

Sustainable and Environmental Friendly Fibers in Textile Fashion

A Study of Organic Cotton and Bamboo Fibers

BY

Muhammad Adnan Ali

Muhammad Imran Sarwar

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Supervisor:

Rudrajeet Pal

Examiner:

Heikki Mattila

Abstract:

In recent times sustainability is a leading characteristic of textile fashion products. Textile fashion companies are focusing more on sustainable products these days, so that they can meet the environmental and social aspects. For getting competitive advantage in fashion business the companies have to take care of social, political and economical issues, and they must be aware of current trends of the market. Sustainable fibres provide solution for the companies facing issues regarding environmental problems; these fibres are also favorable to meet the market demands of quality products these days.

The main objective of this report is to use the sustainable materials in fashion garments; the report contains rich information about two natural sustainable fibres (organic cotton and Bamboo), that describes the brief history, biography, development, processing, application and uses of these fibres. This report briefly describes the advantages and disadvantages of these fibres and underlines the usage of these fibres by famous designers, and by many top brands and fashion companies for their competitive advantage and brand image. The report highlights the potentials of using these materials in textile fashion products and describes that high fashion and quality products can be made by these products to guarantee the environmental and social standards.

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1. Introduction:

From thousands of years human beings are using natural fibers obtained from both plants and animal sources, these natural fibers are used in different industries for making useful products and having different types of applications. Some of these are textiles, food, energy, constructions, medicines, paper industry, etc. Natural fibers grow naturally and did not harm the environment until fertilizers, pesticide and other harmful chemical are used to enhance their production. Natural fibers grow all over the world and rightly fulfill the existing needs and demands. In developing countries many poor people (farmers) have this profession and are making good money out of it for their survival.

At the start of 20th century suddenly changes occurred and new developments were made in the field of synthetic fibers. Their higher and prompt production and other properties reduced the demand of natural fibers and captured the big market share rapidly. But the generation of synthetic fibers involved many chemicals and harmful substances that were not favorable for the environment and society. The environment legislation and awareness among customers resisted the use of synthetic fibers and forced the textile companies to use again the historical, ecological natural fibers. So to minimize the use of synthetic fiber because of environmental issues enhanced companies and people's interest towards natural and sustainable fibers. And this attraction of natural fibers forced Companies, Industries, researchers and technologists to find new and innovative ways of growth, development, cultivation and use of natural fibers in sustainable way.

Cotton is a giant of natural fibers and has big market share in textile products, but its cultivation involves the extensive use of pesticides, growth fertilizers, chemicals and consumption of large amount of water that gives rise to environmental and economical distress. Other than cotton there are also natural fibers like hemp, flax, organic cotton and bamboo that can be used instead of cotton that are resource efficient. Furthermore cotton and synthetic fibers cover the major markets but due to attractive properties of other natural fiber, these fibers are used by the textile companies and will be used in the future of textile industry and are called the fibers of 21st century. The revival of these fibers back in industry is beginning of sustainable approach and these movements and changes help us to secure our planet.

Out of these fibers the most popular one is the organic cotton that is a sustainable alternate of conventional cotton and is very inn in the market and textile fashion. Many fashion

companies are working with organic eco-logical fashion and trying to continuously improve the standards and use of sustainable materials in their product line. Bamboo is another natural sustainable fiber having great potential for textile fashion product applications because of its extraordinary sustainable properties that serves the environment as well as human being in different ways. Fashion companies can survive in the market on the behalf of products that are beneficial for environment and bring comfort in daily life of consumers.

1.1 Scope of Research:

The primary aim of this research project is to create and build awareness among textile fashion companies and other members of whole value chain of fashion products to use the sustainable materials in the product life cycle. It will ensure a check of source and originality of the product from its raw form to the finished product form until it reaches the ultimate consumers.

The project represents the study and research of sustainable fibers (Organic cotton and Bamboo).In this project we provide vision for fashion companies about extraordinary uses and applications of these sustainable fibers to get the competitive advantage in the market. Project briefly describes the story from history to the present use of these fibers for different applications. It will help the designers and companies to change their way of thinking and develop new products with vision and aim of sustainability.

1.2 Methodology:

The research work is based on qualitative analysis of Bergman Sweden AB and collection of data and literature review from different resources like books, research papers, journals, reports and other electronic data sources. This data was then combined for analysis to under pin the main areas of concern under the guidance of our supervisor from our institute. Then after analyzing the data, it was finally assessed and discussed for conclusions and recommendations.

1.3 Limitations:

In the research work describing sustainable materials we limited and concentrated our study on Organic Cotton and Bamboo Fibres. Today a lot of natural sustainable materials are available and some are used in textile products but we have chosen the practical fibers having extraordinary properties that fits in any textile product and adds value to the company products, these fibers have wide range of applications with premium quality.

2. Sustainability:

After globalization all over the world the economic growth changed rapidly in the developing countries and the issue of environment rose at the same time because most of the production and manufacturing units were shifted to these countries. In developing countries environmental issues are not considered as priority, but it is a big threat for the entire world. (Prakash u.d.)

Sustainability is the word used to save the planet in the future. Today with increase in population the use of products and their wastes have been increased and have caused hazardous impacts on the environment. This has drawn the attention of organizations and policy makers for sustainable development. The most suitable definition of sustainability recommended by the world Commission on Environment and Development is **‘meet the needs of the present without compromising the ability of future generation to meet their needs and desires’**. (World Commission on Environment and Development u.d.)

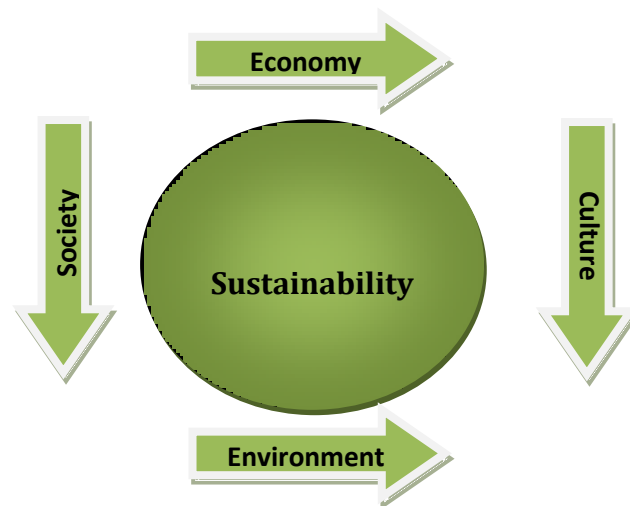


Figure 1: Sustainability Concept. Source: Self Illustrated

Sustainability is working on four main features like economy, society, culture and environment. And the question for future is to make and fulfill the demands and desires by keeping in view about all the wastes and extra materials we are disposing off without thinking about upcoming new generation, future and environment; because we have to save the Planet in future. To overcome and solve these issues we need complete and efficient management systems along with resources to implement these systems. (Prakash u.d.)

2.1 Role of Sustainability in Textile:

Focusing on textile sustainable materials the term Sustainability plays a vital role in textile processing and in all steps. As today requirement is to produce goods that are eco friendly and have ability to serve the customer as well as environment and also support the economy of the company. We take an example of cotton T Shirt; we see that a number of steps are involved in its processing from Cotton fiber to finished goods on the shelves. i.e. the first step is growth of cotton in which different types of harm full pesticides and chemicals along with a lot of water are used, so we can produce the organic cotton which can be grown without using chemicals and harm full materials and also less water is required for it; thus we can save the use of Water and harm full chemicals. We can see that in initial steps how many things we are doing against the environment, move further to the forward steps we consume energy resources, packaging materials, etc. So it is not the responsibility of Government and company management it is responsibility of individuals who use the product and then discard it. Furthermore sustainability is a concept and model that has realized the entire textile sector that the increase in demand and desires of the customers influence their spending behavior on which the textile industry mainly depends. (What does sustainability of textiles mean? u.d.)

In the textile industry it starts from agriculture and move towards the way to retail. Textile manufacturing industries have impact on environment in different ways i.e. use of water in growing cotton, energy consumption in all processes and use of chemicals and materials in the processing. And the industry is always trying to find some solutions for problems like pollution, health matters and global warming and environmental issues. To answer and overcome these issues technologies and innovative strategies are there. So the need is to create awareness among the company management and people. And it does not affect the company cost to implement these steps and the money will be back from the efficient supply chain and competitive advantage in the market. (Scrimshaw 2009)

Efficiency is fundamentally linked with sustainability. Making “more with less” is the heading step towards sustainability. If different companies and brands produce the goods with quality and using less energy and less inputs, than these companies will grow and make profit naturally, and it will also be beneficial for environment. (Scrimshaw 2009).

2.2 Sustainable Agriculture and Environment:

There are many things connected to agriculture industrialization that have serious effects on environment, because a lot of pesticides, chemicals and water required in growing the crops. In order to achieve crop production in higher yield, a lot of fertilizers, pesticides and chemicals along with water are being used from recent decades. As a result of this surface run-off of nitrogen, phosphoric emissions of nitrogen compounds and leakages have negative impact on environment. In 1950's the use of fertilizers was much less as compared to these days. The Western Europe is working on eco friendly plantation and varieties of vegetables and fruits are produced by using new technologies and innovative management systems. The condition of agriculture production is worst in the Eastern Europe as compared to Western Europe because of soil quality. Sustainable agriculture means to manage the resources efficiently to satisfy the needs and desires of the people in the shadow of eco friendly products that can help us to keep our environment sustainable. (Ebbersten 1997)

Things kept on changing with the time and textile researchers tried to find solution for the impacts of textile industry on the environment. So more and more textile manufacturers, producers tried to use and look for Biodegradable and sustainable fibers for their products to overcome the impact of textile harmful chemicals and non eco processes and find some solutions by new and innovative technologies and processes. Biodegradable fiber comes from sustainable sources and is eco friendly in characteristics. (R.S.Blackburn 2005)

Textile products are made, sold, used (reuse) and in the end discarded all over the world. So different technologies, processes, methods and procedures are used in the life cycle of textile product from fiber to garment stage and these all processes work on the way constructed by market key players like business men, politicians and technologists. Globalization brought all new ways and changed the old procedures, policies and a paradigm shift occurred. Because after globalization in the area of fibers, raw material, Government made regulations and retail brands, buyers and multinational companies build new standards and rules for setting the price and quality. The same things fits for Dyeing, processing and biological processes in the finishing. (Tobler-Rohr u.d.)

The development in Spinning, Weaving, Dyeing, Finishing, Cutting and Stitching machinery and technology took more than decade to shift into new era. Million of Euros and Dollars were invested in research and development of these techniques and ideas. In mature technology, the new innovation is requirement for making the system and processes reliable

and efficient, and this can be achieved along with performance in economy as well as ecology. These aspects of ecological and resources are considered by term Sustainability that is increasingly recognized by the customer. (Tobler-Rohr u.d.)

Data and information about sustainability is provided by scientists in specific area, environmental sciences, biology, Social Science, toxicology and many more. Most of the people don't know about the product and its background they are using in their daily life. Young generation that is more trendy and fashionable don't know what they are wearing and from where it is coming or whether it consists of any harmful material or not. So the need is to make awareness among the new generation and try to guide the old one about the sustainability and how we can keep check on our daily life product about their origin and materials in it. Sustainability helps the firms and companies to become more stable economically as well as environmental friendly. (Tobler-Rohr u.d.)

2.3 Materials:

The fashion industry has philosophy to encourage the consumers to throw away the old products (that are still serviceable) they are using and buy the new and more stylish products, is now emphasizing to reserve and preserve in order to be the part of efforts for sustainable development. (Hochswender 1990). When we are going to talk about the sustainability in textile fashion the first thing that strikes in our mind is the material because materials are the starting point for making a textile product and they play a significant role in making the textiles and fashion products good looking and appealing. Fashion is a central characteristic in textile and clothing industry these days. Design and fashion in clothing cater for basic human needs for clothing and for protection and at the same time fulfill the demand for decoration and beautification. The centrality of fashion textiles in human culture reveals that it is the forefront of both technological and artistic development. (Fletcher 2008)

Different types of natural and synthetic fibers are used in producing fashionable textiles. Two main types of textile fibers are used in textile fashion, these are natural and manufactured. Natural fibers are derived from animal and plant resources while manufactured fibers are made from synthetic materials and sometimes also from raw materials derived from plant and animal resources. The demand for fibers for textile fashion products manufacturing is increasing all over the world, but unfortunately today the

textile industry is dominated mostly by few and similar raw materials. Idea of diversity in the materials used in textiles is hard to find, In textiles all over the world cotton and polyester are the mostly used fibers; these fibers together contribute about 80% of the worldwide market in textiles. Demand for polyester fibers has been doubled in last 15 years, and is most popular and required textile material after cotton. This results in large scale production of limited fibers in a specific agricultural sector that reduces the customer choice and increases many risks like ecological and environmental risks. (Fletcher 2008)

We should concentrate on producing different kind of fibers that are more resource efficient. For example instead of conventional cotton we should grow organic (low chemical) cotton, hemp and flax that need less pesticides and water for their production. Similarly instead of polyester we can produce renewable and biodegradable fibers such as Bast fibers and Alginate fibers, these fibers have low impact on environment and decrease our dependency of oil for polyester production. This will result in the cultivation and promotion of fibers that have potential to fulfill our raw material needs with less resource consumption, it will also promote local agriculture with more varied and regional fibers, more benefits for local farmers, more jobs and ultimately more social, economical and environmental benefits. So diversity in raw materials provides a way of sustainability in textile fashion. (Mantford u.d.)

Table 1: Textile Fibre Types. Source: (Fletcher 2008)

Natural Fibres		Manufactured Fibres	
Plant Resources	Animal Resources	Synthetic Polymers	Natural Resource
Cotton	Silk	Polyester	Rayon
Hemp	Wool	Acrylic	Modal
Jute	Cashmere	Nylon	Lyocell
Flax	Mohair	Olefin	Carbon fibers
Ramie	Qiviut	PVC	Acetate
Bamboo			
Sisal			
Banana			

2.4 Importance of materials:

Materials play a significant role in producing the sustainable fashion products in textile industry; the materials dominate our ideas about economical, environmental and social responsibilities, because there are many steps involved in the production of natural fibers and man-made fibers and also the conversion of raw material into a finished fabric and ultimately finished garment involves several steps and different resources like labor, energy, water, chemicals etc. Many complicated chains and processes are also involved in manufacturing industry for making a fashionable textile product. Several aspects do need attention relating to quality control, environment and sustainability in the production of a fashion product from agriculturally produced fibers. There is a need to be careful and cautious about the usage of resources. So by choosing the more resource efficient and culturally responsive fibers that use fewer resources and produce less waste and pollution we can begin to design the textile products and production systems that are sustainable. (Fletcher 2008).

While designing the sustainable textile fashion products we should think and know about the sustainable materials and systems for production, where in each step from raw material to final product we are more resource efficient, social and environmental friendly and the materials is first ladder towards this approach. Textile products produce a lot of waste and pollution even after their usage when they are replaced with new ones. So recycling is needed to reduce this waste & pollution and recyclable materials can be supportive to some extent in these reductions. Our common reaction towards environmental problems is to reduce the waste after it has been produced but the concept is changing now; there is a need to be clean from start of the manufacturing so that less waste and pollution is generated. So the materials are starting point here, the choice of materials that are recyclable and resource efficient is the right way towards sustainable development in textile fashion. The fashionable companies are now using the sustainable fibers as raw material for their products in order to move away from 'end of pipe' approach to clean manufacturing. (A.R.Horrocks 2007).

2.5 Sustainable materials:

Textile fashion industry is focusing more on the concept of sustainability, for this purpose textile fibers are being promoted that are naturally sustainable and have low impact on environment. Natural fibers like organic cotton, bamboo, flax, hemp, jute, ramie, sisal,

abaca, etc, are the examples of sustainable fibers in textile industry. As the sustainability is influencing the businesses these days, people have realized that it is not just a craze but a concept for their survival. Though lot of resources in the form of energy and water are used during fabric finishing and garment manufacturing but the producers in textile industry are thinking about the sustainable contribution prior to fabric formation. So use of sustainable fibers as a raw material for producing textile fashion product is an approach towards sustainability from the starting point. (Holme 2009).

There is lot confusion in sustainability impacts of producing the textile materials. Generally natural fibers are mostly considered as more sustainable and synthetic fibers are considered less sustainable. This assumption is based on the fact that natural fibers production needs less consumption of resources than synthetic fibers and also synthetic fibers have impact on people and environment. But the fact involves much more, though production of synthetic fibers needs lot of resources for their production, but the cotton cultivation has also high impacts, for growing cotton large amounts of pesticides, fertilizers and water is needed. For producing 1 kg of cotton needs 8000 liters of water, while producing 1 kg of polyester uses less water, however it needs twice energy for its production when we produce the same amount of cotton. Organic cotton or low chemical cotton is a sustainable alternative of conventional cotton as it has social and environmental benefits, because organic cotton production is characterized with no use of synthetic pesticides, fertilizers and less water consumption. (Khatri 2008).

The fibers also have other social and ethical impacts, the emission of carbon while producing synthetic fibers is a major issue these days, so there is need of carbon neutral fibers for example plant fibers like bamboo and Lyocell, these fibers absorb the same amount of carbon dioxide gas from environment during their growth as they release during their production cycles, thus helping in keeping the atmosphere clean. Synthetic fibers consume lot of oil during their production, so there is a shift from oil-based non-biodegradable synthetic fibers like polyester and nylon towards renewable and biodegradable synthetic fibers produced from natural resources like Lyocell and PLA (Poly Lactic Acid). So these natural plant fibers and synthetic fibers made from natural resources are naturally eco-friendly, less resource consuming, recyclable and sustainable.

2.6 Green movement in the clothing sector:

Early 1990's, communities and companies all around the world start taking interest in green movement. The thought developed to use eco friendly products like organic cotton, bamboo fibers, biodegradable detergents and papers made from managed and controlled forests, these all product sold and market under the label 'eco-friendly'. But after some time customer realized and dissatisfy because the quality of the product is not up to the mark as the price charge to the customer. The story of the eco friendly fabric and garment is almost similar. (A.R.Horrocks 2007).

Esprit Company launched their first collection made of organic cotton with natural dyes called 'Ecollection'. This collection have big market at that time and make good out it but after some time customer lose their interest because of less color range and dull colors, for example PATAGONIA made new innovative product: Fleece jacket made from recyclable PET plastic bottles. This product has strong success in market and a lot of other companies start coping and follow the same procedure and start making fleece jackets from PET bottles and this give rise to cheap fleece jackets in the low standard market. Some of the manufactures are using different materials, in result of this a lot of cheap fleece jackets are in the market that are actually not made from recycled materials. (A.R.Horrocks 2007).

This green movement is like trendy fashion that hit in the season and vanished after a sometime, to uphold this development it must be associated with the long term benefit and profit of the company. In USA the use of organic fiber (Cotton) starts in the food products and the same trend followed by UK. The UK the researcher starts to find the ways towards safer food products. This innovation generates a thought in the mind of the people that they start to find the whole supply chain of the product from start to end process. And new trends introduce that give rise to growth of organic and fair trade food products and use of organic cotton in the textile and clothing sector to give rise to sustainable fashion products. (A.R.Horrocks 2007).

In this era the fashion business boom up and watching this opportunity the fashion designer Katharine Hamnett make a plan and introduce an ethical fashion business in spring 2005.

So it is found that these products have very vast and brilliant response and demandable in the recent years. The question that arises is whether the products are recyclable or not. The uses of organic and recyclable products both are beneficial for the environment. The use of organic cotton is better than the conventional cotton because it grows without pesticides,

herbicides and chemical. Organic cotton provides comfort for the end use that it does not cause any harm to skin of the end user and very good for skin sensitive people like babies. (A.R.Horrocks 2007)

On the other hand recyclable materials are also good for environment because the materials and product recycled by applying few process so it generates less waste at the end. But for the customer the question is still there that what type of recyclable materials are using in product and from where it comes. Every year scientists, professors and researchers gathered their information, share their views and ideas around the world to discuss their latest findings in the textile industry. They share their results, comparisons, research data, lab tests on various types of fibers and fabrics to share their new innovative and successful ideas and knowledge to find how it might have impact on the textile industry and either our research is eco friendly and how we go further in that way. (A.R.Horrocks 2007).

2.7 Fiber:

Fiber is the start raw form of Fashion textile products, the whole product processing and methods depend on the fiber. In textile many fashion companies are making research on fiber and raw materials to make their product feel soft, smooth, lustrous and comfortable for the user. (Akira 2000)

The raw material of fibrous goods (Fiber) can be categorized in two types on behalf of their production. The fiber can be natural fiber and man-made fiber. Natural fibers are available on the earth from history and man-made fibers are in used from recent years. There is a lot of innovation made in use of these fibers in products e.g. apparel, garments and home textile and to make these product efficiently new and innovative technologies and production methods developed. Research continues in textile sector and the use of natural fiber increases as compared to manmade fibers. (Akira 2000)

Natural fibers are obtained from natural resources like plants, animals and minerals. It can be further classified in different form according to their generation. Manmade fibers are also made in two type Regenerated fiber and synthetic fibers. Regenerated fibers have molecules in thread-state and can be separated by organic natural things and in synthetic fibers molecule thread produce chemically. (Akira 2000).

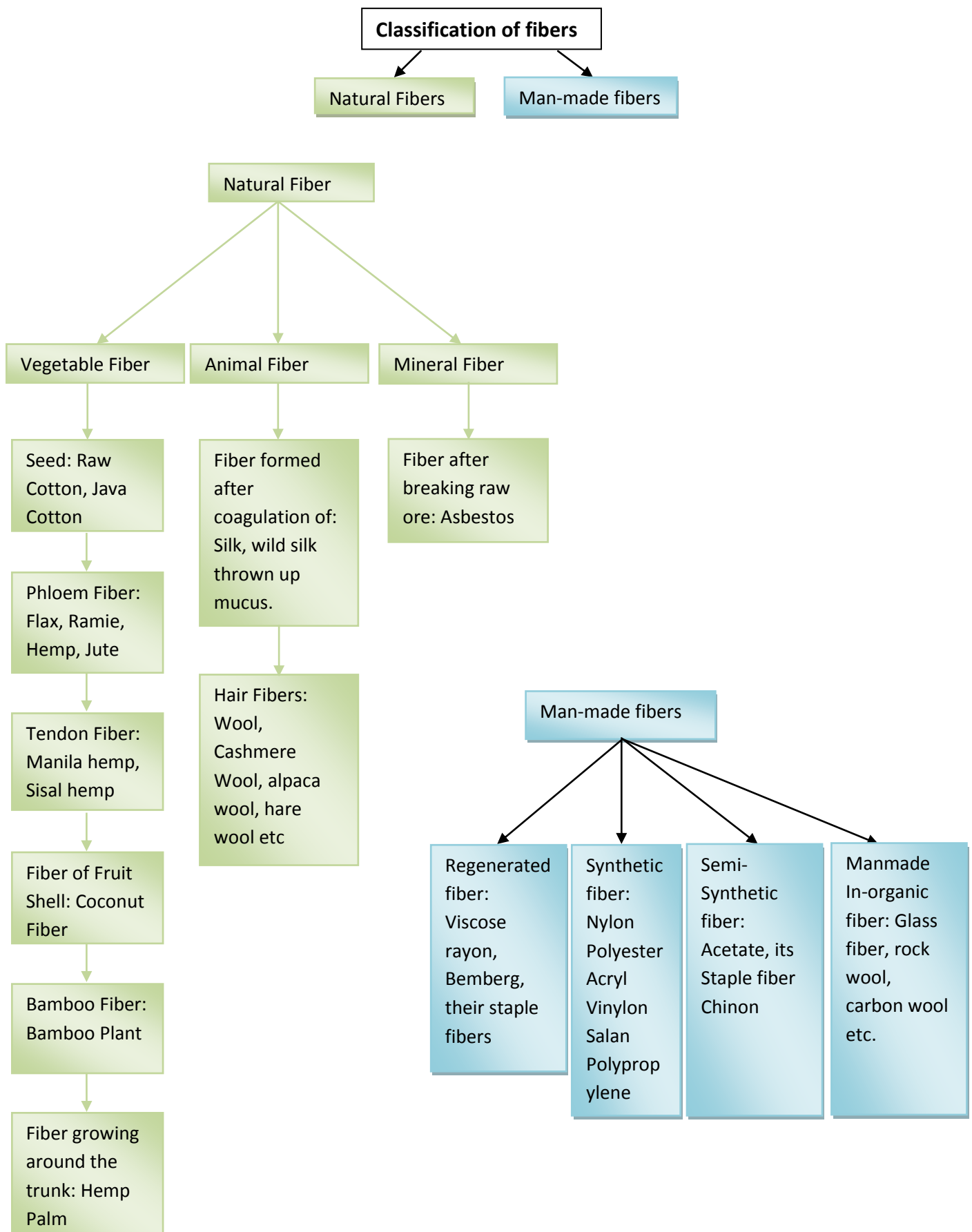


Figure 2: Classification of Fibres. Source: (Akira 2000).

3. Organic Cotton:

3.1 History and Background:

Cotton is a main part of textile industry and has been produced since ancient times. According to the Foods and Nutrition Encyclopedia cotton was grown for the first time in Mexico about 8000 years ago. The species (*Gossypium hirsutum*) grown at that time is the mostly planted species today in the world and is known as American Upland Cotton; it contributes about 89.9 % of worldwide cotton production. Cotton was cultivated 7000 years ago by the people of Indus valley civilization; Indus valley was the part of sub-continent in Asia and comprises of western part of Pakistan these days. (Australian Government, Department of Health and Ageing 2008).

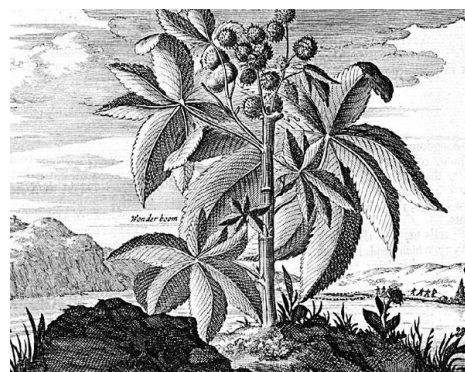


Figure 3: Cotton Plant.
Source: (www.vos.noaa.gov)

Then the inhabitants of other regions of China in Asia and people of Egypt in Africa started the cultivation of cotton, then this cultivation of cotton spread from sub-continent to Mediterranean and then to rest of the world. Archaeologists have revealed that people in India and America started making the fabric from cotton about 4000 years ago. And by the sixteenth century cotton was grown mostly in the warmer regions of Asia, America and Africa. (Sarah U. Wisseman 2004).

Till the end of 18th century all the processes in fabric formation from cotton were by hand, these included cotton cultivation, harvesting, ginning, spinning and finally weaving to make a fabric. Sub-continent dominated the cotton industry at that time, while with the beginning of industrial revolution England and America dominated the market and they became world's leading suppliers of cotton fibers. While after some time India and China again captured the market by entering in industrial race. The cotton was grown naturally and organically throughout its 8000 years of history of production, farmers never used the chemicals for cotton growth. These pesticides and growth fertilizers were used in the 2nd world war to increase the production of cotton, and these chemicals have drastic effects on the surroundings and environment. (At Home Naturally u.d.).

Instead of availability of many other natural, synthetic and other regenerated fibers cotton is most popular and demanding fiber in the textile fashion industry, it provides about half of all

textile fibers requirements in the world. While other natural fibers like wool, silk and flax mutually provides about 10 percent of the global fiber requirement. Cotton industry occupies the place of backbone in the industry mania of many developing countries and it has played an important role in boosting the economies of these developing countries. (Fletcher 2008).

However the production of conventional cotton is considered to be perilous these days due to its environmental and social impacts, as conventional cotton cultivation is characterized with excessive use of pesticides for insects, fertilizers and water. These chemicals harm the environment and also cause soil infertility. In United States about 10 percent of the total agriculture chemicals are used in cotton production while 6.9 million pounds of chemicals are used for cotton only in state of California. According to a research extensive use of these pesticides, fertilizers and chemicals has caused harmful impacts for soil, water, human health and other living things. (Patagonia u.d.).

Organic cotton is a practical solution of these problems. The term organic is generally used for the cotton grown without use of harmful chemicals like pesticides, synthetic fertilizers, growth regulators. Organic cotton production is not simply to replace synthetic fertilizers and pesticides with organic ones but it is a systematic approach that focuses on selection of locally adopted varieties according to local conditions like climate and soil. Natural methods are used to control the pests and diseases instead of pesticides and fertilizers. Organic cotton cultivation form needs two years to convert it from conventional cotton production to organic cotton production. (Organic Cotton u.d.)

Organic cotton production is much beneficial for small scale farmers in the developing countries. By growing organic cotton they can get more premiums for their crop and can compete the commercial farmers in industrialized and developed countries. Though organic cotton production is much valuable but it is very demanding, it needs lot of devotion, commitment and experience. Besides the environmental and agricultural benefits organic cotton production is also a good tool for social change as it includes ethical principles in its production system. Organic cotton growth promotes the local varieties and species and hence generates the revenue for local inhabitants. (Fletcher 2008).

3.2 Organic Cotton Development:

Efforts towards organic cotton production started in Turkey in late 1980s, by (GFF). GFF (Good Food Foundation) is a European co-operative of five European companies that is involved in producing and importing the organic food. Local farmers were already growing the organic foods at that time, the GFF demonstrated the farmers to not only stick with organic food production but also cultivate the organic cotton, and the farmers were ready to grow it. A Dutch company named 'Bo Weevil' was build to deal with organic production issues at GFF farms. (Stolton 1999).

After that further initiatives were taken in Turkey and as a result of these projects for organic cotton production organic cotton companies were established where organic cotton was used from farm growing to garment manufacturing. Later in 1990s, research and development occurred in organic cotton with the awareness of environmental issues and when consumers started liking environmental friendly textiles, and the use of these textiles became fashion. Cotton growers in USA were looking to reduce the cost of pesticides, fertilizers and chemicals for cotton, in USA some food crops were already grown without pesticides and fertilizers, so a company was established in California to see the potential for growth of organic cotton. Then the companies from all over the world started many projects for organic cotton production. (Ebbersten 1997).

The Texas Department of Agriculture formed an organic certification program for cotton in 1989, and this program is considered to be the most significant program for developing and enhancing the production of environmental friendly materials. This program was developed for production of organic cotton at that time on the demand of a US company for making baby diapers. (International Cotton Advisory Committee 1993)

Since the beginning of 21st century the worldwide market for organic cotton has undergone a magnificent growth, with the increasing awareness of environmental issues among the consumers, the buying pattern of consumer in the fashion textiles was shifted and they started demanding the products made from environmental friendly fibers, it urged the companies to fulfill the customer demands and many companies like Patagonia, Nike, and Timberland started to use organic fibers in their production line, it ultimately increased the demand of these organic fibers. (Organic Exchange 2007).

In 2006 and 2007 many other fashion companies and retailers like H&M, Marks & Spencer, and Wal-Mart started manufacturing the fashion products from organic cotton and as a

result of extensive use of organic cotton in apparel, home textiles and personal care products the retail sale of organic cotton reached 1.1 billion \$ globally in 2006, and these sales were increased to 2.0 billion \$ in 2007. In 2008 brands significantly expanded their programs towards sustainability and using organic fibers and wider array of products in apparel for women and children were available than previous years, and retail sales of organic products reached to 3.2 billion \$ in 2008 at an annual growth of 63 percent. Organic cotton demand was increased to 74,839 metric tons and in 2008 it reached 92,998 metric tons. Today farmers are growing organic cotton in more than 22 countries and more than 1500 fashion brands and retailers are using organic cotton in their product line. (Organic Exchange 2008).

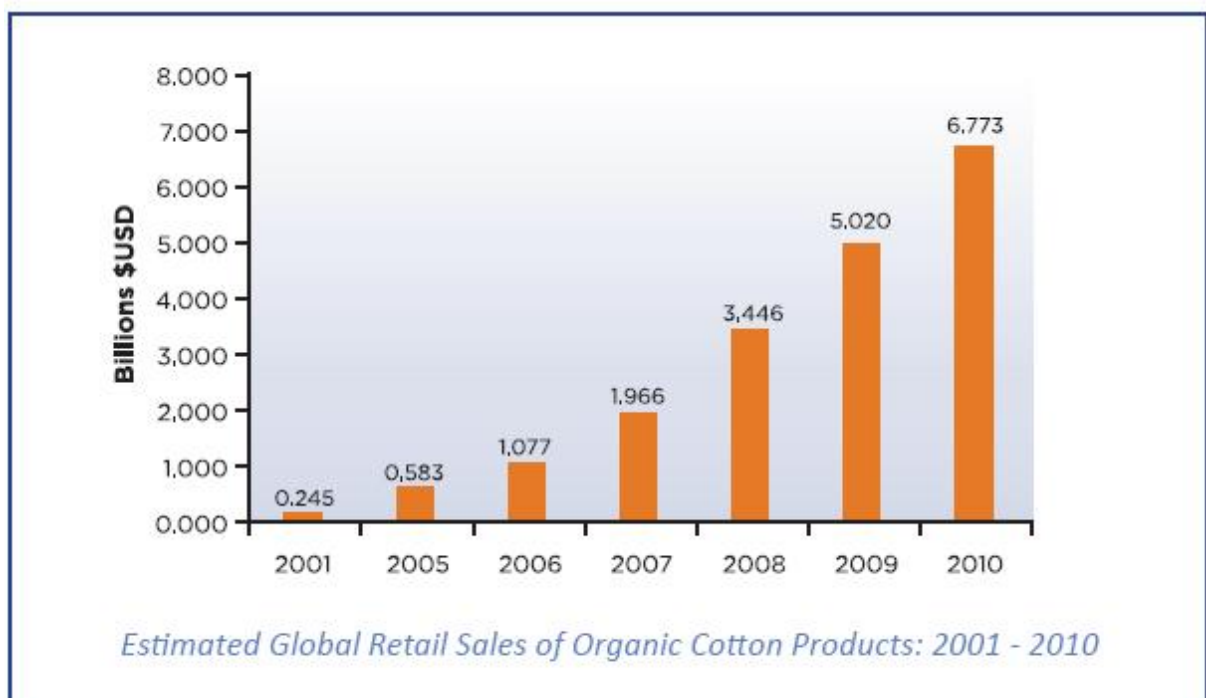


Figure 4: Global Sales of Organic Cotton Products. Source (Organic Exchange 2008)

3.3 Key Factors in Organic Cotton Development:

There are several factors that played a key role in rapid and incessant development of organic cotton products in the global market, some of the main factors are described below, (Organic Exchange 2007).

- Changing life style of consumers
- Companies making their business strategies more sustainable
- Access to Knowledge about organic program development

3.3.1 Changing life style of consumers:

With the increasing awareness of sustainability issues, consumers' life style has been changed. The life style has become more sustainable, they are looking for green and sustainable products. According to a survey conducted on consumers in USA, 50 % of women want that the brands and retailers should carry green products in their product line. (Organic Exchange 2007).

Consumer demand for organic products made of sustainable materials is increasing for their basic needs, like apparel, food, and cosmetics. Consumers behavior have been changed they are thinking differently these days, consumers are fed up of over consumption and are moving from quantity to quality, they have become more responsible and buy according to their needs instead of their wants and desires, there is a shift in consumer approach from "we want more" towards we "want more authentic".

3.3.2 Companies making their business strategies more sustainable:

The global companies, brands and retailers are aligning their business strategies with sustainability objectives; Patagonia is a big example of it which firstly started using organic cotton in textile products being more sustainable and less harmful than conventional cotton and now IKEA has also organic cotton development program, this approach persuaded many other companies and they started manufacturing their textile products from organic cotton and it ultimately enhanced the demand of organic cotton. (Organic Exchange 2007)

Table 2: Brands and Retailers with Largest Organic Cotton Programs Top 5 by Fiber Volume. Source (Organic Exchange 2007)

2005	2006	2007
1. Nike	1. Wal-Mart/Sam's Club	1. Wal-Mart/Sam's Club
2. Coop Switzerland	2. Nike	2. Nike
3. Patagonia	3. Coop Switzerland	3. Woolworth's South Africa
4. Otto Group	4. Patagonia	4. Coop Switzerland
5. Wal-Mart/Sam's Club	5. Otto Group	5.C&A

There has been an enormous growth in knowledge in the recent years for developing the growth of organic cotton, many nonprofit organizations like Organic Exchange, Organic Trade Association, Helvetas, Fair Trade Foundation, Roots Capital, Triodos Bank and foundations such as ICCO and Shell Foundation as well as many development agencies have developed programs that provide information and tools for organic cotton production, these programs help the farmers and growers to effectively implement the production systems for growth of organic cotton that ensures the long term health for our environment and region , and these programs has also inspired many growers and farmers to take the advantage of this niche product. (Organic Exchange 2007).

3.4 Growing Organic Cotton:

Growing organic cotton not simply means to grow the cotton without use of pesticides, growth fertilizers and harmful chemicals. It is a systematic approach of organic forming; organic forming is usually defined by a formula,

**No synthetic fertilizers + no synthetic pesticides = less yield
x higher price**

But this approach still leads towards unsustainable farming system; organic farming can be best defined by the formula,

**Local verities + reduction of nutrient loss + use of local organic material + a wide rotation
+fostering natural balances + mechanical weed control = no need for synthetic inputs.**
(Stolton 1999).

The systematic approach for organic cotton production needs integration of many processes like soil fertility, crop covering, crop rotation, strip cropping, weed management, etc. for growing organic cotton a grower needs to be certified by a third party, third party has many on-farm inspections and gives a certificate to the farmer that grows cotton according to the standards. Growing organic cotton needs organic seed, organic seed is derived from organically grown plant or a seed derived from plant that is not genetically modified, and then comes the other production stages. (National Sustainable Agriculture Information Service u.d.).



Figure 5: Organic Cotton Plant.
Source: (Organic Exchange 2007)

3.4.1 Soil Fertility:

Fertilizers are used to improve the yield of crop in conventional cotton farming; these fertilizers provide the necessary nutrients for rapid growth of crop and are applied at the time of sowing and once or twice during the growth stages of crop. However in organic cotton farming these fertilizers are not used, instead natural practices are followed to maintain the nitrogen level up in the soil. In some organic growing systems natural fertilizers like bone meal, castor cake and wood ash are used, but they are not used in routine. (Stolton 1999).

To maintain the soil fertility for growth of cotton, organic cotton farmers use the natural ways and resources instead of using growth fertilizers. Soil organisms are properly managed to release the mineral nutrients that are necessary for crop growth. Organic food sources are fed to the soil; the soil organisms digest these resources and release the necessary nutrients for crop growth. And level of these minerals is built up by the use of animal manure, compost and soluble rock powders. (National Sustainable Agriculture Information Service u.d.)

3.4.2 Crop Rotation:

Cotton is usually known as monoculture crop, but organic cotton is grown with rotation to the other crops, the rotation is an effective tool for reduction in the buildup of insect pests, diseases and weeds. It also maintains the proper soil structure by balancing the rates of extraction. Crop rotation also beneficial economically for farmers, it reduces the risk and generates more revenue by diversity of crops. (Stolton 1999).

Crop rotation is considered as a fundamental for success in organic farming, crop rotation controls number of cotton pests including nematodes. A cotton study at Auburn, Alabama revealed that rotating cotton crop with legumes produced cotton yields equivalent to the yield grown with the use of nitrogen fertilizers. Same yield by using natural ways instead of using synthetic fertilizers. So the crop rotation is helpful in both ways, economically and biologically. (National Sustainable Agriculture Information Service u.d.).



Figure 6: Crop Rotation. Source (soilquality.org/practices/row_crop_rotations.html)

3.4.3 Cover Cropping:

Cover crops are a sustainable tool for soil covering, soil fertility and soil management; it also helps in protecting soil from erosion. Soil erosion abruptly reduces the growth of crop and results in low productivity of crop. When ploughed into the soil, Cover cropping provides the nitrogen and improves fertility by adding organic matter for subsequent cotton crop, the increased organic matter in soil enhances soil structure as well as water and nutrient holding capacities of soil. Cover crops are often termed as green manure. These green manures manage several soil macronutrients and micronutrients, these nutrients are very supportive in nitrogen management that is most limiting nutrient in crop production. (National Sustainable Agriculture Information Service u.d.)

3.4.4 Weed and Pest management:

Usually in organic cotton fields the variety of weeds is more than in the conventional cotton fields, in conventional cotton growing system these weeds are treated with herbicides, but in organic cotton farming the weeds are mostly controlled by rotation. In organic cotton farming the all the weeds are not treated for cleaning because some of the weeds are favorable for crop, they harbor natural enemies for the pests and sometimes divert the attention of pests from cotton plant. (Stolton 1999).

Cotton grows at a Soil temperature of 61° F, when there is a delay in planting until the soil temperature reaches 66° F, then cotton grows very rapidly and energetically and has a competitive advantage over many weeds. (National Sustainable Agriculture Information Service u.d.).

In conventional cotton pest management has always been a problem, and cotton is the crop on which most pesticides are used but in organic farming these pesticides are not used the processes of controlling pests in not difficult without using pesticides and also there are fewer pests in organic cotton farming than conventional cotton farming. In organic cotton system pests are managed by their natural enemies. Here are some techniques used for controlling the pests without using synthetic pesticides in African cotton. (Stolton 1999).

Table 3: Pest controlling methods without using Synthetic Pesticides in African Cotton. Source: (Stolton 1999)

Pest	Control Method
The American bollworm (<i>Helicoverpa armigera</i>)	<ul style="list-style-type: none"> ❖ Trapping of adults ❖ Planting of trap crops (maize, pigeon peas) ❖ Establishment of ants like <i>Acantholepis</i> SPP ❖ Application of <i>Bacillus thuringiensis</i>
The Spiny bollworm (<i>Earias</i> Sp.) & Pink bollworm (<i>pectinophora gossypiella</i>)	<ul style="list-style-type: none"> ❖ Use of mating disruption pheromone ❖ Promotion of <i>Acantholepis</i> ants ❖ Application of microbial
False codling moth (<i>Cryptophlebia leucotreta</i>)	<ul style="list-style-type: none"> ❖ Application of granulosis virus ❖ No problem as long as insecticides are not used ❖ Promotion of natural enemies
Cotton leaf worm (<i>Spodoptora leucotreta</i>)	<ul style="list-style-type: none"> ❖ Manual collection of eggmasses ❖ Application of baculovirus
Aphids (<i>Aphis gossypii</i>)	<ul style="list-style-type: none"> ❖ Avoid excessive irrigation ❖ Trap crops like maize and sorghum ❖ Promotion of natural enemies like <i>chilocorus</i>

A systematic approach for growth of Organic cotton

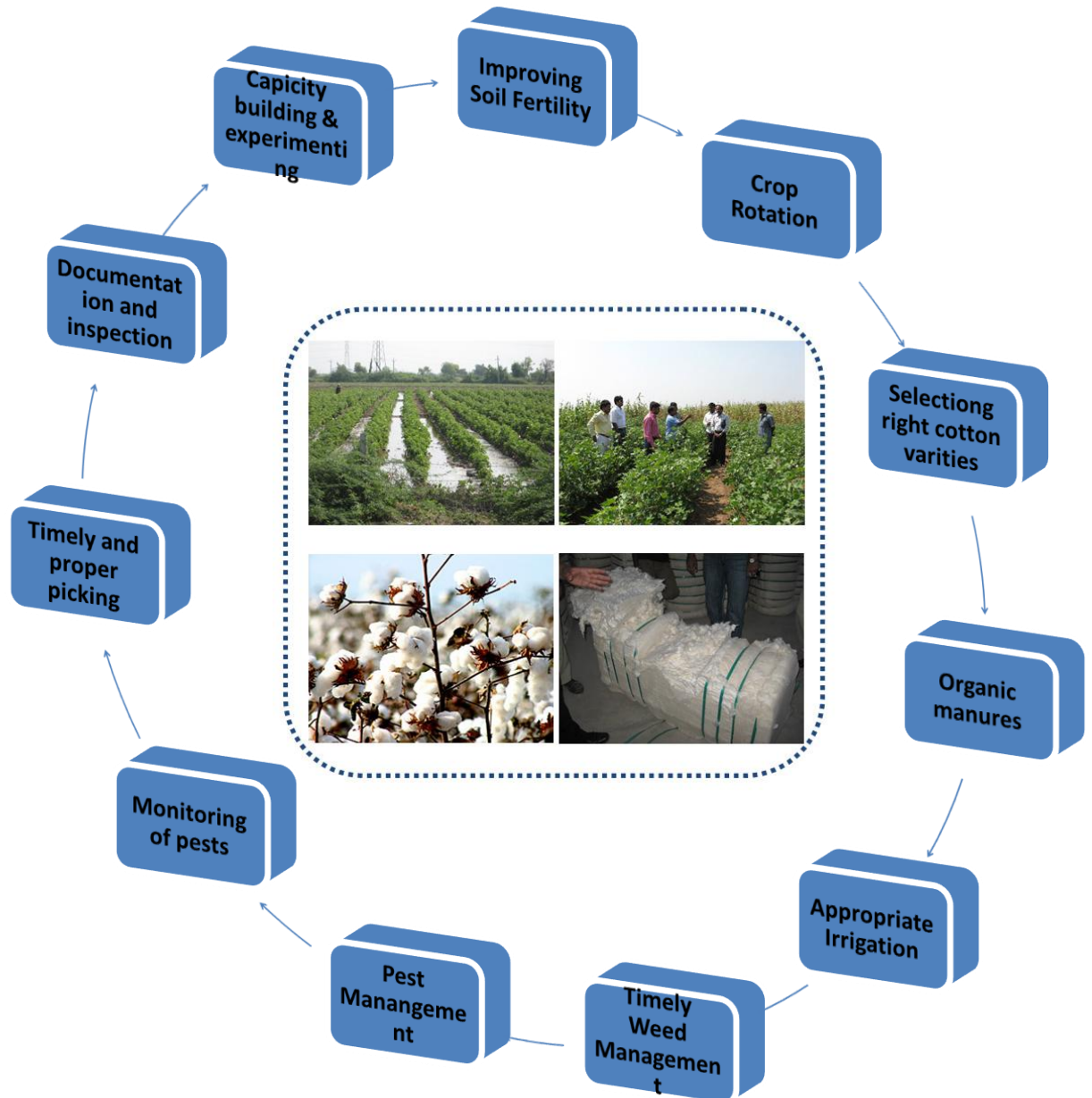


Figure 7: Showing a Systematic Approach for growth of Organic Cotton. Source: (FiBL u.d.)

The above figure shows a systematic approach of all processes and steps involved in the production of organic cotton that had been explained above.

3.5 Advantages of organic cotton:

Cotton is most useable fibre in the nature but the conventional way of farming cotton has severe side effects and is very harmful both for environment and living organisms, the use of insecticides in conventional way of farming cotton comprises about 35% of the total usage of pesticides globally. In USA 55 million pounds are consumed for pesticides. (National Agricultural Statistics Service u.d.).

The organic cotton is a better solution in these adverse situations. The organic cotton is beneficial in many ways; it creates healthy environment and boosts up the economy by using local resources and varieties, it helps socially by giving more premiums to the growers (Farmers) and eliminates the risks of chemical impact on human beings and its surroundings by eliminating the extensive use of fertilizers and pesticides during its growth. During processing stages from spinning to finishing the harmful chemicals (Formaldehyde, Aromatic solvents, Chlorine bleach, Azodyes, etc) are not used. (Sanfilippo 2007). Organic cotton also ensures our food security and health care by providing contamination free food.

The advantages of organic cotton in comparison to the conventional cotton are summarized below in the form of table.

Table 4: Advantages of Organic Cotton in Comparison with Conventional Cotton. Source: (Stolton 1999)

	Conventional Cotton	Organic Cotton
Environment	<ul style="list-style-type: none"> ▪ Water pollution ▪ Loss of biodiversity ▪ Adverse changes in water balance ▪ Pollution of soil and air ▪ Pesticides killing beneficial insects 	<ul style="list-style-type: none"> ▪ Improved water utilization ▪ Increased biodiversity ▪ Soil and air are hygienic ▪ Eco-balance between pests and insects
Social	<ul style="list-style-type: none"> ▪ Health problems in regions where regulatory systems are weak ▪ Poisoning and casualties due to extensive use of pesticides 	<ul style="list-style-type: none"> ▪ Use of local varieties and resources ▪ Helpful for low income families due to more premium
Economy	<ul style="list-style-type: none"> ▪ Resource consuming ▪ High production cost ▪ No alternative crops 	<ul style="list-style-type: none"> ▪ Less resource consumption ▪ Lower production costs ▪ Niche product ▪ More revenue for farmers
Food	<ul style="list-style-type: none"> ▪ Pesticides entering human food through cottonseed oil ▪ Contamination of meat and milk from animals fed on cotton products 	<ul style="list-style-type: none"> ▪ No danger of contamination of edible items originated from cotton source.
Agricultural	<ul style="list-style-type: none"> ▪ Reduced soil fertility ▪ Poor irrigation, contamination fields becoming barren 	<ul style="list-style-type: none"> ▪ Increased soil fertility ▪ Crop rotation maintains soil structure
Health	<ul style="list-style-type: none"> ▪ Chemicals remained in final product cause health problems ▪ Chronic diseases (cancer, infertility, weakness, illness) 	<ul style="list-style-type: none"> ▪ No use of pesticides, or chemicals that saves the farmer and surroundings from chronic diseases.

3.6 Disadvantages of organic cotton:

Besides of the enormous benefits of organic cotton production here are some problems associated with organic cotton that act as a barrier in development of organic cotton.

3.6.1 Productivity:

The productivity of organic cotton is less than the conventional cotton, in conventional cotton production the farmers use growth fertilizers for higher productivity and are reluctant to grow organic cotton. (Stolton 1999)

3.6.2 Cost:

The growth of organic cotton in a field of conventional cotton needs a transition or conversion period, during this period farmers observe the organic cotton standards but they are not able to sell this cotton as organic cotton, this works as an obstacle to convert conventional cotton growth into organic cotton without financial assistance to farmer. (Stolton 1999).

3.6.3 Cultivation:

In conventional farming systems seeds are directly sown in the soil, while in organic cotton growing first mostly weeds are removed prior to sowing the seeds. So farmers feel easy to grow the conventional cotton. (Stolton 1999)

3.6.4 Time:

Growing organic cotton is a systematic approach that needs a lot time and there is a transition time of approximately three years to get organic cotton from conventional field so the farmers have not the organic premium in this time. Also organic cotton timely intervention during its growth, a farmer can naturally produce more crops with industrial methods. (Stolton 1999).

3.7 Fashion Brands and Retailers using organic cotton:

Several top fashion brands and retailers are using organic cotton materials in their product line, among these are Nike, Patagonia, Marks & Spencer, Wal-Mart, H&M, Otto group, C&A, Coop Switzerland, Tesco and many others. These companies are using organic cotton in blend with other fibres, but not still using 100 % organic cotton.



Men's Organic Cotton Clothing:



Figure 8: Men's Clothing Collection of Organic Cotton by Patagonia. Source: (www.Patagonia.com)

Women's Organic Cotton Clothing:



Figure 9: Women Clothing Collection of Organic Cotton by Patagonia. Source: (www.Patagonia.com)

4. Bamboo Fiber:

Basically bamboo is a grass; it is the world's fastest growing 'Woody Plant'. Bamboo has more than 1000 species that grows very fast at the rate of 3-4ft per day depends on its species and atmospheric conditions. It can be found all over the world i.e. Africa, Australia some parts of USA. Some of Bamboos becomes flowers but the bamboo used in fabrics is not the same as bamboo eaten by panda bears. It belongs to perennial group of plants. Some of ancient species of bamboo have height up to 250 ft. (Bamboo - What is it? 2010)

Bamboo life begins in CHINA, according to Bamboosa industry Bamboo is find in China forests and in 2007 they CHINA has plan to grow Bamboo on approx 12,84 million acres that is equal to 2,3 billion trees. In 2008 China also announced that we are going to plant additional 2.5 billion trees on 13.39 million acres in 2009. (About Bamboo u.d.)



Figure 10: Bamboo Plant. Source: (istockphoto.com)

Bamboo grows naturally without using any herbicides, pesticides and irrigation, it grows with natural rainfall. There is no need of planting of Bamboo because it grows from stalks cut off and buried it in the ground and these starts to grow after a short time period. As compared to the other trees that take approximately 70 years to become mature bamboo plant matured within 3-4 years and have all the eco-friendly properties. Bamboo has very vast root system that helps in its growth faster as compared to normal plant. (Bamboo-why is it sustainable 2010)

Organic and eco friendly product or material is defined by National Organic Standards Board of US department of Agriculture (USDA) as "An system of ecological production that supports and improves following soil properties biological activities, biodiversity and biological cycles.

For organic agriculture these are the management practices that restore by minimal use of off-farm inputs, and keep sustain and enhance ecological harmony. Organic certification means a verification process that was carried out by any company, or independent state to make sure that the organization strictly follows the organic standards in the production. (Bamboo-is it organic? 2010)

4.1 History and Background:

Bamboo fiber and starchy pulp are made from Bamboo and are mostly grows in Asian countries. Basically starchy pulp is the refined form of Bamboo leaves and stems and made by the process of multiphase bleaching and hydrolysis alkalization, and different chemical



fiber factories convert it into bamboo fiber after process it further more. (COM4TH.com u.d.).

Bamboo is a cellulosic and bio-degradable fiber extract from natural bamboo plant. It is synthetic viscose made from bamboo cellulose not made from fibers and leaves of the plant. It is famous for its naturally green properties and also because of fast growing and cultivated plant. Bamboo is also produced by different method and processes like steaming and boiling etc. Bamboo fiber can be extracted naturally from Bamboo Culms, and Bamboo viscose is produced by applying chemical processes. (COM4TH.com u.d.).

Bamboo fiber is free from chemicals and additives. Because the fiber is directly picked up from natural bamboo and used physical and mechanical processes to make bamboo fiber free from chemical methods.

There are two types of use bamboo fiber available, it use as a source of raw cellulose in viscose production after substituted for beech and the natural bamboo (so called Linen bamboo because of it hand and drape properties) extract from bamboo viscose and culms directly. There is a single company in China, who is doing commercial production of bamboo without using any harmful chemical and additives but there may be some issue in it because the method use for the production of conventional viscose has high impact and in similar way bamboo viscose process, but still it is beneficial that it is being sourced from rapidly regeneration raw material. Bamboo is abundant and vigorous plant so it should be harvested in a sustainable way to get maximum ecological benefit. (Fletcher 2008)

In different Asian countries there is a development policy for the natural resources consumption in which they mentioned that try to use natural resources in limited amount and make vision on the renewable ones. This type of policy and model help them to judge the importance of countryside activities such as handicrafts production, forestry and

agriculture. In all these fields bamboo fiber are used so the demand of bamboo is increases because of its multipurpose use. Regarding bamboo growth it can be increase in the areas where agriculture is not use for profitability and also in widely isolated communities.

The use of bamboo by handicrafts manufacturers are increase because it requires few techniques and equipment to made the items and this terminology is highlighted in many countries. It's a blessing to have high skilled craftsmen with strong cultural heritage and efficient supply chain of resources and materials. But there is still a need to improve the design of the handicrafts and develop the market for the product in a professional way. This can help the people living in rural area in their income and also they remain in their culture and way of life. (SwicoFIL n.d.)

4.2 Methods of Bamboo manufacturing:

There are two methods of manufacturing of Bamboo:

- 1- Mechanical method
- 2- Chemical method

4.2.1 Mechanical method:

In this method 'woody' part of bamboo plant crushed and treated with natural enzymes to break down the bamboo in to the soggy substance and then this material is combed-out into spun yarn. It is the most reasonable method of manufacturing bamboo yarn and the bamboo produced by this method is very rough like linen. The problem with this method is that it's a little expensive method and is not preferable by Chinese manufacturers. In reality all the bamboo products, bed sheets, garments, fibers, fabrics are made by China and only few companies of USA are using this type fiber or yarn in their products after importing the material from China. (COM4TH.com u.d.).

4.2.2 Chemical Method:

In this method Sodium hydroxide is used to crush the woody bamboo and then the crushed bamboo is dipped into caustic soda and it converted into cellulose material. In U.S. market products like Bamboo beddings, shirts and duvet covers and



Figure 12: Mechanical Process for Bamboo Fiber Manufacturing.
Source: (www.marginup.com)



Figure 13: Chemical Process for Bamboo Fiber Manufacturing. Source: (www.morungexpress.com)

towels are made by this type of bamboo. (COM4TH.com u.d.).

There is some misconception in people about sodium hydroxide, but it does not cause any harm to environment and health of workers. It is approved by Global Organic Textile Standards (GOTS) and the Soil Association that it can be used in Organic Cotton processing and it cannot stay on bamboo fabric as residue and easily remove after washing and can be neutralized to non-toxic sodium salt. In spite of that sodium hydroxide has many uses, it is used in paper making, food preparation, soap manufacturing for washing and soft drink productions, chocolate and cocoa processing and thickening of ice cream. (COM4TH.com u.d.).

4.3 Bamboo yarns and Fibers:

Bamboo fiber is regenerated cellulose fiber made by high tech process, its raw material found in non-polluted regions in Yunnan and Sichuan Province CHINA. The new bamboo plant possesses good character and ideal soft feel when they are 3-4 years old. The production and generation of this Bamboo plant is green and free from pollution and harmful chemicals. In China the bamboo suppliers and manufacturing companies strictly follow the standards ISO 9000, 14000, 17025 standards. Bamboo is 100% natural cellulosic fiber with unique properties and bio-degradable in soil by sunshine and microorganisms. Its generation and decomposition does not cause any harm and pollution in environment that's why bamboo is explained as:

'The Fiber comes from nature and biodegradable properties return it to the nature completely in the end' it is the 21st Century fiber 'BAMBOO'. And its properties encourage its use in textile fashion products, because it's a big solution for the question arises against environment. (COM4TH.com u.d.).

4.4 Appearance and Properties:

The original bamboo fiber is similar to Ramie or Bast fibers, in its appearance and properties. But Bamboo fiber is bit thinner and finer than ramie fiber and also has specialized and functional properties like anti bacterial, Anti UV, deodorant and germicidal.



Figure 14: Appearance of Bamboo Fiber. Source: (www.bamboo-china.com)

According to research it has been approved that the properties of thinness and whiteness of bamboo fiber is better than the bleached viscose. And have strong durability, tenacity and stability. These properties of bamboo will be very useful for ladies fashion garment where fine and lighter fabric required. It grows naturally without any pesticide; it owns unique antibacterial and bio-agent named 'Bamboo Kun'. (COM4TH.com u.d.).

During the process of being manufacturing of bamboo fiber this substance is combined with bamboo cellulose. Bamboo fiber works naturally as anti bacteria and have properties of bacteriostatic and deodorant. Japan Textile inspections Association tested the bamboo fiber fabric and washed those fabrics up to 50 washes and found that the fabric still possess the antibacterial properties approx 70%. On the other hand when apparels treated with chemical and anti microbial materials they cause irritation and skin allergy. So the bamboo fiber used in all surgical items, bandages and mostly hospital products e.g. bed sheets, gowns, masks, nurses wear, socks, cloths, underwear, decorative items etc. (COM4TH.com u.d.).

Bamboo fiber has quality to spin perfectly and the fabric or yarn made from this type fiber has good quality with respect to quality standards. Fabric made of 100 % Bamboo pulp fiber is called bamboo fabric and have good properties of permeability, soft feel, hygroscopicity, and easiness to straighten and also have excellent dye, pigmentation color effect property. It is new raw material having excellent eco-friendly properties and when it is mixed with cotton, and other materials its properties get boom. Bamboo works as air conditioned fabric because of it breathable and coolness properties. According to authoritative testing figures Bamboo fabrics is 1-2 degree cooler than normal apparel in summer season. And can be used by fashion companies for their summer collection some designers like Kate O Conner using these fibers in their summer collection as alternative to silk and cashmere. (COM4TH.com u.d.).

4.5 Key properties and features of Bamboo:

Bamboo plant harvested annually and its establishment required minimum cost initially and can be grow by the farmer and foresters having skills of plant cultivation. Bamboo can grow faster than any other tree i.e. 4-5 years. It is the fastest growing timber plant having many applications as wood substitutes. Bamboo has excellent property of anti soil erosion and

used for land restoration. It can be cultivated with vegetable plants also. Bamboo plant itself is a complete bio degradable material and its all parts are very usable i.e. Bamboo poles are used as building materials, its shoots and leaves are used in animal feeding and branches are useful in making handicrafts. (COM4TH.com u.d.).

Bamboo fiber has good dye ability, because of its soft and feel it is used in Towels and bathrobe items and when dye apply on these fabrics it gives sparkling and shinny look. It has antibacterial property and also have high absorption rate so it is very useable in foot mats and floor mats. Peoples having sensitive skin may have allergic problem, bamboo fabrics have antibacterial properties and have soft feel and touch so it will be very useful for people having sensitive skin and research keep going in its bed sheets and medical wearers. (Bamboo-is it really hypoallergenic? 2010).

Bamboo is very practical and has many physical properties inherently so it's a smarter choice for many families. Bamboo has 'bamboo Kun' material that works as antibacterial agent and anti fungus agent and help to make fabric odor free. It has buttery soft quality and even softer than silk, cashmere and cotton. It also have soil release property and more durable and less expensive than silk and cashmere. Fabric made of bamboo requires less washing because of its soil release property and save time, money, water and energy. It acts like thermal regulator on human body and its breathable structure keeps your fabric dry and you feel comfortable. It is good for skin sensitive people having allergies, dermatitis and eczema. (Bamboo-is it really hypoallergenic? 2010).

4.6 Mother of bamboo: (Social Step towards sustainability)

In poor countries where most of young women have bad profession of prostitution to fulfill the needs of their children and earn money to survive, got Aids and HIV. There is a woman who is fighting against that trend and wants to trained women to make bamboo product and sell them to other villages and shops to earn money. She is trying to make awareness about



Figure 15: Samata (Mother of Bamboo). Source: (Irwin 2010)

the bamboo uses and applications to get them out of poverty and bad profession. Her mission to reduce the poverty by using sustainable wood she is called 'Mother of bamboo'. (Irwin 2010).

She is getting INBAR (International network for bamboo and rattan) is the company who's trying to help the poor people living on the countryside; company aim is to strengthen the rural communities and provide them better solution for their life by using their capabilities. Economic development program in 2001 vision is to create the sustainable approach for the rural livelihood by using bamboo products and wicker. The aim of the company is provide platform to poor people to get them out of poverty. Bamboo is a natural cellulosic fiber serves environment in multiple sustainable ways and also help the poor areas to decrease poverty in underdeveloped countries. This is why Bamboo is also called 'the wonder wood of poor' said by Cheila Mawanundu, Senior Technical Advisor, Environment and Natural Resource Management at the International Fund for Agricultural Development (IFAD). (Irwin 2010).

Samata (Mother of bamboo) takes benefit from that program and she visited China and Philippines find new uses and production methods of Bamboo. She learned more about bamboo uses in houses, furniture and scarves, textile fashion items. And she found that she could save the energy, time and earn money to overcome poverty. According to Samata; "I don't know the incredible features of bamboo plant, until the day the organizations IFAD and INBAR sent me to China and the Philippines for learning and training," says Samata. "This is why I want everyone to understand the potential of bamboo, and the many things that they can do with this plant. Mothers need money to feed their children, but because their choice of employment is limited they end up falling into the prostitution trap." (Irwin 2010).

When Samata come back, she makes groups of women and trained them about bamboo and organized different training courses for her society women community. Samata aim is to trained her fellow women and safe her from HIV/ AIDS because of their prostitute profession. Her courses are free and have one condition that the women she trained must stay with her for approx 6-months and she trained 60 women about bamboo products. And women having little educational background teach the other women a little mathematic calculations and some alphabets how to write their name etc. She collects bamboo wood from surrounding forests and villages and sends to local village people to manage the tasks given to them and pay these women for their jobs. She made basket to other office

furniture's like table etc and some catalogs to distribute it in different office and the money they earn from that use to feed their children, buy their medicine and to make their lives better. She said that I want to aware the people of Tanzania about the uses of Bamboo and how they can make money from it and have their own houses rather than living in rental houses. Her efforts continue and her mission helps a lot of poor people to make money out of bamboo and have some standard life style. (Irwin 2010).

From the above example we can see that how one women efforts thousands of people to make their life better and sustainable at a time. Sustainable approaches help and serves environment in different ways.

4.7 Bamboo in Demand:

In 2003 bamboo fiber is used in home textile, apparel clothing and baby products by different companies in USA trying to create awareness among people about the advantages of this sustainable fiber. We can see that from 2007 different industries starts looking for the bamboo made product and there have been amazing increase in the demand of bamboo products.

Since 2004 the demand of bamboo products i.e. bamboo bedding, bamboo towels, bamboo baby products and bamboo clothing rise up to 5000%. Because of bamboo extra softness, and comfort for the user becomes successful in the market and its product result much traditional ones.

If we compare the bamboo fabric product with other materials like organic fabrics or cotton we can easily judge that the use of these product decreases day by day and bamboo baby bedding and sheets become more and more famous. (Viscose from Bamboo Fabric Trends 2010).

The similar thing fit in the fashion industry, designer are trying to make the product that more sustainable and bring comfort for the human, and now a day designer work for bamboo fashion clothing because of keep in view about its advantages in different apparel and home textile products they think that it is better to use this natural fiber full of nutritious eco- properties in fashion products. Many textile fashion companies want to use it in their product range but due to lack of it s knowledge and research they hesitate to use this in their products. The desire is to motivate the companies to use the natural and

sustainable fiber in their product it cost them a little higher but they can get benefit and profit in the long term and also they can help to save the environment for the upcoming generation. (Viscose from Bamboo Fabric Trends 2010).

4.8 Bamboo Chemistry:

Bamboo rich with mineral elements and have approx 17 sorts of amino acid and 2,4% of protein. Bamboo elements serves human being medically it shoots consist of germaclinium that is used to activate human. Bamboo shoots contain amino acids Lys, Arg and Glu, Lys amino acid that help in growth and development of child. Bamboo shoots are richer in mineral elements and amino acid than rice, corn, vegetables and flour. Bamboo also contains 0,05 % fat, 2,5% sugar content and the fiber length is 0,65-1,2% that was fit for human consumption. Bamboo contains different numerous elements like Chromium, Zinc, Magnesium, Manganese, Nitrate, Copper etc. (Use of Bamboo 2008).

4.9 Bamboo Production recommendations:

4.9.1 Spinning:

Bamboo production process is very similar to viscose production, in bamboo spinning we have to take care of different things out of which humidity is the most important factor, it is recommended in bamboo spinning to keep humidity (65%-70%) and at low temperature approx 25 °C because during drawing and roving bamboo fiber produce fly, if bamboo is dry before starting the process then its better to apply vapor treatment to enhance its humidity. Bamboo fiber has weak cohesion properties so during the process the coefficient of twist kept high with low card web and roving tension. (Bambro Tex 2003).

4.9.2 Bamboo Weaving:

As bamboo fibers have very weak tensile strength, so in weaving process it cannot be use alone so it is recommended that use bamboo with twist coefficient of 350-400 turns per meter. In warping and sizing it is recommended that keep the tension low during the process to reduce the broken ends, because bamboo fabrics have good elongation and moisture regain property but during the weaving process some time more elongation occurs that cause broken end ratio more, for high density fabrics with fine yarns it is recommended that keep the tension low in both warping and sizing processes. Bamboo fibers have hydrophilic

properties and that's why size materials are easily applicable, to reduce the hairiness of fibers it is better to add some acrylic acid in size solution to enhance the softness of the yarns. Bamboo fibers have some properties that are not feasible i.e. it is sensitive to moisture regain and become weak as its moisture regain increases. So during the whole process the suitable rate of moisture regain is 8%-9%. (Bambro Tex 2003).

4.9.3 Bamboo Processing (Dyeing):

There are number of processes involved in bamboo textile dyeing. Bamboo fiber is cellulosic in nature and very sensitive to acid and base. So alkaline processes are applied in moderate condition and it should merge with enzyme and desizing process carried out that should be more than 80%, scouring is not required but sometime it is washed with alkaline soap. Alkali is used in washing of bamboo when it is blended with cotton and in pure bamboo fabric very low amount of alkali is used for scouring. After that as per requirement and thickness of the fabric bleaching process is applied. In order to increase the absorbency of the fabric sometime mercerizing process is used. But normally it is not used because it already has good luster. Bamboo is kept in little mechanical tension (negative or low tension) when dyeing process is applied on it, reactive dyes are used for its dyeing with weak alkali. The whole dyeing process is carried out in low temperature (less than 100 °C). (Bambro Tex 2003).

4.9.4 Bamboo Finishing:

Bamboo fabrics require only drying in finishing but not direct drying method is used for it i.e. single drum or multi drum, because it is very hard to control the temperature, because direct drying makes fabric harsh feel or may be get yellowish tone so it is better to use stenter and rotor drummer dryer to control the width and over feeding (5%-10%) of fabric under the temperature of 130 °C. (Bambro Tex 2003).

4.10 Application and uses of Bamboo:

Bamboo has numerous applications in different fields, Bamboo has a big list of uses, and here we can discuss only few of them. Bamboo is used for construction and building houses in Asia and South America, sometimes it is as strong as steel, bamboo has ability to bend and it is very useful for countries where cyclone and earthquake hits commonly. It is very good construction material rather than the traditional and old materials there is an example, when earthquake hits the Costa Rica with magnitude of 7.6 only 30 houses remain safe without

damage and these are made up of Bamboo. According to research it has been calculated that approx 1000 bamboo house are made from 173 acre area of bamboo plantation, and if these houses were made with timber than they will destroy approximately 1482 acres of natural forests. (Viscose from Bamboo Fabric Trends 2010).

In Asia bamboo is used in paper industry from many years approx three tons of bamboo produced one ton of papers and this paper is very cheap and it is also used in making fish poles, snowboards, surf boards, musical instrument, sewing needles and cutting boards. In US some companies use bamboo fabrics in Vacuum cleaners as bag because bamboo also has soil residue property. (Viscose from Bamboo Fabric Trends 2010).

In US bamboo fabrics are under research for Military uses, Bandage are made from glass fiber with viscose from bamboo is used in US military after a lot of research. The advantage of this bandage is that the glass filament helps initially in coagulation of blood and bamboo gives wicking properties. Combination of both plays very effective role, it is not a typical bandage the glass fiber helps to clot the blood and bamboo help to bring the blood on the surface because of its wicking property. Because of this bamboo fibers are using in medical gowns, bandages, surgical pads and also in other equipments. (Viscose from Bamboo Fabric Trends 2010).

China is known as kingdom of Bamboo. It is very big survival substitute for people living in ancient China. There was a literature giant of Sony Dynasty (960-1279) SU DONGPO said that 'poor people of China cannot live without Bamboo'. The people of that time were using bamboo for making shoes, bags, hats, rafts, tiles and also as firewood's. Bamboos also used as food, the culms inside the shoot of bamboo are eaten in the jungles of Indonesia, but the culms are boiled before consumed. There also very famous dishes in China made of bamboo and they very delicious because of crispness and sweet taste. Bamboo in China also used in medicine, the leaves of bamboo produced heat and phlegm that is very good for asthmatic patients. (Bamboo: A Supreme Technology u.d.).

In China women art and crafts are very famous, they are making flower baskets, animal toys, tea boxes and different types of curtains with different designs and sold them and earn good money out of it. Bamboo is also used in original form or may be processed form in Bamboo charcoal, vinegar, in making furniture, clothing and fabrics, and transportation etc. (Bamboo: A Supreme Technology u.d.).

4.11 Advantages of Bamboo fiber:

4.11.1 Advantages for consumer:

Bamboo fabrics are used in different types of clothing, in past it is used for different purposes like construction, furniture, medicine and foods. Because of its specialized properties it is also used in clothing sector. Product made of bamboo has awesome characteristics, and also a lot of fashion companies thinking to start its use in their product line. Bamboo is extraordinary soft, it serves the wearer as he or she wears cashmere fabric or garment. Bamboo is smooth, luxurious, and comfortable, if take a look of bamboo in microscope we find a lot of round on its surface that's why it sits perfectly next to the skin. Bamboo is strong fabric used in scaffoldings and skyscrapers, because it has high tenacity and abrasion proof properties. Bamboo has good wicking properties, its absorption rate is 4 times greater than the cotton, and it absorbs and evaporates the moisture very quickly. And keep fabric or garment dry, soft and comfortable. (Bamboo fiber advantages 2008).

Bamboo garments works as air condition for the user in summer, bamboo absorb the sweat and evaporate it in seconds and keep the garment dry. Bamboo is having natural breathable properties (because of tiny hole on its surface) and brings comfort for the user. Bamboo works as thermo control system (highly breathable) in summer it becomes cooler and in Cold it keeps you warm. It keeps you comfortable in both weathers. Bamboo also have antibacterial properties, and antifungal properties that keeps you skin out of bacteria and very use full for skin sensitive people having itching, and rashes problem. Bamboo also resists UV rays and very good for the pregnant women to protect them from UV rays, it is also use in hospital to prevent patients from ultra violet rays it cut out 98% harmful UV rays. (Manning 2008).

4.11.2 Advantages for the environment:

Bamboo serves the environment and has properties to serve the desires and needs of the world in the sustainable ways. Bamboo is the world fastest growing plant that requires very less water and grows without using fertilizers, pesticide and herbicides. Bamboo can grow anywhere even on hills and inclined surfaces where other trees survive hardly and after cutting of bamboo grass it helps in soil stability. Bamboo grows to maximum height in 4 months and becomes mature in 3-4 years having all eco friendly properties. The approx yield

get from bamboo acre if bamboo is 10 times more than the cotton fields. (Green Cotton 2008).

5. Designer's Sustainable Approach:

In recent years when sustainability gets jump into the textile industry, many fashion companies using different designers to capture their product market in a better and efficient way. Designers are the trend creator people and think about the future perception of people or future approach of people. In simple way designers are backbone of any fashion or retailing company and most of the company's product sales depend on the designer recommended products. Designer design the product and get inspired by anything like, any color, place, existing fashion, magazines, catalogs, and surrounding etc. During making the designs designers recommend companies the whole supply chain and explain the product from its raw form to finished garment. So it is very important that designer should have sustainable approach and recommend sustainable materials in company product line. Some the famous designers are working on organic and bamboo cotton and launched their fashion product made of organic and bamboo sustainable materials. (COM4TH.com u.d.)

Some of famous designer Kate O' Conner who was famous for creating and making of ponchos, and knit that fit with the women body cuts. She usually using silk fiber and sometime cashmere in her product that fall and softness bring comfort to wearer but these fibers cost her big amount, she always said that I was always searching for yarn or material having properties similar to silk and works perfectly in my products. She surged when saw the bamboo fiber and said it feels like blend of cotton and silk and feels like light, smooth and soft. In October spring / summer 2005 at Mercedes-Benz Fashion show at Smash box Studios she shows a bamboo made long knits skirt along with her other product range and she also said that I am going to ship in the end of this year more than 2000 knit garment, out of which more than half are made of Bamboo the environmentally friendly fiber. Also searching for substitute of Cashmere a big designer Amanda Shi shifts her AVITA (sustainable and ethical fashion) line to bamboo fiber. She said that bamboo material is less expensive and also have less duty as compared to silk and cashmere. The incharge of Fashion Institute of Design and Merchandising Museum (In Los Angeles) said that 'People will accept any kind of material and fabric as long as this material and garment is soft and comfortable to wear'. (COM4TH.com u.d.)

Amanda Shi said that designers are worry what to put on labels of the garment and the best is the truth and in sustainable way. She also mentioned that more than 200 stores are selling my products like Fred Segal in Santa Monica, Calif. And most of them placed order for Bamboo knit products. Same Kate O Conner said that I am noticed that most of my buyers demand for bamboo garments and they are making good money out of it. From there we can see that sustainable materials and product have big demand in the society and also beneficial for the environment at the same time. (COM4TH.com u.d.)

Eco-Collection by Amanda Shi



Figure 16: Women Collection by different Designers made of Organic Cotton and Bamboo Fibers. Source: (<http://gliving.com/category/gliving-videos/page/5/>)

The company in America Green earth bamboo is working on sustainable fibers and trying to search more sustainable product and use of sustainable materials and fibers in different products. They are producing organic baby products, organic towels, bamboo clothing's, organic baby cloths, bamboo sock, bamboo beddings and bamboo towels. They have vision to go for more fashion product made of bamboo. They are mentioned few famous designers name that recognize the awesome features of bamboo fiber in different sectors and recommend and trying to design the fashion item having bamboo fibers in it. These designers are Kate O Connor, Alfred Sung, Diane von Furstenberg, and Oscar de la Renta. And also they mentioned those designers whom are using bamboo in fashion garments. These are Allie Yoko, Jing Liu, Sara Kirsner, and Linda Loudermilk. They are using the name of these designers to create an understanding among the companies and customer about bamboo products and its use in the textile fashion products. (Viscose from Bamboo Fabric Trends 2010).

6. Case Study:

6.1 Bergman AB:

Today many companies are working on environmental issues and trying to be responsible for environment and society aspects. Fashion companies are continuously striving to keep focus on their production and over all supply chain and these companies are establishing policies to control the environmental feat from raw material (Cotton) to final product (Garment).

Bergman AB is working with Organic Cotton and offering good quality products in a sustainable way. The company was founded in 1986 by Mr. Bergman, situated in Borås, Sweden. The main products of Bergman are Sweaters, T-Shirts, Bath gowns, Baby garment, Dress shirts, Pants and Underwear both for men and women. Bergman AB uses organic cotton in their products and they are sourcing Organic Cotton from 'Peru' fields. Mr. Bergman supports the farmers, educates them about Organic Cotton and guides them in growing of Organic Cotton. Designer of Bergman Mr. Andreas Bergman said: 'We follow up the cotton from field to finished products. This makes us unique from other companies'.

When world-wide demand of green products rose, the customers in Sweden also raised the demand for greener products. At that time Bergman Sweden AB realized the demand and started focusing to launch their products made with certified Organic Cotton. In November 2007 Bergman / Rivera was build after the unification of Bergman Sweden and Cortextil's Organic Cotton project. They opened new store to display the range of products with new and innovative designs near the golden hotel, Viskan river central Borås. The company is working with cooperation of farmers having their own land and produce organic Cotton under the Brand Name WHITE COTTON in Southern Peru. (Bergman AB u.d.)

The company developed its website showing all the data on the screens very transparently, and demonstrating the certifications for Organic Cotton and its partners. Bergman Company develops the methods and working environment like agriculture, textile processing materials (Dyes and Chemicals). The business of crop is continuous and number of farmers are getting job in this field in different valleys throughout Peru. Bergman works with different types of cotton like white cotton (White Organic Cotton) and Wild Cotton (Color Organic Cotton). Bergman is the first company in USA that is working on 100% Organic Cotton products and it keeps focusing on whole supply chain, company is certified with G.O.T.S. (Global Organic Textile Standard) that helps the company to show the customer originality and reality with transparency. Bergman Company is working sincerely in the market and their aim is to make

more innovation in Sustainable development and always show respect to environment. On the other hand conventional cotton growth involves a lot of harmful pesticide, chemicals and a lot of other chemicals that are carcinogenic in nature and these chemicals play a hazardous role in the life of farmers, their families and other living organisms. Organic cotton is free from all these chemicals and their by products. Bergman offers a wide variety of products made of organic fibres under certification of G.O.T.S, like children garments, shirts, supplies yarn, and knitted and woven fabrics. (Bergman AB u.d.)

6.2 Product Strategy:

Bergman offers their products in a wide range from yarn to apparels made from organic cotton. According Mr. Stephen Bergman (Director Bergman AB), all our products are based on quality and functionality. Though our products are not much fashionable, these are very simple and colors are basic but we are trying to produce fashion products in future. We already have launched our first collection in 2007. Bergman AB store in Boras, Sweden represents the whole business idea. (Bergman 2010)

6.3 Bergman AB Supply chain:

Company focuses on its supply chain thoroughly; company has long history of more than 20 years of working with farmers of Peru to produce Organic Cotton. The company is now working with 2nd generation of Peruvian farmers. In start Mr. Bergman faced many problems to motivate the farmers to switch from conventional cotton to Organic Cotton. Bergman makes sure to the farmers that they will get money even if the crop is failed to grow because the production of organic cotton is less as compared to conventional one. As per Mr. Bergman it takes approximately 3 years to make awareness among farmers. It is very important for any company to develop consideration among their employees.

Organic cotton is produced in almost 10 countries India, Pakistan, Peru, Syria, China, United States, Uganda Turkey, Tanzania, and these countries are fulfilling the demand of Organic Cotton all over the world. The region Andean and Peru have been regarded as the origin of the cotton species *Gossypium barb dense*, they are producing the finest and longest Cotton commercially. (Organic Exchange 2007).

Mr. Bergman believes that their company is responsible to answer the issues regarding society and environment. Mr. Bergman strictly keeps an eye on the labor law and follows it, he doesn't allow child labor and he says that it is not the best way to work ethically but it's a

best business strategy. Bergman is involved in the supply chain fully and follows the entire steps that everybody in the supply chain gets fair wages. Product development and production of Bergman AB, from growing organic cotton to making final garment is done in Peru; however Bergman AB also works on CMT for their garment production. Bergman AB vision is to make the environment healthy, this business starts from farmers, and helps the farmers to improve their life style and also provide platform to learn good methods and techniques to improve the quality and fertility of soil by natural techniques. (Bergman 2010).

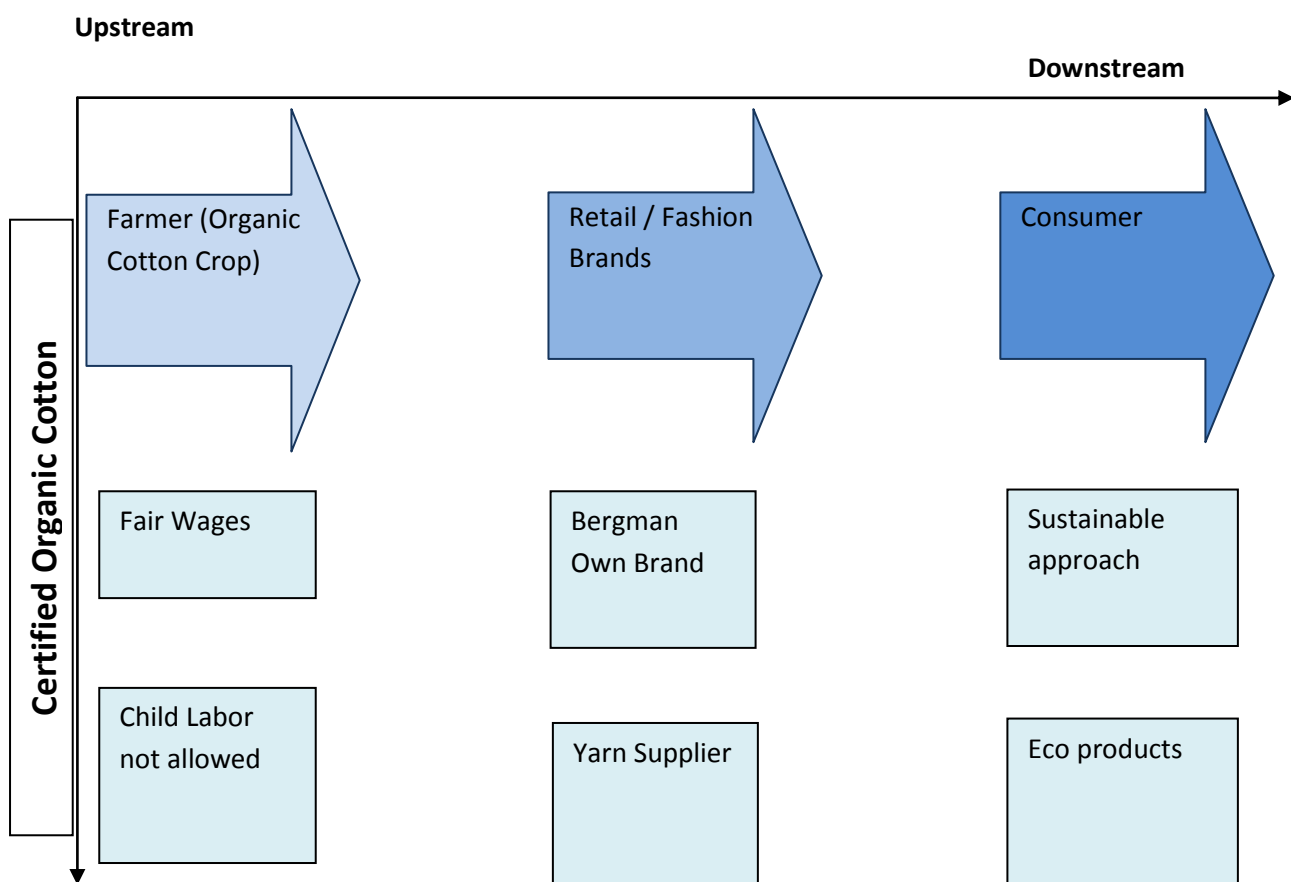


Figure 16: Bergman AB Supply Chain, Source: (Bergman AB)

6.4 Five Force Model for Bergman AB:

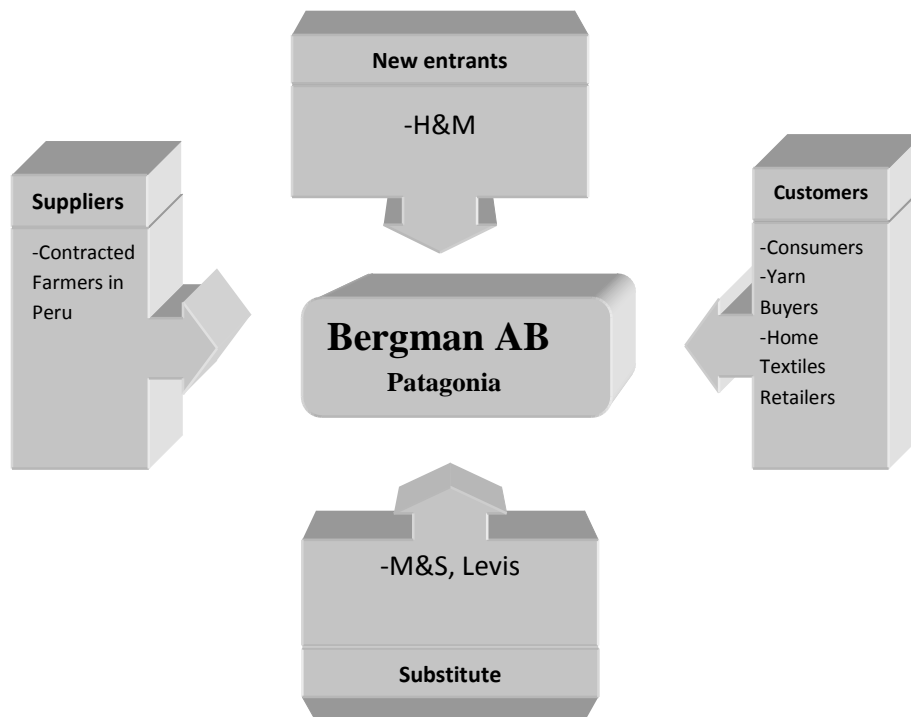


Figure 17: Five Force Model for Bergman AB

The model represents the effect of other established and upcoming brands that are introducing 100 % organic cotton in their fashion product line. In case of Bergman AB the company H&M is a potential establisher that is producing organic cotton products in composite form and have future plans to make 100 % organic cotton products. Bergman AB has its own stores where it sells the fashion products, company also acts as wholesaler from where consumers buy the organic yarn and home textiles. The customers are contented to buy the products because they are buying quality and transparent products. The company does not need to search for more or new suppliers because the suppliers are contracted farmers having their own land in Peru, Southern America. A substitute for organic cotton fashion product is a product made of same material at lower price or with superior design.

7. Discussion and Analysis:

7.1 Impacts of organic cotton in sustainable textile fashion:

The organic cotton plays a vital role in achieving sustainability in textile fashion by providing better quality, healthy and hygienic products, from growing organic cotton to making a final fashion garment all the processes in the value chain are clean and transparent, and contribute in achieving sustainability by helping in environmental, social and economical aspects, conventional cotton uses 150 gm of toxic pesticides and fertilizers for making 1 t-shirt while organic cotton uses none. Use of organic cotton in the textile products reduces about 25 % use of insecticides. (Organic Cotton - A Little History u.d.)

When the companies buy organic cotton they offer more cash to farmers than conventional cotton, it improves the financial situation of low scale farmers, buying organic cotton we support the backward regions where people are not skilled and educated and they are not familiar with the cancer causing chemicals. (Organic exchange u.d.). And Bergman AB is the leading textile company that is working on this business strategy, the company has contracts with local growers of organic cotton in Peru, and ensures their premium in case of any damage to the crop, thus taking social responsibility of the local farmers and their families. All the product development and production of Bergman AB is done in Peru, all the members of this value chain get fair wages that helps in improving their lifestyle.

Organic cotton is recognized worldwide and consumers are becoming aware of it and organic cotton has won the confidence of consumers, so the demand of organic cotton products is increasing world-wide. Organic cotton is grown naturally free of chemicals and there is no issue of skin irritation or allergies when we wear the garments near to skin, so organic cotton products are also healthy one.

In textile value chain organic cotton have many beneficial effects for the whole members of the chain; these chain members are farmers, brands & retailers and ultimately the consumers. These benefits have been summarized below.

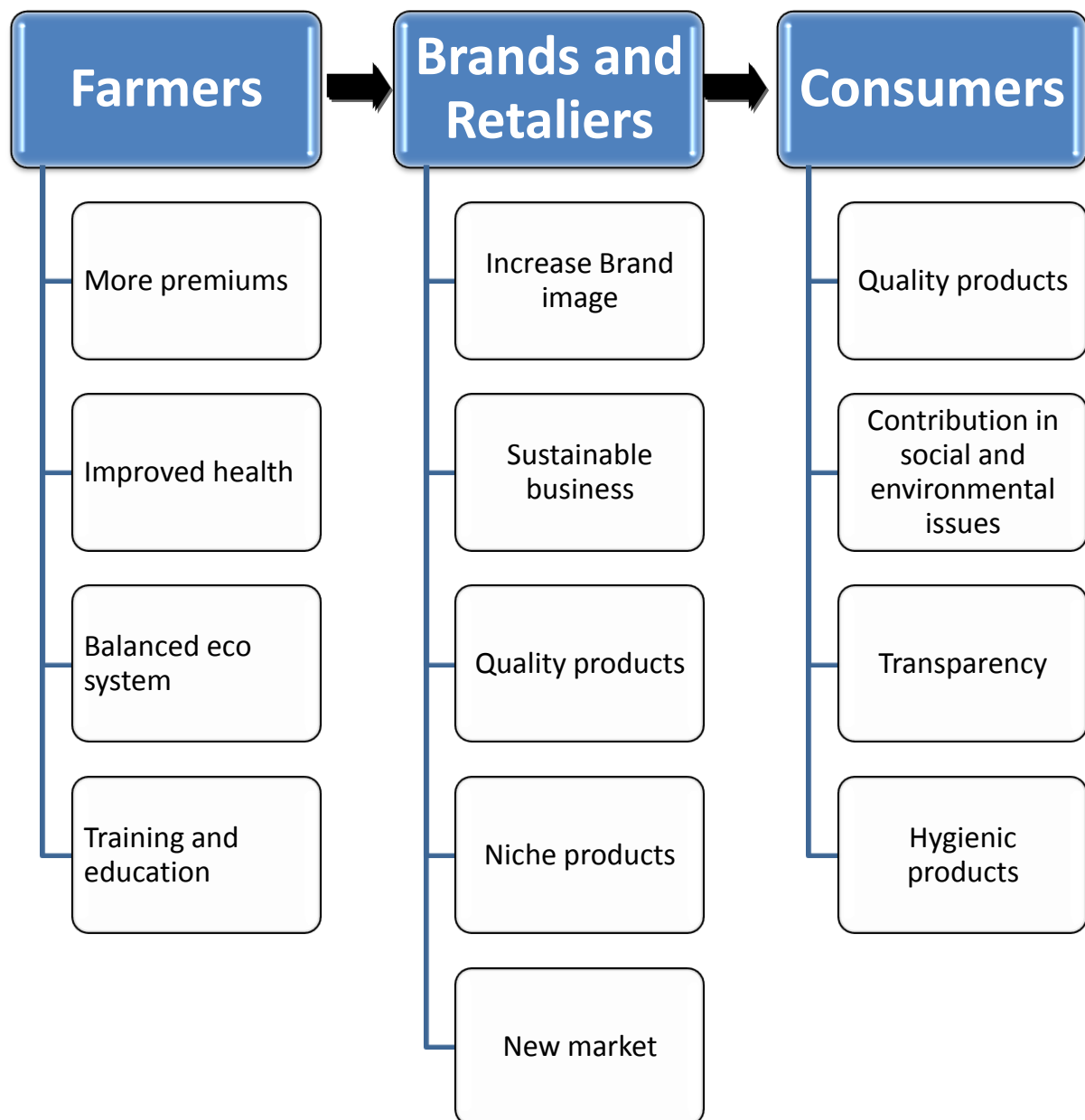


Table 5: Beneficial Impacts of Organic Cotton in Textile Value Chain. Source: (Own illustrated)

Textile industry impacts against sustainability:

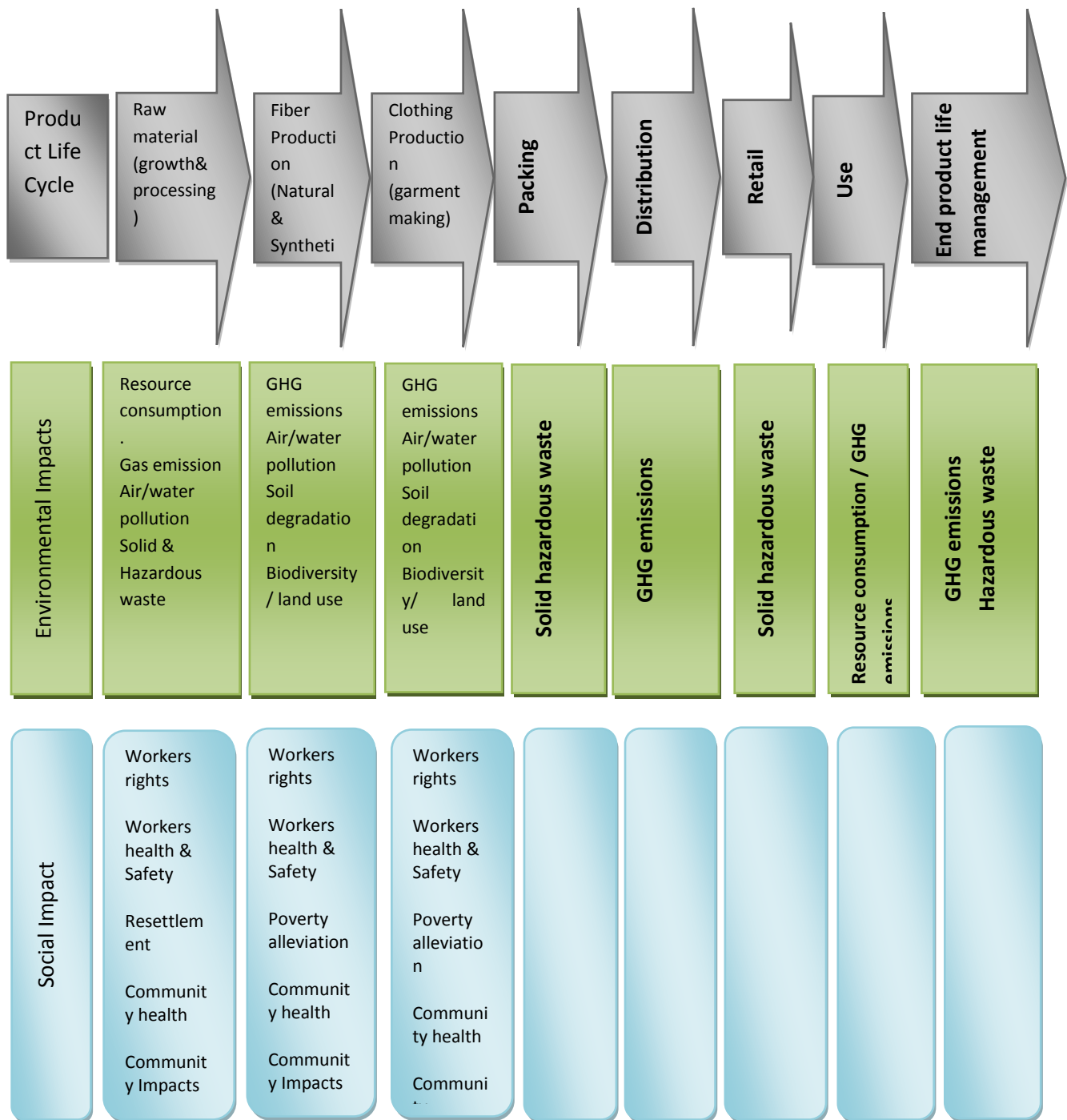


Figure 18: Clothing Industry impact on Environment and Society. Source: (Department for Environment, Food and Rural Affairs 2008)

7.2 Environmental Impacts of clothing industry:

In this picture the whole supply chain of clothing industry is shown regarding its impact on environment and society which are the main features of Sustainability. We can see from picture that textile industry has different harmful impact on environment. It is responsibility of buyer or retailer to keep eye on their suppliers what they are supplying to them and from where they are taking the raw materials. In picture it is clear that for growing of cotton (raw material) a lot of water is required and also different (harmful) chemicals, pesticides are used that have very bad effects on the environment. Furthermore during washing and processing of fabric a lot of energy is required and the use of fossil fuel in processing of synthetic fibers that generates GHG emissions e.g. polyester, nylon is energy consuming. During the dyeing process we found that different chemicals and synthetic dyes are used because of which we serve toxicity and hazardous water to environment. (Department for Environment, Food and Rural Affairs 2008). Bergman AB is aware of these issues and they do not use these harmful chemicals during the organic cotton processing.

7.3 Social Impacts of clothing industry:

Clothing industry is a big job sector or industry in the world, but the issue with this industry is that in Asia most of the people working in this sector are working in poor condition, some factories are not following the child labor law and workers are getting very low wages. There are no proper health & safety policies for workers. Small scale farmers do not have direct access to the buyers and middle man is making money rather than poor farmers. (Department for Environment, Food and Rural Affairs 2008).






Instead Bergman AB has direct contact with farmers and pays them fair prices for their crops and also educate them how they can grow organic cotton in order to contribute in sustainable development. Bergman AB also strictly follows the labor laws.

7.4 Product Development with sustainable fibres in Textile Fashion:

The increasing awareness and demand of consumers about sustainable products has put on many fashion companies to use the sustainable materials for making their products, organic cotton is a better initiative in this way, though many fashion brands and retailers are selling the organic cotton products but the use of organic cotton must be increased and all the companies should make the products from organic cotton instead of conventional cotton, by this they can also contribute towards sustainable approach . For example a textile company Bergman AB is producing basic fashion garments made of 100 % organic cotton grown in Peru, South America. By this way they are contributing in sustainable fashion along with financially helping the poor farmers of South America. In past the terminology under discussion was reuse, recycle and reduce and now a day it shift towards 'Sustainability.' These three techniques work efficiently and many companies focusing on it. e.g. PATAGONIA company launch recyclable fleece jacket that have good popularity and companies make good money out of it by showing people transparency and originality. After some time small companies also start to copy it and trying to make jacket by recycling the PET bottles, but these companies are not using 100% recyclable materials and sell these jackets cheaper than PATAGONIA. Some of the companies and university also raise slogan regarding reduce the use of product to overcome waste and resources issues, this is also an approach towards sustainability.

7.5 Organic Cotton for New Product Development in Textile Fashion:

Organic cotton is a better initiative towards sustainable approach and is alternative of conventional cotton for making eco-friendly and quality products, followings are the main drivers for development of organic cotton products.

-  Competitive Advantage
-  Supply chain
-  Life cycle Impacts
-  Brand Value
-  Consumer Demand

7.5.1 Competitive Advantage:

Today in fashion market there is a massive competition between quality brands, retailers and fashion companies. They are designing their products according to the needs of market and customers in order to get the competitive advantage. As customers are demanding sustainable products these days, so companies can get more premium and advantages by providing these products and products made from organic cotton are better options for companies because organic cotton is naturally sustainable and has positive environmental and social impacts.

7.5.2 Supply Chain:

A significant part of textile fashion industry is based on cotton, with increasing demand of organic products; demand for organic cotton is increasing, the suppliers and farmers are getting more premiums and benefits. Besides these increasing demand farmers get lot of benefits by growing organic cotton, they save their farms as they are using natural ways for growing cotton and does not use drastic chemicals that are harmful for human beings and its surroundings, thus by promoting use of organic cotton in textile products we can support the low-scale farmers and the people of third world as most of the cotton is grown in backward and under-developed parts of the world. Also there is a genuine problem for low scale farmers with conventional cotton as the yield has declined due to bad agricultural practices and there is bad reputation of conventional cotton with respect to social and environmental problems. Organic cotton is a better option for both suppliers and farmers to get better yield, good quality cotton and better prices. Organic cotton is supportive in promoting sustainability in the cotton sector.

7.5.3 Life Cycle Impacts:

There are several environmental impacts involved in different stages of life cycle of a textile product, these stages are mainly,

- Fibre production
- Processing (Spinning, Weaving, dyeing, Finishing)
- Manufacturing

In making a textile product at different stages a big amount of waste is generated and large quantity of resources like water and energy is consumed. The intensity of environmental impacts during the production of a textile product is different at different stages from

growth of fibre to make it a final product, and conventional cotton has drastic environmental impacts from its growth till end use. Organic cotton is grown free of pesticides and chemicals and during all stages of its processing hazardous and polluting compounds is not used; therefore organic cotton is natural, less resource consuming, eco-friendly and has less environmental impacts during its life cycle. so organic cotton is a better sustainable solution for textile products.

7.5.4 Brand Value:

Top brands and textile companies are using organic cotton in their products these days, due to sustainability issues of the other textile raw materials, many NGOs, and media have highlighted the social and environmental issues in textiles, so companies are using sustainable fibres as a risk management perspective to guarantee the sustainable standards and making the products from these sustainable fibres like organic cotton will increase the brand value and image in the customers.

7.5.5 Consumer Demand:

The consumers are becoming aware of sustainability issue these days and they are more interested in buying sustainable products and the demand for sustainable products is increasing, and large numbers of consumers are aware of organic cotton products and they are demanding these products, so opportunity is there for retailers and brands in the fashion market for organic cotton products and thus the organic cotton can meet the demands of customers. So consumer demand is driving the development of organic cotton products.

7.6 Bamboo for New Product Development in Textile Fashion:

From the above data we can easily analyze and understand the marvelous properties of bamboo fiber and its application in different fields. Textile fashion companies are trying to search for sustainability and sustainable materials in recent years and this research has become more and more contradicted with the history of materials and processes using in textile industry. Every company in Europe is trying to become more sustainable but it is not the simple word there is a big giant hidden behind it. Some of companies are taking responsible steps towards sustainability but still there is a question that is it true? What they are saying? This is very simple question that innocent customer is searching for. Everybody is connected to textiles because it's a demand of society and this demand has transferred

towards fashion. Retail companies invest a lot in the fashion garments and products; Fashion is somehow linked with society, market, surroundings and thoughts of different people having different culture. At this time new terminology Sustainability gets attraction and companies are launching sustainable products in fashion market and this approach has impressed the consumers, at the same time companies are making a lot of money and profit out of it. Companies are trying to build a relationship with the customer to do their business in efficient way.

Bamboo is a useful fibre it will help to provide farmers and rural side people with better opportunities of employment; they will get fair wages and benefits in bamboo product industry. Retail companies and fashion brands are trying to enhance the use of sustainable material in their product line to catch customers interested in sustainable products, this strategy of business and approach will make these company eco friendly. Bamboo fibre is a sustainable and a better substitute of other high impact fibres. On the other hand customer will also get benefit in terms of comfort and security from harmful chemical that is not suitable for the skin and produce different diseases.

7.7 Customer Review:

We got the data by interviewing different customers at Bergman AB store in Borås regarding the use and importance of sustainable products in their daily life. The customers were mostly ranging in the age from 30-55. They have different reviews about the organic and eco-friendly products and most of the customers were aware of eco products and they were purchasing these products regularly, there were also some customers that did not know much about the sustainability but they visited the shop just to see the difference between conventional cotton and organic cotton products, they did not buy the products but they liked the approach of company business. There were few teen age customers that were reluctant to buy these products due to their basic and classic designs and they were searching for fashion products but were ready to buy if any company provides the fashion products with sustainable materials and they were even ready to buy these products at higher prices.

Some customers were willing to buy the products from Bergman AB due to their transparency and 100 % usage of organic cotton in their products. Customers were satisfied from Bergman AB products due to their quality and functionality. Some customers were happy about the company they said that Bergman AB shows a clear picture of their products origin and thus it provides confidence to them because they know that the products they are wearing is made of sustainable cotton that is good for their skin and the environment and they feel comfort by wearing it. A customer who visited the store first time was amazed to see the price range, he said that he was thinking that products will be of higher prices, but the products were not much expensive so he was happy to buy quality and healthy products at reasonable price.

8. SWOT Analysis:

8.1 Organic Cotton SWOT Analysis

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none">• Eco-friendly due to not using pesticides and fertilizers.• Hygienic fashion products.• Niche products for brands and retailers• More premiums for its growers.• Increases brand value.• Fulfil consumer demand of sustainable products.	<ul style="list-style-type: none">• Market share is less than conventional cotton.• Small fashion companies hesitant to use due to higher prices.• More transition time for its production from conventional farming.• Lower production than other crops.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none">• New market for organic cotton products.• Increasing demand due to customer awareness.• Production can be increased by development and training programs.• Saving our natural resources.	<ul style="list-style-type: none">• Other sustainable plant fibres like bamboo, flax and hemp.• Eco-friendly Synthetic fibres.• Low cost fibres.

8.2 Bamboo SWOT Analysis

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Fastest growing plant of the world • Environment friendly natural fiber (grow without fertilizers, pesticide and herbicides) • 100 % BIODEGRADABLE (come from nature and return back to nature). • Anti bacterial and antifungal properties. • Bamboo product source of income for countryside people. • Soft, Smooth, luxurious, and comfortable. Highly breathable (Air conditioned fabric). • Resistant to harmful UV rays • High absorption rate (3% more than cotton) 	<ul style="list-style-type: none"> • Tensile strength very low. • Production processes have many complications. • Only available in CHINA. • Alkali used in its processing (Strong alkali is hazardous for environment). • Multiple species.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • Use in Fashion products. • Bamboo unique properties can be used in other products e.g. bath Suits, mats, blankets and towel (High absorbance). • Bamboo can be also use in non-woven. • Use in medical textiles (anti bacterial masks, gowns, surgical items etc). • Industry decoration, furniture products. 	<ul style="list-style-type: none"> • China covers 80% of bamboo processing industry. • Political interferences fashion companies policies (import and export of garments). • Deforestation carries on.

9. Conclusion:

Sustainability has become an essential attribute of today's textile and clothing industry, the process of transforming textile industry into more sustainable one is very sensitive, needs a lot of knowledge, skills and commitment. Use of Sustainable fibres in textiles is a part of this process and a step towards this milestone. Organic Cotton and Bamboo fiber have demonstrated strength in the market of textile fashion; these are much better and useful alternatives of dominant and high impact fibres. Both fibers have wide range of applications. But the use of these fibers is not common in textile fashion products especially when we talked about Bamboo fiber. Cotton has captured big market share because of its properties but cotton growing is not favorable for the environment it requires a lot of water, pesticides and fertilizers. On the other hand if we consider organic cotton and bamboo that are resource efficient in their growth, have better properties than cotton and have no perilous effects on environment and human society. Natural rainfall is sufficient for the growth of bamboo fibers and no need of fertilizers and other chemicals for their cultivation and growth.

The quality and yield of both fibers is good and their application in different industries; especially in form of composite with other natural materials make them beneficial fibers. But the problem is that they can grow in some parts of the world especially in case of bamboo, China has the big share (80%) of total supply of bamboo all over the world. Use of these natural fibers is the best alternative or substitute of cotton fiber, and the natural properties of these fibers delimit the environment from harmful forces like hazardous chemical. The use of these extraordinary fibers opens new market and trends for the fashion companies as well as consumer.

Use of these fibers in the textile fashion industry is very limited or in very little percentage in different composites, these fibers have potential to use in fashion products and other industries to make the environment green. By-products produced from these fibers are also very useful, some of the shoots of bamboo are used in food dishes and medicines, and bamboo has been used by famous furniture companies. The environment is a main driver for both industrial and governmental sectors, and the requirement for this driver is to give it eco-effective products, because future survival depends on it.

Fashion is the name of change and change is the part of life. People's desires and needs have no limits and companies are continuously striving to fulfill the consumer needs. Cloths are the basic requirement of every person and changing of cloth is the habit of people. And these habits of changing cloth of people give companies a big platform for business to get revenue through this platform. Many fashion companies are working on this platform from hundreds of years, but technology and innovations change the company thinking and also surroundings change the people trends and varieties of products born in comparison to both changes. Now a day lot of companies and brands are working in this business and variety of products are available in the market. And today thought of sustainable approach strike these companies business and also consumer mind. Consumers are becoming aware of sustainable concerns and want sustainable products that work for environment.

Many fashion companies are still working with conventional cotton products and making a lot of fashion products with multiple designs and colors. But these things are not workable for a long time. Customers are becoming aware day by day and want products that are good for their skin and bring comfort for them. And this learning makes customer aware about harmful and hazardous products they are using in their daily life. Bergman AB provides the entire product range with sustainable materials (Organic Cotton) with very reasonable price. And company vision is to make the profit in manageable and sensible way. Bergman behaves sincerely through the entire steps and processes in their supply chain, and continuously audit all of them to make them transparent.

The future of textile industry will depend on the products that have reduced environmental and social burdens during their entire product life cycle. A part of this is the introduction of sustainable materials that will reduce these impacts during their growth and processing. And this report will provide fashion companies good knowledge of sustainable fibers (the raw material for their products) and brief description about their properties to support the use of these fibers in their product that will serve the society as well as environment.

10. Recommendations:

1. Textile companies are using organic cotton in their products in composite form; we recommend textile companies to enhance the use of organic cotton in their products to add value to green product line. Like Bergman AB is using 100 % organic cotton in their products
2. Bergman products are basic and classic in design; they should also make the fashionable garments to attract the young customers.
3. Textile fashion companies and brands are using organic cotton in their basic product line and not using in fashion articles, we recommend these brands to use organic cotton in their fashion products also.
4. China has bamboo production up to 80%; we recommend companies and researchers to find some other places to grow it in other parts of the world to increase the natural sustainable production plant that will be helpful to fulfil the future demand of Bamboo.
5. We recommend fashion companies to use the bamboo fibre in their product line to make their products more eco friendly and comfortable.
6. Bamboo is the future fibre of the world; we recommend more research and study required regarding its processing to make its use convenient for fashion companies.
7. Bamboo will help fashion companies to diversify their business in further lines of home textiles, furniture, sportswear (Anti bacterial property provides resistance against sweating).

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Appendix I:

Interview of Stephen Bergman Director (Bergman Sweden AB/ the Ecocotton CO AB)

1: When the company started Organic Cotton Fashion Clothing business?

ANS: As producer of organic cotton in the year 1986.

2: Why you have chosen the Organic Cotton clothing business Line?

ANS: To give our product an added value and give farmers a sustainable life.

3: Company is working as Supplier, Wholesaler or Retailer?

ANS: Agriculture (Ecotton SAC, Peru) (part owner), Ginning, spinning, weaving and confection (Bergman Rivera SAC) (part owner 50%). Wholesaler and retailer (The Ecocotton Co, Sweden).

4: Do you have Organic Cotton Suppliers: If yes than from where you get the Organic cotton?

ANS: Our own premises thru contracted farmers.

5: Do you think Organic Cotton Processing (Spinning, Weaving, Finishing) is Sustainable?

ANS: Yes.

6: What is the role of Organic Cotton Clothing in Social Responsibility?

ANS: Better for the soil, better for the humans, fair trade.

7: What is the customer response towards Organic Cotton or Sustainable Materials?

ANS: Positive and growing.

8: What do you think about other (Sustainable) natural fibers, Like Bamboo, Hemp, and Flax? Have your Company any Plan to work with other sustainable materials in future?

ANS: Bamboo is not a sustainable fiber. It is a viscose fiber and not different from other cellulosic fibers. Hemp and flax can be sustainable if it is grown organic. We work with flax, hemp and wool. All are organic.

9: Would you like to add bamboo (Sustainable material) in your products line?

ANS: NO!

10: Do you face problem to market Organic Cotton products?

ANS: No demand is increasing.

11: What about the price difference between Conventional and Organic Cotton products?

ANS: It is not a problem if we discuss price of cotton but a problem in retailing as 20% extra for organic grows too much in retail phase. A pair of jeans has cotton costs of 1 USD and it makes no difference if cotton price is USD 1, 50. Based on cotton lint.

12: What do you think is the future of Organic Cotton in Textile Fashion?

ANS: Will be a natural thing. H&M will have all cotton organic 2020.

13: Where do you see your company in Future?

ANS: As a supplier of different brands and a main supplier to private brands

Appendix II:

Questionnaire (For Customer Review).

Q1. Have been at Bergman AB before or visiting first time?

Q2. Why do you come to Bergman AB?

Q3. Have you ever purchased organic cotton clothing?

Q4. How much you know about sustainable Fashion?

Q5. Do you think products in the store are sustainable?

Q6. Do you buy sustainable product in routine?

Q7. Will you come to Bergman AB again?

Q8. Are you satisfied with the quality of these products?

Q9. What do you feel after wearing these products?

Q10. Do you tell other friends about these products?

Q11. Would you like to pay more for these products?