material, it varies. It is obvious that comparison at the fibre stage cannot give an accurate ranking for garments of different materials. Hence an accurate PLCA requires each and every stage of the product lifecycle.

11. Limitations

Sustainability is a vast area and it is difficult to cater to each and every parameter. The perception and parameters for sustainability in fashion industry might differ from person to person.

Despite the rise in the popularity of sustainability rankings, it is difficult to verify the validity of these assessments and the criteria used for evaluation. Sustainability evaluation is difficult, especially in cases where the value chain is extensive and the products are varied in terms of raw materials and their different processing methods.

12. Conclusion

Many fashion brands are marketing themselves as sustainable brands at the moment by using only eco-friendly fabric types in their collections. A brand can stand out from its competitors by using eco-friendly trims and packaging materials along with those sustainable fabrics.
Producers are accountable for the things that are sold in the market, and designers should use this conceptual framework to address the effects of their products.
The fashion industry has come under growing scrutiny as a major cause of environmental problems worldwide. A common method for examining how a product's life cycle affects the environment is called life-cycle assessment (LCA). Identification of people and organizations whose interests should be taken into consideration when creating a policy or project is done systematically through the process of stakeholder analysis. By combining stakeholder analyses and life-cycle assessment, this research offers a conceptual and analytical framework for incorporating these factors into the design of fashion goods, enabling a methodical and comprehensive response.

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