

Sustainability Challenges Faced By The Indian Textile Industry – Policy Implications

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Abstract:-In the Indian economy, the promotion and expansion of the textile and clothing industry (T&C) is crucial because of the significant stake enjoyed by the industry in the nation’s gross domestic product. The T&C industry is closely entwined with the concerns of ecological relevance that are prevalent in the world today. This paper asserts the significance of T&C industry through its contribution towards generation of employment, provision of raw materials to other industries, and the subsistence of ancillary mercantile activities – especially in India. The study dwells deeper into the various methods that can be adopted by T&C industry to promote more ecologically viable and therefore sustainable production over the long run. The study concludes that even though sustainable measures like waterless dyeing, promotion of organic cotton etc have been adopted more significant efforts need to be instilled by the state to ensure sustainable growth of Indian T&C industry.

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I. INTRODUCTION

Particularly in the context of the Indian economy, the promotion and expansion of the textile and clothing industry of is crucial because of the significant stake enjoyed by the industry in the nation's gross domestic product, and the widespread protection provided to rural activities. The industry's value in the future will be established by its capacity to acclimatize to the requirements of an environmentally sustainable and ecologically mindful world.

The textile and clothing industry is closely entwined with the concerns of ecological and societal relevance that are prevalent in the world today. The significant detriments caused to the environment and society due to the constituent processes of the industry have been evaluated through this thesis, and an attempt has been made to ascertain the fact that methods employed universally in the production of textile goods are highly unsustainable and fundamentally untenable in nature.

Following an in-depth analysis of the multiple dimensions associated with the industry, an endeavour was undertaken to present suitable recommendations with respect to the comprehensive policy measures required to initiate remedial actions in the long run to promote sustainability in the textile and clothing industry. In spite of the efforts being made to implement relevant courses of action to uphold sustainable development in the textile and clothing industry across the world, there still continues to remain an immense scope for joint cooperation amongst producers, traders, policy makers, and consumers so as to assist the improvement in the performance of textile goods across the supply series.

II. CHAPTER IMPORTANCE OF THE TEXTILE AND CLOTHING INDUSTRY

"In no other category of manufactured goods do developing countries enjoy such a large net exporting position (as they do in the textile sector)."

- World Trade Organization Report of 2006

An account of the Indian history and progression of the textile industry over roughly five centuries reveals that up until the 17th century, the manufacturing and retail processes of textiles was performed by individual artisans within their own premises, leading to a predominantly limited scope of growth in the industry despite the large amount of employment generated. Nardinelli (2008) closely examined and commented on the changes observed in the early 18th century, with artisans inventing ways to increase the efficiency of their production process, and cotton eclipsing silk and wool to become the most important textile as a raw material for the rapidly emerging textile and clothing industry. Gutmann, Myron P. (1988) aptly proposed that at the end of the eighteenth century, the textile industries worldwide moved rapidly into the industrial era and factory production largely introduced manufacturing to the cities. It was also observed that domestic markets had expanded well beyond the luxury trade of the fifteenth, sixteenth, and seventeenth centuries. These changes eventually led to the mass production of the textile goods of yarn and cloth, and marked the establishment of textile and clothing as a mainstream industry.

In today's day and age, the textile and clothing industry holds a well recognized and unwavering place in the economies of major nations of the world. The industry can be seen as a global phenomenon that constitutes every single activity involved in the developing, manufacture and retail of textile goods. The remainder of this essay seeks to examine the significance of this industry and talk about its widespread involvement in the economy through generation of employment, provision of raw materials to other industries and support to ancillary industries. Often thought to be the principal importance of textile and clothing industry in today's economic climate, the first significance of the industry analyzed is the generation of employment, and large scale contribution to domestic output and exports – especially in developing nations such as India, China and Turkey.

As the World Trade Organization report of 2006 states, international trade facilitated by the textiles and clothing industry continues to play an extremely vital role in the process of development of many countries, eventually also furthering their integration as nations into the world economy. As of the present scenario, developing nations as a group are responsible for more than half of the global exports of goods produced by the textile industry.

I. a) Growth of the Turkish Textile Industry

While taking up the illustration of Turkey to better understand the responsibility of textile and clothing industries in India, we discover that textile and clothing was the first industrial sector that developed in the nation, with the establishment of customs union with the European Union giving a major boost to the industry in 1990s (EMIS Company Data, 2013). Currently, the industry is the largest manufacturing subsector in Turkey in terms of production and employment. Clothing and textiles is among the best-performing sectors of the Turkish

economy, accounting for around 7% of the country's GDP. There are close to 56,000 textile and clothing companies operating in the country that offer employment to roughly two million people (ibid).

The General Secretariat of the ITKIB (as in 2014), stated that the exports of Turkish textile and clothing goods have been on the rise in the recent years, but its share in the country's total exports is decreasing. In 2012, Turkey was the ninth-biggest textiles supplier in the world with a 3.0% market share and seventh-largest clothing supplier with a 3.4% share market share in the world. With the removal of international trade barriers for China recently, the Turkish textile sector has started losing its labour cost advantage and in order to maintain its competitiveness, many local producers have moved toward new designs, fashions and quality labels. The strength of the Turkish textile and clothing industry lies in its strong availability of resources such as cotton, proximity to European markets, and a skilled workforce operating under an adaptable and accomplished faction of entrepreneurs.

I. b) Development of a diversified clothing and apparel industry in Turkey

The Turkish textile industry has made an important contribution to the rapid emergence and development of the clothing and apparel industry as well (Ibid). In the late 1990s, the share of the textile sector within total exports became 9.3%. In today's age, the industry has become one of the most important components of the Turkish economy by attaining an export value of 5.4 billion dollars. The Turkish textile industry employs the usage of modern technology, and the existence of well developed production units allow large scale manufacturing and marketing of associated goods as well.

I. c) Contribution of the Indian Textile Industry to GDP

In line with the experience of Turkish T&C industry, Indian T&C industry has also registered large positive influence in the overall economic growth from the latter half of the twentieth century. The importance is underlined by the fact that the industry accounts for close to five percent of the nation's gross domestic product (GDP), 14% of overall industrial production, and close to 18% of the total export earnings, as per the Dun & Bradstreet (commercial data) findings of August, 2015.

I. d) Contribution of the Indian Textile Industry to large scale employment generation, and the industry structure of Indian textiles

Besides contributing largely to the rapidly growing GDP of the nation, the industry is also responsible for generating employment for nearly 35 million employees (Reinert, 2005) in the form of both, skilled and unskilled workers. The textile and clothing industry in India is the second largest employment generating industry in both rural and urban areas, and is surpassed only by the primary sector employment of agriculture. The vast pool of both, skilled and unskilled workers, availability of a large amount of varied labour at low costs, and a strong base for the production of raw materials are the characteristics that exemplify the textile and clothing industry in India.

The increases in domestic demand, as well as the ability of the various firms in the industry to produce small or customised orders of textile goods prove to be advantageous and set India apart from its close competitors in the world markets. The textile sector in the nation is highly diversified and is constituted of hand woven segments at one end of the spectrum; and capital-intensive, modern mills at the other. Each of the type of industry structure constituting the textile and clothing industry in India possesses its own contribution to the economy in terms of employment and increase in export surplus.

Table 1 shows the fabric production in different sub sectors of the Indian textile and clothing industry. The cotton fabric production is the major contributor to textile exports (Ministry of Textiles of India Annual Report, 2006).

It is projected that the number of power looms will rise to 3 million in the upcoming future. Of the total cloth produced in India, 62 per cent comes from the power looms sub-sector (as observed in Table 1), and the ministry estimates that more than 60 per cent of the country's cloth exports originated from that sector. With its employment of 4.86 million workers, the power looms sub-sector comprised approximately 60 percent of total textile industry employment. Decentralised hosiery sector itself contributes to employment with a 15 - 20% growth rate annually (ibid).

PRODUCTION OF FABRICS BY DIFFERENT TEXTILE SUB-SECTORS
(IN MN. SQ. METERS.)

MILL SUB SECTOR

Type/Year	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007 onward
Cotton	1019	969	1072	1192	1030	1229
Blended	263	253	243	252	206	260
Non Cotton	214	212	211	212	156	240
TOTAL	1496	1434	1526	1656	1392	1729

HANDLOOM SUB SECTOR

Type/Year	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007 onward
Cotton	5098	4519	4792	5236	4207	5953
Blended	118	117	146	145	118	182
Non Cotton	764	857	784	727	572	736
TOTAL	5980	5493	5722	6108	4848	6871

DECENTRALIZED POWER LOOMS SUB SECTOR

Type/Year	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007	2007 onward
Cotton	6761	6370	7361	8821	7188	10310
Blended	4695	4688	4526	4632	3915	4952
Non Cotton	14498	15889	16438	17173	14175	18297
TOTAL	25954	26947	28325	30626	25278	33559

TABLE 1: Source: Author's construction and compilation based on The Indian Textile Ministry's Annual Report of 2006

I. e) Contribution of the Indian Textile Industry to the subsistence of Agriculture

The Indian economy has always primarily been an agriculture-driven economy. The vast stretches of land, natural resources and climatic conditions prevalent in the nation aid the production of varied raw materials for differentiated industrial purposes. Historically, India has been known for its high-quality cotton, jute and other natural fibre. Over the years, however, the domestic industry has progressed and diversified into many types of fibre and yarn, both natural and man-made. The type of yarn used is dictated by the end product that is manufactured. Sundaram, P. (2011) suggests that the abundant availability of raw material is one of the significant advantages of the textile industry of the nation. It is well established that India possesses natural advantages over its competitors in terms of raw material availability. India is the largest producer of jute, the second-largest producer of cotton and silk and is among the largest producers of wool across the world. The interdependence between the textile and clothing industry and the primary sector industry of agriculture can be examined from another purview as well, because the high domestic demand for textile goods directly implies a greater need for agricultural goods as raw materials to facilitate production. This heightened domestic demand thereby raises the employability of the primary sector further and even allows for the creation of a guaranteed outlet of export for harvested goods of cotton, jute and other textile goods. Thus, the growth and establishment of the textile and clothing industry is extremely essential for the subsistence of the agriculture industry and associated industries as well.

I. f) India's Integration into World Markets

With respect to India's integration into world markets and establishment as an economic power, the growth and promotion of the textile and clothing industry of the nation is imperative, because of the large share enjoyed by the industry in the nation's GDP and export. As per the India Law Office's report (2012), the Indian textile industry contributes around 25% share in the world trade of cotton yarn, and is the largest exporter of yarn in the international market. The Apparel Industry is one of largest foreign revenue contributors and holds 12% of the country's total export.

I. g) Contribution of the Indian Textile Industry to the subsistence of Ancillary Industries

The existence of a well established textile and clothing industry in India is also essential for the subsistence of ancillary units that are direct dependents on the industry in terms of the raw materials and finished goods. George B. (2003) states that smaller industries such as those of the button-making, zip and hook manufacturing, embroidery, textile craft based industries (of block printing and patchwork), or even commercial activities related to transport, storage and shipping of textile related goods can only continue to provide employment to fifty million workers in the domestic economy so long as the textile and clothing industry continues to thrive and further develop in the nation's present economic climate. The textile and clothing industry of India further guarantees the protection of rural activities. Gainful job creation in rural areas generated through handicrafts and other allied activities of the textile and clothing industry promote the further development of crafts, which in turn represents a positive contribution to the number of alternatives to resource destructive agricultural practices as means of employment. The study conducted by IDRC Ottawa (1986) was testament to the contribution of the handicrafts and textile based activities to overall employment opportunities in Asia. In the context of the Indian economy, it was observed that more than two million workers are engaged in full-time craft employment (Pye, 1988), and the revenue from artisan-produced handicrafts and textile goods amount to 16 percent of India's total trade.

Thus, while examining the contribution of the textile and clothing industry to all spheres of the world in the economic climates of the past and present ages, we realize that it is one of extreme importance. Beyond the generation of employment, increase in national output, provision of protection to rural handicrafts, and overall assistance in bettering the standard of living of the population in several developing and developed nations; the industry's influence in the fields of fashion, design and digital marketing also gives anyone falling under the sway of the industry the liberty to express their individuality and attain employment in the field of their liking. With the introduction of new technological advancements, refined patterns of consumer demand and generation of diversified sectors of production, the textile and clothing industry's importance in the upcoming future will be determined by its ability to adapt to the requirements of an environmentally sustainable and ecologically conscious world. A rapidly and continuously developing textile and clothing industry exemplifies the future of emerging nations and their ability to become economic powers of the world in the coming ages and hence its importance as an industrial sector remains indisputable.

Having established the importance of T&C industry in the Indian economy the subsequent chapter looks into the sustainability argument in the industry. Given the growing importance of T&C in India it is imperative that ecologically viable and highly sustainable techniques are incorporated in the production cycle. Introducing such techniques/methods shall ensure long run sustainability which is in line with India's objective of contributing towards eco-friendly methods of production.

III. CHAPTER SUSTAINABILITY CHALLENGES OF THE TEXTILE AND CLOTHING INDUSTRY

According to the Retail Forum of the European Commission, other than being the world's second largest economic activity in terms of intensity of trade (and accounting for seven percent of world exports), the textile and clothing industry is heavily intertwined with the environmental, social, and governance issues that are prevalent in the world today. The activities of producers and retailers have in the past been conventionally limited to improving the social aspects associated with the textile and clothing industry, such as the establishment of suitable working conditions and minimum wages, the setting of social standards and imposition of bans on forced labour, and the endorsement of occupational safety of workers. Presently, however, a growing concern is harboured with respect to the lack of sustainability of the industry due to its becoming the fourth largest contributor to environmental hazards (EIPRO, 2006) – closely following the food, transport and housing industries.

A. Tukker (UNEP, 2003) states that the textile and clothing industry employs the usage of several different types of fibres in the production of garments, and thus the precise environmental impact and implication of sustainability also varies greatly. Generally speaking, the environmental effects of the production processes involved in the industry can be classified as but are not limited to energy usage, greenhouse gas emissions, release of nutrients directly causing eutrophication, 'eco-toxicity' from washing; and the dyeing of textiles. Each of the above impacts, along with other significant detriments caused to the environment and society due to the constituent processes of the textile and clothing industry have been effectively analyzed through the means of this paper. Additionally, an effort has been made to ascertain the fact that methods employed universally in the production of textile goods are unsustainable in nature and require the introduction of comprehensive policy measures to initiate a long term corrective action in the upcoming future.

II. a) Greenhouse Gas Emissions and the Use of Energy Resources

The major injurious impacts of the sector arise from the use of energy resources and the subsequent generation of greenhouse gas emission (Geerken, 2006). The processing of naturally limited fossil fuels into synthetic fibres such as polyester or nylon directly leads to the depletion of scarce natural resources that are necessary for present use and future subsistence. The sector's increasing contribution to climate change also stems from the overriding requirement of burning these fossil fuels to generate electricity for heating the water and air required in laundering of finished textile goods. Further, major energy usages (and thus emissions) arise in the provision of fuel for agrarian machinery and the creation of electricity to provide for production processes. Talking about the domestic economy of our nation, the per capita consumption of textile goods in India is presently roughly twenty kilograms an annum (Athalye, A., 2015); implying a high energy requirement and consequently a high carbon footprint of the textile industry. A growth in the industry from its present valuation of seventy billion USD to a proposed 220 billion USD by the year 2020 would also proportionately increase the carbon footprint, thereby further depleting natural resources.

II. b) Inequitable and Unplanned Usage of Water Resources in India

The World Bank's Growth Forum in 2006 aptly stated that water as a resource was extremely valuable in nature and has played a central role in human societal development over the ages. Water is believed to be a key driver of sustainable growth and poverty alleviation on a large scale because of its versatile role as an input in industries ranging from agriculture, energy or transport. Thus, keeping the above significance of the resource in mind, it is essential to reflect on the issue of water resource development and management in order to promote industrial growth in any developing nation. Sadoff, C. (2008) measured the importance of water in an economy and emphasized the unproductive use of the resource in textile and clothing across the world to highlight the sustainability challenges faced by the industry. The textile and clothing industry is largely water intensive. The resource is primarily used for cleaning the raw material initially, and then for other flushing steps in the entire production process to either convey the chemicals used in that step, or to wash them out before the initiation of the succeeding step. Other than being accountable for employing the use of a scarce resource in an unplanned and inequitable manner, the industry can also be held responsible for the expulsion of chemical laden waste-water into streams and rivers, which in turn pollutes the surrounding environment due to the effluent's increased and unnatural pH, and its uncharacteristic heat properties.

II. c) Utilization of Chemicals in the Production Process

Porter, J. (1972) states that the textile and clothing industry has been largely condemned as being one of the world's most severe offenders with respect to the disruption caused by it to the environment due to its utilization of large quantities of chemicals in the form of colour agents, bleaching agents, or transfer agents in the manufacturing stages of pre-treatment, dyeing and printing. Through his research he testifies to the fact that almost every chemical substance used in the production process of textile goods (such as de-foaming agents, detergents, optical brighteners, equalizers and coloured dyes) saturates the input liquids of water and oil, and can further contribute to the creation of ecotoxicity. The largest sustainability challenge faced by the textile and clothing industry presently is of adopting more water-friendly technologies to dye and process cotton and polyester, the two most largely marketed textiles (Hattori, K., 2013). While waterless dyeing (that utilizes air pressure and little or no water in its process) exists, the widespread adoption of the practice is decades away as no present technology can address the varied manufacturing processes of diverse textile fabrics.

II. d) Employment of Fertilizers and Pesticides in the Agrarian sector of India

As previously confirmed, there exists an interdependence of a large magnitude between the textile and clothing industry and the primary sector of agriculture, especially in developing economies such as India and Turkey. The high domestic demand for textile goods directly implies a greater requirement for agricultural goods as raw materials to facilitate the process of production. While the Indian domestic economy possesses a natural advantage over its competitors in terms of raw material availability and thus production, soil fertility depletion due to the various degrees of degradation continues to become a cause of grave concern for Indian agriculture (United Nations FAO, 2009). A gap of close to ten million tonnes of nutrients continues to exist between the removal of nutrients from soil due to crop cultivation, and the re-addition of the nutrients during cultivation procedures.

Due to the introduction of modern agricultural practices with the advent of the Green Revolution in the 1960s, a sizeable usage of enhanced fertilizers has been employed in order to increase agricultural productivity of the primary sector (ibid). This modern implementation can be credited for increasing net agrarian output in the long run, but can also be held responsible for the large scale release of nutrients in the form of nitrogen and potassium compounds into the atmosphere and soil.

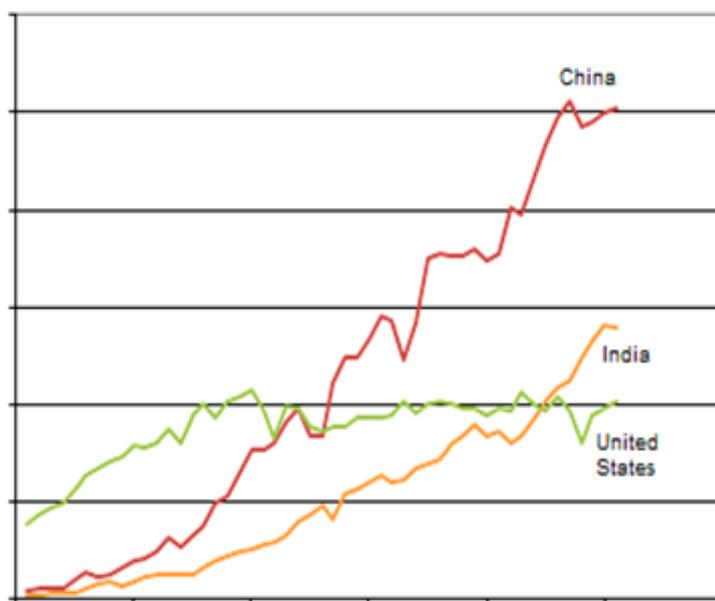


Figure II(d)i): Fertilizer Consumption in China, India and the United States between the years 1961-2011

Figure II(d)i) shows the comparison between the nations of China, India and the United States of America with respect to their relative usage of NPK (Nitrogen, Phosphorus and Potassium) based fertilizers over fifty years, from 1961-2011. As shown, while India's fertilizer consumption is increasing steadily to a point where it has surpassed the usage employed by the United States, the consumption of fertilizers in the Indian domestic primary sector remains categorically lower than that of China.

According to the 2012 report by the World Wildlife Federation, this process of nutrient release further increases the turbidity and salinity of the surrounding water bodies and interferes with sunlight penetration and air-water transfer mechanisms; thereby leading to eutrophication, growth of unnatural biomass, the reduction of biodiversity, and an overall decrease in water quality.

As per the research conducted by the University of Cambridge (Institute of Manufacturing, 2006), even though the concept of sustainability stems from the implication of whether or not the textile and clothing industry is environmentally and economically viable to account for future challenges, it is imperative to take into account the relevant communal concerns prevailing in the society that eventually determine the future potential of the industry.

II. e) Inability of the Indian T&C industry to ensure employment security and minimum wages

The textile industries in countries across the world are highly labour intensive and employ a multitude of both, skilled and unskilled workers. While the nations of the Western hemisphere able to ensure a legal minimum wage (generally ranging from USD 13-22 per hour) to their industrial workers without difficulty, presently developing nations such as India are faced with a predicament where they are unable to provide realistic minimum living wages to their labourers (Allwood, J., 2006). Thus, even though the textile and clothing industry provides large scale prospects for human development by creating employment opportunities of varied skill levels, workers are unable to escape the vicious cycle of poverty, with the majority of them receiving less than a dollar an hour. Further, there remain limitations in the appropriate regulation of minimum standards of working conditions across the supply chain of labour despite several policy implications and efforts made by textile and clothing factory operators – eventually leading to growing concerns about the officially permitted number of working hours, safety issues in the factory premises, and the employment of children below the legal working age (UCIM, 2006). In most situations, the right of workers to form labour unions to represent their concerns and collective bargains is also suppressed.

II. f) Role of Consumers in Environmental Detriments

The sustainability of an industry is eventually dependent on the role played by each of the members that are a part of the supply chain (RMS Europa, 2013). Even though the conventional belief is that suppliers and producers are liable for the considerable damages caused to the environment and society as a result of industrial production, and hence are to be held accountable for the corrective measures required to prolong the subsistence of the industry; consumers of intermediate and finished textile goods are also equally responsible for

both: the detriments, and the much required remedial actions. For instance, talking of a finished textile good such as a cotton shirt – most of the energy usage employed in the life cycle of the shirt is a result of the processes of laundering and drying facilitated by the consumers post-purchase, rather than by the suppliers during its production. It is also estimated that consumers can be held accountable for the generation of obscene magnitudes of textile good wastes in solid form, such as the generation of a million tonnes of textile waste annually by the consumers in the United Kingdom (Bocken, N., 2006).

Against the above background, an inference can be drawn to display the fact that if the prominent textile and clothing industries of nations across the world maintain their present course of action and employ scarce resources in an inequitable and unplanned manner rather than investing in the discovery and development of alternate and sustainable means and modes of production, the nature of the industry will become extremely unsustainable and unviable for the upcoming challenges of the future. Thus, several voluntary initiatives must be introduced at every level of the production and consumption cycle to reduce destructive impacts on the environment and to address the predominant issues faced by the society as a result of the processes that constitute the working of the textile and clothing industry, especially in presently developing nations such as India.

IV. CHAPTER POLICY IMPLICATIONS IN THE TEXTILE AND CLOTHING INDUSTRY

As elucidated through the course of this paper, the concept of the importance of the textile and clothing industry has been well understood, especially in the context of presently developing nations such as India. An attempt has also been made to establish the fact that the currently existing nature of the industry is highly unsustainable in nature and if the present course of action is maintained with the employment of scarce resources in an inequitable and unplanned manner rather than investing in the discovery and development of alternate and sustainable means and modes of production, the industry shall be unable to face the upcoming challenges of the future. In this regard, multiple initiatives and policies must be introduced wherever possible in order to reduce the detriments caused by the industry to the environment and societal structures, and to promote a long term sustainable textile and clothing industry that optimizes the natural resources available to it and caters to the rapidly emerging forms of demand for varied textile and apparel goods.

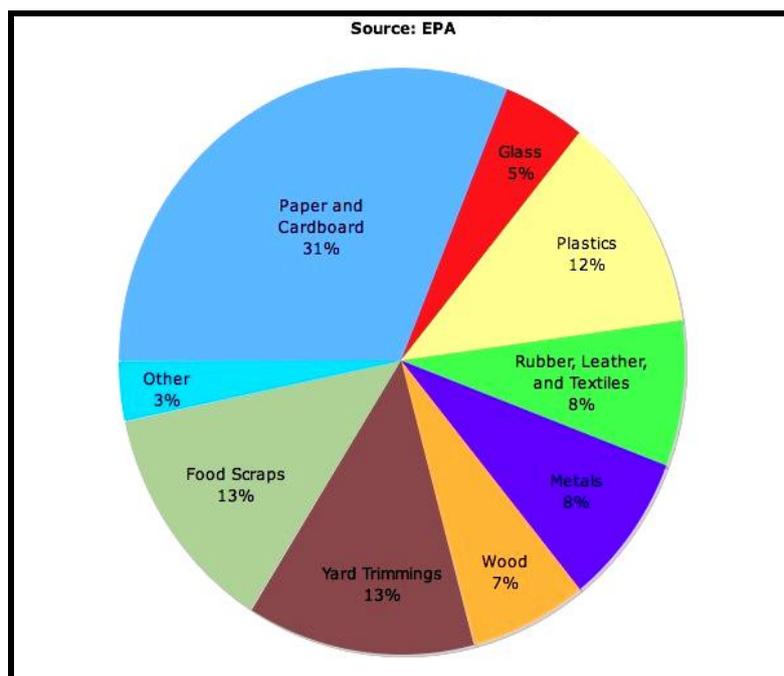
According to the United Nations Environment Programme report of 2004, development of production processes in a manner that results in a lower usage of water resources, pesticides, insecticides, and hazardous chemicals is imperative in order to mitigate the damage caused by the textile and clothing industry to the environment.

III. a) Major degradation control strategies for the Indian T&C industry

In order to control and reduce the ecological degradation caused by the textile and clothing industry in order to promote a sustainable outlook for the future, two major control strategies can be employed (Chandrashekar K., 2006) – the introduction of environmentally cleaner production techniques and processes, and ‘end-of-pipe’ treatments. The complex environmental concerns that are a resultant of textile production processes require a comprehensive and integrated approach to tackle the issues of pollution. Reduction in the use of water resources and raw materials that constitute the input of the industry, along with minimization of solid and water waste should be the highest priority wherever applicable. Simply put, the above resolution is implicative of how all types of input resources, along with the entire product life cycle should be used as optimally as possible in practical applications. In a textile production process, bringing structural changes in production parameters would facilitate optimization of available resources. Secondly, promotion of ‘end-of-pipe’ treatments and selection of appropriate effluent treatment strategies are necessary to optimize the production process (ibid). Such treatments imply the segregation and separate handling of specific effluents, which is often considered to be a more efficient process than treating combined and complex ones.

III. b) Role of the Entire Supply Chain in Ecological Improvement of India's industries

Hartlin B. (2007) declared that for an appropriate and effective policy implementation in order to account for the presently unsustainable nature of industrial production, each member of the production and consumption cycle must play their part. In the present scenario, the producers and retailers of the textile and clothing industry across the world are the ones responsible for steering the improvements in sustainability of textiles and are also working towards creating a rise in consumer awareness. There is an emerging attention towards not only social concerns, but also environmental impacts of textiles; especially for specific kind of products such as garments, demand for more environmentally friendlier textiles is continuously increasing. Figure III.b)i) shows the total municipal solid waste generation sorted by material in 2008. As shown, even though the textile solid waste is significantly smaller than that of paper, plastic and food wastes; it is of a large enough magnitude to become a contributor to ecological degradation.



Selby (2008) furthered Hartlin's views by stating that despite the initiatives taken by the producers, a noteworthy change in the sector to reduce environmental impact and promote social equity will occur only when it is governed by consumer choice. According to the analysis of his report, in order to create a change, a consumer should contribute by purchasing textile goods made with least energy and toxic emissions by workers that are paid a credible living wage; and should reuse garments wherever possible. Consumer behaviour with respect to the care and disposal of textile goods is equally important so as to extend the life of the garment to the absolute maximum. The responsibility of the consumer should entail the selection of appropriate laundering conditions (such as suitable washing temperatures and mild detergents), proper care of the garments while still in use, and encouraging recycling of textile goods wherever applicable. A multitude of barriers hamper the adoption of this behaviour by a large majority of the consumers catered to by the textile and clothing industry. In order to overcome these barriers an increase in consumer education is vital – to ensure that fact based information on the specific impacts of a product are available and understood, and an increased emphasis is placed on durability as an important feature of the apparel industry's finished goods.

Rapidly emerging changes in the clothing and apparel sector of the textile industry can prove to be an opportunity for the rapid uptake of sustainable garments, but improvements cannot be guaranteed in every sort of garment produced. This is so because such trends could quickly be replaced by others in the fast paced world of fashion (Nilanjana B., 2011). In other areas of textile goods production such as items of home décor, the innovation cycles are much slower and thus a promotion of sustainable alternatives can be easily introduced into the market.

With the norm of sustainable development becoming an understood part of the production processes employed in the textile and clothing industries, large apparel brands have also begun to incorporate environment friendly practices into their company policy (Webb, F., 2013). One of the most spoken about examples of this incorporation is that of Levi's and their creation of a range of denim apparel, where each pair of jeans was produced using eight plastic bottles.

III. c) Conservation of Scarce Water Resources

As per the findings of Braungart, M. (2010), the textile and clothing industry is finding it increasingly important to turn towards water conservation and management for an array of reasons, the most important one being the heightened competition for attainment of clean water due to the declining water tables, and thus reduced sources of serviceable water. The growth in industrial and residential sectors across the globe further augment the demand, eventually causing an increase in the cost of the resource.

As discussed earlier, the majority of water as an input is required for washing the raw materials; and this washing process can be characterized by the washing efficiency of the amount of the material removed as a result of cleaning. Washing efficiency describes the manner in which alterations made to temperature (and as a result viscosity of water); speed of the fabric in the washing range, and the openness of the material itself can optimize the process of washing and thus reduce the quantity of water required per processing sequence (Shaikh,

Ayaz M., 2009). Efforts to increase the washing efficiency require changes in the operational structure and machinery presently employed by the textile industry in question. These changes are generally expensive and are thus not pursued actively by owners and operators of the factories; but with the continuously increasing costs of water resources, a greater number of producers are realizing the importance of optimizing their water inputs despite having to incur a large one time installation cost.

Through the implementation of water conservation and reuse schemes, the monetary funds and capital available to the producer can be better utilized in the improvement of process equipment or expansion of the industry itself (ibid). The measures to introduce water conservation to every level of the chain of workers include the training of employees on strict housekeeping measures, and processes such as reusing the water used in the bleach bath and dye while producing the textile goods. The proper utilization and regulation of water resources on a large level will itself contribute to shifting the nature of the textile and clothing industry to a more sustainable one.

III. d) Waterless dyeing as a sustainable alternative

As previously examined, along with the inequitable usage of water resources, the utilization of enormous amounts of chemical compounds to finish and dye the textile and apparel goods can also be held liable for the vast magnitude of disruption caused to the ecological balance of the natural environment by facilitating consequences such as ecotoxicity.

III. d)i) The concept of Waterless dyeing

According to Shannon, P. (2011), much of the answer in solving the waste involved in dyeing textiles lies in an industry's mechanisation processes. Waterless dyeing as a sustainable alternative utilized in the industry would promote the conservation of water resources and protection of water bodies from contamination. In Hattori's (2013) view, polyester as a fibre would be the prime candidate for the process, because dyeing happens best in an airless environment with pressurised high heat – allowing dyes to disperse throughout the fabric.

III. d)ii) The role of Private firms: worldwide, and in India

One company taking on the textile sector's excessive consumption of water is 'ColorZen'. Its process modifies cotton's molecular structure and allows dye to settle within the fibres without requiring the massive discharge of water, eliminating the need to rise off fixing agents that keep a fabric's colouring consistent (Michael N., 2012). Another US firm, AirDye, insists its technology uses air to disperse dye. AirDye's process embeds dye within textile fibres instead of merely on them, so colour lasts longer and is more resilient to chemicals and washings. Other than vague talk about partnering with non governmental organizations to reduce water consumption, few large companies such as Adidas currently consider new waterless or near-waterless technologies in their processes of production of textile and apparel goods. (Lyn Ip, 2009). Instead of water, Adidas' supplier uses compressed and pressurised carbon dioxide as the agent to disperse dye within polyester fabric.

III. e) Substitution of Regular Cotton and Polyester with Organic Fibres in Indian T&C

McDonough, W. (2010) aptly stated that improvement in the ecological viability of the textile industry depends on the energy and toxicity life-cycle profile of the material or fibre used in production. For textile goods produced from cotton, the requirement for energy resources is driven by laundering practices, while the use of chemicals in production is a result of agricultural practices. According to Rucker, J. (2003) – for products in which production processes dominate the impacts, attaining efficiency in production processes should be pursued and the detriments will be reduced by extending the life of the product or by re-using and recycling the good; and for products in which raw material production processes dominate the impacts, substitution of raw materials with sustainable alternatives should be pursued. A switch from conventional to organic cotton growing would eliminate maximum toxic releases, at the cost of price rises in the domestic economies that house the textile industry.

IV. CONCLUSION

While significant efforts are being made to introduce and implement relevant policies in order to promote sustainable development of the textile and clothing industries across various nations in the world, there still exists a vast scope for mutual collaboration between producers, retailers, policy makers, and consumers in order to facilitate the improvement in the performance of textiles across the supply chain. Each of the above bodies in their own power should support and aid the implementation of sustainable practices affecting the textile and clothing industry.

While consumers must remain engaged in raising further awareness about appropriate use, reuse and disposal schemes with respect to textile and apparel goods; the responsible authorities should investigate new technologies and engage in research about new fibres and materials that possess lower environmental and societal impacts as compared to natural fibres. By maintaining these efforts, the people within a domestic economy will be successful in allowing the textile and clothing industry to adapt to the growing challenges and shifts in demand patterns observed in the upcoming future, and will truly change the nature of the industry to become a sustainable and environmentally viable one.

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