



Application of Eco-friendly Textile Fiber in the Context of Sustainability

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ABSTRACT:-

The term "eco-friendly fabrics and textiles" refers to a certain category of fabrics and textiles that have a lower carbon, energy, and environmental impact when compared to the conventional method used to make fabrics and clothing manufacturing. Eco-textile fibres like organic fibres, manmade fibres and recycled fibres are used in the formation of fabric and garments to support sustainable fashion, also called eco-fashion. Today, customers have changed through the years and gained understanding about materials and manufacturing strategies, which has prolonged their desire to make ethical alternatives and update their wardrobes. The goal of this review article is to apprehend the modern country and exercise of sustainability innovation with inside the fabric industry, which focuses on environmentally friendly fibres, production techniques, and sustainable manufacturing processes.

Keywords: - Eco-friendly Fibers, Sustainability, Textiles industry, Eco- fashion, technology

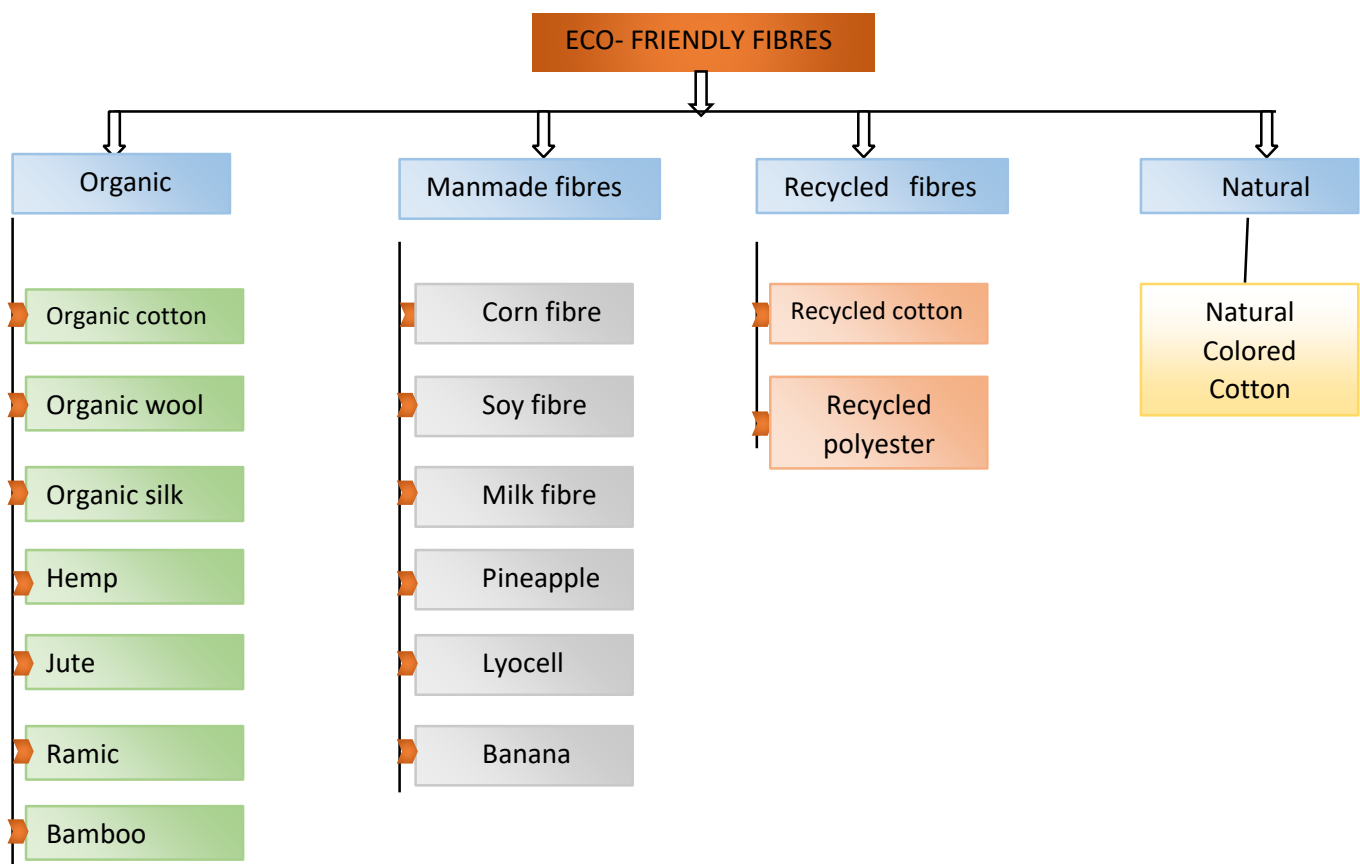
I. INTRODUCTION

The design, manufacture, and distribution of textiles, together with garments, yarn, and material, are the number one issues of the fabric commercial enterprise. [5] Because the fabric commercial enterprise is 1 of the maximum technologically superior and environmentally negative industries with inside the world, several improvements are made to guard our mom planet. [3] One of the international businesses that meet basic daily necessities for people is the textile sector, which employs tens of millions of people globally. Since that it is the second-most essential human need after food and water, this is not surprising. [4] The second-biggest employment-generating quarter in India is the fabric enterprise, which has produced substantial employment for each professional and unskilled exertions with inside the enterprise. [5] The transformation procedure is likewise pretty complex, starting with fibers and yarn and finishing with fabric that contain diverse operations and bring diverse kinds of precise merchandise. [4] The fabric enterprise produces a number of merchandise, those merchandise locate end-use utility throughout more than one non- traditional industry, inclusive of agrotextiles, automobile textiles, production textiles, geotextiles, business textiles, scientific textiles, packaging textiles, defence textiles, aerospace, and game textiles. [4'6]

II. ECO- FRIENDLY TEXTILES

Eco-pleasant fabric refers to any fabric that has been created and reused in an environmentally responsible manner. Ecotech and Okeotech are two terms for ecotextile in environmental engineering. [1] A wide variety of natural and recycled fibers are used in eco-friendly textiles and fabrics. As comparison to the normal method used to create fabrics and clothes manufacturing, "eco-friendly fabrics and textiles" refers to a particular class of fabric and textiles which have a decrease carbon, electricity, and environmental effect. [2] In general, there is not actually any such issue as a hundred percentage green garments due to the fact all garb calls for electricity and water (for the increase of the fibers) (to make the material and the very last garments). [3] Therefore, green garb may be described as garb fabricated from herbal fibers like natural fibers (cotton, wool, silk, hemp, and jute), manmade fibers (corn, pineapple, and banana), recycled fibers (cotton and polyester), naturally colored cotton fibers, clothing that has been dyed organically with vegetable and plant-based dyes, and clothing that uses little water, dynamism, and chemicals that are dangerous to the nature.

2.1- Classification of Eco- friendly Fibres



2.2 Organic Fibres

1. **Organic cotton-** Natural cotton refers to clearly formed cotton without utilizing any artificial agrarian chemical, along with diseases, germicides or transgenic technology. [7]
 - Biodegradable
 - Wicks away sweat
 - Breathable
 - Soft
2. **Organic wool-** Organic wool is a herbal, renewable, biodegradable and sturdy fibre that comes from farms that placed animal welfare and the surroundings first.[8] natural wool isn't processed with harsh chemical substances and that comes from farms with green practices [9] Wool is a very practical cloth with several significant qualities that make it incredibly alluring. One of wool's main advantages is that it effectively absorbs moisture by luring it into the fiber's center.[3]

3. **Organic silk-** Without using any chemical substances or remedies regarding insecticides, insecticides, or artificial fertilizers, natural silk (additionally referred to as uncooked silk) is produced. Agriculture this is environmentally pleasant makes use of natural and sustainable methods. Of course, uncooked silk degrades certainly. While a few natural silk is certainly dyed, herbal dyes also are used to make herbal silk colors [10] advantage of silk is that it luxurious and cool to touch, soft, smooth and hypoallergenic, very lightweight, beautiful drape qualities, Breathable, shrinkage can be restored by ironing.
4. **Hemp-** Cannabis plant stems are used to make hemp, a natural plant fiber. Hemp is the most environmentally friendly crop in terms of sustainability. The hemp crop helps replenish soil nutrients and enhance soil health while using little water to develop. One of the stronger textile textiles, it is also biodegradable. Moreover, hemp cloth has anti-radiation, anti-bacterial, and insulating qualities.[11]
5. **Bamboo fibres-** One of nature's most sustainable resources, bamboo is completely biodegradable and has a built-in ability to regenerate itself. After being removed from the plant, the bamboo is crushed, and the partitions are then damaged down right into a pulp the usage of herbal enzymes in order that the herbal filaments can be automatically trolled out and twirled into yarn the usage of a lot of procedures. Natural antimicrobial, hypoallergenic, and thermal-regulating properties characterize bamboo cloth. It is also mold-resistant.
Bamboo's porous structure allows it to breathe and wick moisture away. Moreover, bamboo has a silky-cashmere texture and a wonderful drape. [12]
6. **Jute-** originally, it was processed by hand because to its texture. In phrases of utilization, global consumption, manufacturing, and availability, it's far the second-maximum extensive vegetable fiber after cotton. Carpet, clothing, composite materials, upholstery materials for furniture, and ornamental color boards are all made with jute fibers. Jute non-woven fabrics have numerous uses in geotextiles, meditech, agrotech, and protech.[12]
7. **Ramic-** Ramic is a very sustainable, environmentally beneficial fibre. It is 8 instances extra-long lasting and sturdy than cotton, and it receives even more potent while it receives wet. Ramic is a flowering plant, and it could be harvested up to 6 instances in a success yrs. after the vegetation begin to open. Ramic has an integrated defence in opposition to rot, insects, mild damage, and germs in addition to mildew and mildew. Herbicides and insecticides are not needed for healthy growth.[12]

2.3 Manmade organic fibres

1. **Corn -** A relatively new development in textiles is corn fibre. It is a synthetic fibre produced from renewable resources. A variety of textiles and uses are produced from the fermentation of simple plant sugar derived from corn. Another name for corn fibre is Ingeo fibre. The fibre has very high melting point, Good clarity and high crystallization levels. The fibre has a high strength that is comparable to regular poly fibre; hence its application is fairly widespread. The hand feel, brightness, and other qualities of corn fibre are comparable to those of lustrous silk. According to reports, clothes made of corn fibre have outstanding after-wash look, quick drying, and effective soil release. [13'14]
2. **Banana-** These fibres, which are formed of densely walled cell tissues, are joined together by natural gums. The intermediate layers are often employed after the removal of two to three outer sheaths. The plant's outer layer produces difficult fibres which might be extraordinarily fragile, and the innermost sheaths also are rejected due to the fact they comprise pulpy material. With cotton or different artificial fibres, it is easy to combine.[12]
3. **Alovera-** Aloera has many advantages for the skin, but it also imparts some interesting characteristics to the cloth itself. Because it's far certainly anti-bacterial., it keeps clothes fresher and reduces body odour. It is demonstrating to be an interesting and advantageous fibre for the wearer.[12]
4. **Soy Fibre-** This lower recognized 100 percent biodegradable verdant textile is drafted from tofu- fabricating waste. Soy protein is thawed and also stretched into long, non-forestall guts which may be lessen and reused like a many no identical spinning fibre. Because soy has inordinate protein content, the substance can be veritably open to natural colorings, so there's no want for synthetic colorings, so there's no want for artificial dyes. [12]

5. **Pineapple-** With other fibres, pineapple fibres blend well. Pineapple fiber-based fabrics have a classy appearance. The application of pina fabrics for hometech, car mobitech, and geotech is commendable after numerous inventions.[12]
6. **Lyocell-** This fibre is made from the biodegradable lumber pulp utilizing chemical- free processes. Non-toxic detergents are applied in its product and also reclaimed, developing a fabricating expressway with veritably little derivate (still, it sounds detect it insolvable to repel nonetheless uses a ton of dynamism, so it's now not full.) It can be connected with special guts to produce textile like SeaCell (Lyocell and Seaweed, demonstrated over) and Hempcel (Lyocell and Hemp.) [12]

2.4 Recycled fibres- Recycling of fabric waste offers grittiness an alternate cultures in a rejuvenated cultures circle and as an end result will balloon the exclusive value of that reclaimed fibre. Still outside of recycled guts end up in low value wares, so the evolution of recent better value wares from recycled guts will encourage application of the waste guts and make a donation to the unborn sustainability of assiduity. [15] Fibres can be recycled mechanically or chemically. Recycled cotton prevents extra fabric waste and calls for some distance fewer sources than traditional or natural cotton. This makes it an exquisite sustainable option. [16]

2.5 Process adopted for eco-friendliness fabrics.

Some enlightened mainly technique had been evolved to lessen the poisonous releases and this guarantees the enhancement of Eco-pleasant nature fabrics. Some of them indexed below.

Table. 1

Technology	Process	Advantage
Enzyme technology	Different type of enzyme uses in textile for different process. Mostly used enzyme is hydrolases. Laccases & cellulose enzyme used in finising, amylase in desizing, protease, lipases & cellulose use for wool and silk treatment.	Replace harsh chemicals Biologically degradable Acts as a catalyst No pollution
Foam technology	It is made via way of means of colloidal gadget such as a mass of fueloline bubble in a liquid non-stop phase. This remedy used for pretreatment, dyeing, printing & finishing,etc.	Batter colour Super levelness No pollution Minimum wash
Super critical fluid dyeing Technology	In this era sure fueloline use the region of water solvent. Because of excessive diffusion price and occasional viscosities fueloline are permit the dye to penetrate into the fibre.	Cheapness Non – toxicity Enhance ecology Elimination of water pollution
Plasma technology	Plasma era has partly ionized gases that encompass ions, electrons and impartial particles. In this technique plasma fueloline produced at managed ecosystem and strain via way of means of	Low impact dyeing Eco-friendly bleaching Polluted free water Environmentally friendly finishing

making use of low frequency electric current.
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Sources: - poonam k. et.al (2013)

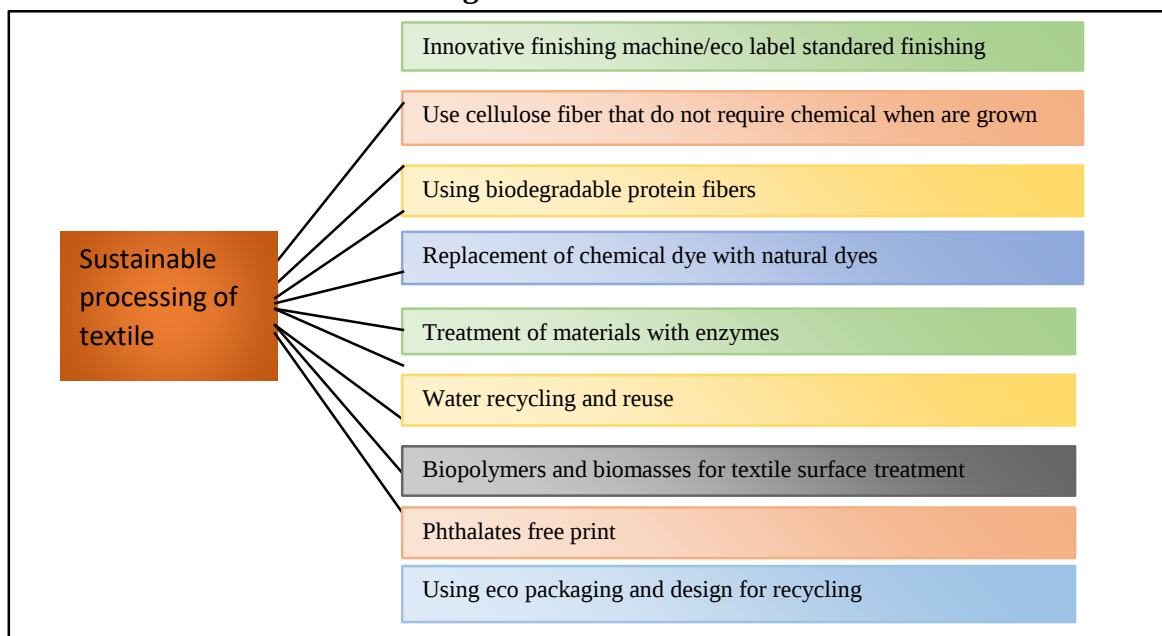
3. Sustainable Textile - It is a well-known concept that the fashion and textile industry is one of the most polluting industries in the world. The planet has a major impact on the pollution of the textile industry citing several reasons; mainly the purchasing behavior of consumers has changed in recent times with the introduction of the concept of fast fashion. The stages of textile production include bleaching, dyeing, etc. Contribute to a large amount of toxic waste and thus make an important contribution to making it more sustainable. [18]

Sustainable living is getting increasingly important in the 21st century as the jolt of mortal product and waste inescapably becomes putative. The tenure has been applied to food product, transnational trade, marketable assiduity and now also to the cloth assiduity. [19] The goal of sustainability is to create a cycle of behavior that produces the greatest long-term benefits for as many people as possible. Sustainable textiles start with sustainable materials. Once sustainable materials are available, we need to insure that the factual product of fabrics is also done responsibly. Of course, recycling the textile itself is also a sustainable method. For textiles, this is achieved by using natural or recycled fibres, reducing the use of pesticides, animal welfare, using environmentally friendly dyes, promoting fair treatment of textile workers, and many other actions. [19]

3.1 Requirement of sustainable textile: - Focusing on sustainable textile materials, sustainability plays a key role in textile processing and every step. Today's requirement is to be able to produce eco-friendly goods, serve customers and the environment, and support the economy of the company. The fabric enterprise began out in agriculture and has moved to retail. Textile production affects the surroundings in lots of methods i.e., via the intake of water in cotton cultivation, the intake of electricity in all processes, and the usage of chemical substances and substances in processing. And the enterprise is continuously searching for answers to issues which include pollution, fitness issues, worldwide warming and environmental issues, global warming and environmental issues. The maximum critical sustainability element is the environmental effect that takes place throughout the manufacturing of style and fabric items. In addition, many nations forget the social duty and monetary factors of style and fabric manufacturing, a worldwide problem. [20] And the industry is constantly trying to find solutions to problems such as pollution, health issues, global warming and environmental issues. The maximum critical sustainability element is the environmental effect that takes place throughout the manufacturing of style and fabric items. [21]

3.2 Step towards sustainable textile: - Implemented via way of means of numerous fabric processing industries which include eco pleasant bleaching (Peroxide bleaching), green dyeing (low effect resistant dyes, herbal dyes, azo-unfastened dyes) and printing (phthalates Free print). Also the sustainable processing of textiles consists of organic remedy of textiles. [22, 23]

Figure. 1.



III. METHOD AND MATERIAL

This review composition paper was prepared utilizing information from the collection of review and exploration papers accessible in nonidentical databases, similar as Scopus, Web of science, Google Scholar and s other Web sites. The database seeks changed into primarily based totally at the key phrases utilized in context of sustainable style and fabric manufacturing. Major Key phrases that have been used together with: environmentally friendly fibres, production techniques, sustainable manufacturing processes, sustainable innovations and technology. The search was limited to article published between 2013 and 2023 and type of paper comprehended substantially published papers in colorful diurnals, congregation proceeding, and exploration theses (Masters and PhD). Out of these, an aggregate of 25 to 30 papers were named for the study.

IV. RESULT

4.1 Recent Innovation of Eco- Fabrics

Table. 2. Some recent Eco-fabrics

S.no	Material	Process	Innovated product
1.	Apple leather	Apple leather- grounded is a bio-primarily grounded completely textile made the operation of apple with the aid of utilizing- wares from the juice assiduity. When apples are pressed to produce juice, we are left with apple pomace and peels. Those with the aid of using-merchandise comprise a number of cellulose content, that's terrific for generating new fabrics. It is frequently used to supply footwear and small add-ons like wallets or handbags.	

2.	Leaf leather	Leaf leather-based is a plant-primarily based totally leather-based opportunity crafted from tree leaves (normally Teak leaves). It is powerful and water-resistant, and the leather-based functions the herbal layout of leaves, making it particular and stunning. The drying technique bonds them, which leaves us with a big sheet of leaf cloth this is then mended with cotton cloth. Before it is able to be sewn into add-ons, a skinny BOPP movie is implemented to make the cloth water-resistant and extra durable. Tree Tribe and Jungley each create cool wallets, luggage and journals out of leaf leather-based	
3.	Vegea	Wine leather-based, is a material crafted from leftover grape skins from winemaking, vegetable oils in addition to different herbal fibers from the agroindustry. It is envisioned that for each 10 liters of wine produced, 2.5 liters of waste are created. Thankfully, this waste may be up cycled into one rectangular meter of wine leather-based. To produce Vegea, the grape marc, which includes grape skins, stalks and seeds, has first to be dried. After this step, its miles mixed with vegetable oil and water-primarily based totally polyurethane. The blend creates a bio-primarily based totally cloth this is lined into a material.	
4.	Orange Fabric	An Italian agency, Orange Fiber, determined to do something positive about it and created a sustainable cloth crafted from orange juice with the aid of using-merchandise. To produce orange fiber, the agency makes use of loads of heaps of lots of orange waste. It extracts the cellulose from the peels the usage of its patented technique and turns it right into a fiber this is spun into yarn. Then, it's miles woven right into a silk-like cloth this is tender and lightweight. It also can be vivid or opaque relying at the very last use.	

5.	Lotus fabric	Made from the lotus flower, lotus cloth seems like a mix of silk and linen, and it's miles breathable and wrinkle-resistant, which makes it perfect for garments and add-ons. It is likewise tender to the touch, stain-resistant and 100% water-resistant. The manufacturing technique of lotus cloth is stimulated with the aid of using historical techniques. It is sustainable and really time-eating in view that it's miles finished with the aid of using hand. Once the stems of the lotus plants are harvested, employees delicately extract the microfibers from the stems with the aid of using hand. The fibers are then dried, and they're cautiously rolled right into a thread so that it will be used to weave clothing. You can locate stunning garments and add-ons crafted from lotus plants at Jungley and Lotus Paradis	
6.	Banana fiber	Used because the thirteenth century, banana fiber is a green material that has been slowly however really revolutionizing the style industry. Banana fiber is crafted from a banana tree's stems and stalks. The stems are without a doubt a derivative of the banana tree due to the fact they're usually discarded while the culmination are harvested, that can handiest be carried out as soon as withinside the tree's lifetime. There are distinctive manufacturing methods, however the maximum regular one includes stripping off the sheaths of the banana stem, layer via way of means of layer till we're left with handiest the fibers. Then, the fibers are dried, and finally, they're knotted collectively the use of a twisting technique.	
7.	Coconut fiber	Coconut grittiness is one of the herbal filaments abundantly to be had in tropical regions, and is uprooted from the cocoon of coconut conclusion. It's also appertained to as coir grittiness. Coconut grittiness is uprooted from the external pod of a coconut.	

Sources- sustainable-chic.com, Huzaifa Wazir (2020) & <https://textilelearner.net/>

4.2. Role of consumer in sustainable textile

More and more young consumers are interested in preserving the environment and tackling social concerns through sustainable consumption now that sustainable consciousness is on the rise. The research reveals that, despite fast fashion customers' continued ignorance about the eco-textile business, eco-fashion strategies are becoming more and more significant in the fast fashion (eco-fabric) market. The customer has been impacted as a result of the fast fashion industry's increased importance of sustainability. [26] Together, corporate leaders and politicians must create sustainability innovation in the textile sector as consumer demand for eco-friendly products and regulatory requirements increase. [4]

4.3. Current status of sustainability in textile industry

To begin with, using organic materials and effective procedures are no longer the only aspects of sustainability in the textile and apparel industries. Sustainable fashion seeks to laboriously contribute to the evolution of burgeoning communities and ecosystems. This may number raising the value of locally produced goods and services, dragging the useful lives of accoutrements, elevating the value of archetypal apparel, cutting waste, and lessening environmental damage caused by product and consumption.[27] Sustainability invention practices in expressions of product invention stripes encompass ecodesign, ecolabel, actuality circle valuation, substances, and packaging; procedure invention consists of cleaner manufacturing, ecoefficiency, waste running, deliver chain operation, and enzymatic fabric processing; and association invention consists of EMS and company procedure, collaboration, marketable company interpretation invention, expressway of life and see- how operation.[4] sustainable fashion not only covers clothing but now days jewellery and luxury items are also in demands.

V. DISSCUSION

At present, the demand for eco-friendly items is increasing. Eco friendly items are slowly making their place in market. The aim of this article is to present the innovation and current status of sustainable textile. The result found that, in the last few years, the demand for sustainable fashion is increase in market and in last few years a lot of new innovation related to eco-fibre and research have been happen in textile industry. From the fibre manufacturing to fabric making and marketing eco- friendly textile have been made their place. Now days the consumers of new generation have also become aware about the sustainable development and many branded companies are also doing sustainable manufacturing and promoting eco-friendly nature. But there is lack of knowledge about eco- fibers and the products are also very high in price. So make it more accessible to more people their need to more awareness about eco-friendly textile product.

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