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A Study on Life Cycle Analysis (LCA) of a Cotton Woven Shirt

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Abstract

The property of textile materials has gained a lot of attention thanks to the resource consumption and waste material emissions at the moment time. So, it's terribly essential and a core demand to gauge the environmental result of textiles from a life cycle perspective to develop the property of textiles. Environmental problems became vital over the previous few years owing to increasing pollution, waste materials, heating, etc. shoppers have additionally begun to demand inexperienced products. As a result of these events, additional strategic and systematic approaches square measure necessary for ever-changing environmental problems. Life Cycle Analysis (LCA) is one of the tools to satisfy this necessity. During this research, we have a tendency to square measure analyzing the LCA of a 'Cotton woven Shirt', and scientifically evaluating the environmental impacts also as resource utilization to supply, from raw materials to the disposal of the merchandise at the top of life.

Keywords: Cotton; Woven Shirt; Shirt; Environmental Impact; Life Cycle Analysis.

1. Introduction

Life Cycle Analysis has the simplest definition such as by the international organization for Standardization (ISO): ISO 14040 and ISO 14044, that assumed LCA as not solely the collection and analysis of the project's inputs and outputs however conjointly the potential environmental effects of a product system throughout its lifetime [1].

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Life-cycle analysis (LCA) is an effective methodology, standardized by the ISO 14040:1996 and ISO 14044:2006 (ISO, 1997, 2006). This methodology principally targeted the analysis of potential environmental impacts related to the merchandises through the appraisal of applicable inputs and outputs throughout the complete lifetime of the product together with the raw materials and, treatments and process and ultimate disposal. there's terribly restricted peer-reviewed literature offered on LCA and is sometimes supported by a special practice or analysis institute. Previous LCA studies conducted on textiles made by different fibers such as Polyester, Nylon, Acrylic, and Spandex, but the cotton fiber products showed greater environmental impact [2]. Life cycle analysis (LCA) may be a comprehensive and general tool that helps to spot environmental hotspots and might show enhancements throughout product life cycles, throughout product innovation and development [3]. A shirt, button shirt, button-front, button-front shirt, or button-up shirt may be a garment with a collar and a full-length gap at the front, that is fixed victimization buttons or shirt studs. A button-down or button-down shirt is a dress shirt that has a button-down collar – a collar having the ends fastened to the shirt with buttons. A dress shirt is normally made from woven cloth and is often accompanied by a tie, jacket, suit, or formal wear, but a dress shirt may also be worn more casually [4]. In British English, "dress shirt" ("formal shirt" or "tuxedo shirt" in American English) means specifically the more formal evening garment worn with black- or white-tie. Some of these formal shirts have stiff fronts and detachable collars attached with collar studs [4].

2. Methodology

We prefer a 100% cotton woven shirt to carry a cradle-to-grave life cycle analysis because 100 % cotton fabrics are the primary materials for apparel in Bangladesh's market. Our research concentrated on the environmental impacts of the goods. This study is carried according to secondary data collection, the represented unit is a piece of 100 % cotton woven shirt. The secondary data was collected from the internet, blogs, and literature reviews. We discover hotspots throughout the life cycle of the cotton woven shirt considering the impact of classifications of water use and toxicity. The LCA consists of secondary data collected in the following categories: raw material collection, manufacturing, transportation, final product, use, and end-of-life. ISO 14040 and 14044 specify how to conduct an LCA study. There are four phases of an LCA:

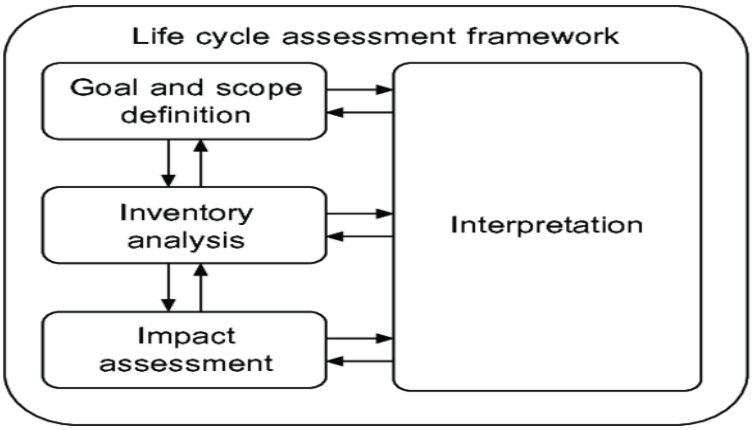

Figure 1: Four phases of LCA

2.1 Goal and Scope definition

The particular objective of this study is to evaluate the environmental impacts, to recognize the environmental hotspots, and to investigate improvement opportunities during the life cycle of 100 % cotton woven shirts in Bangladesh. We analyze two main impact categories to discover hotspots throughout the life cycle of the cotton woven shirt. The first category is total water consumption the second impact category is the energy consumption of the full lifetime of a cotton woven shirt.

2.2 Secondary Data

We collected all the information regarding raw materials to the product's end-use from websites, blogs, and literature reviews. After that, we collaborated on all the necessary information to conduct a complete study on LCA of a cotton woven shirt. Here our existing knowledge of apparel manufacturing technology helped a lot to determine which process would most likely be related to which information.

Figure 2: Life cycle of shirt

3. Impact Assessment

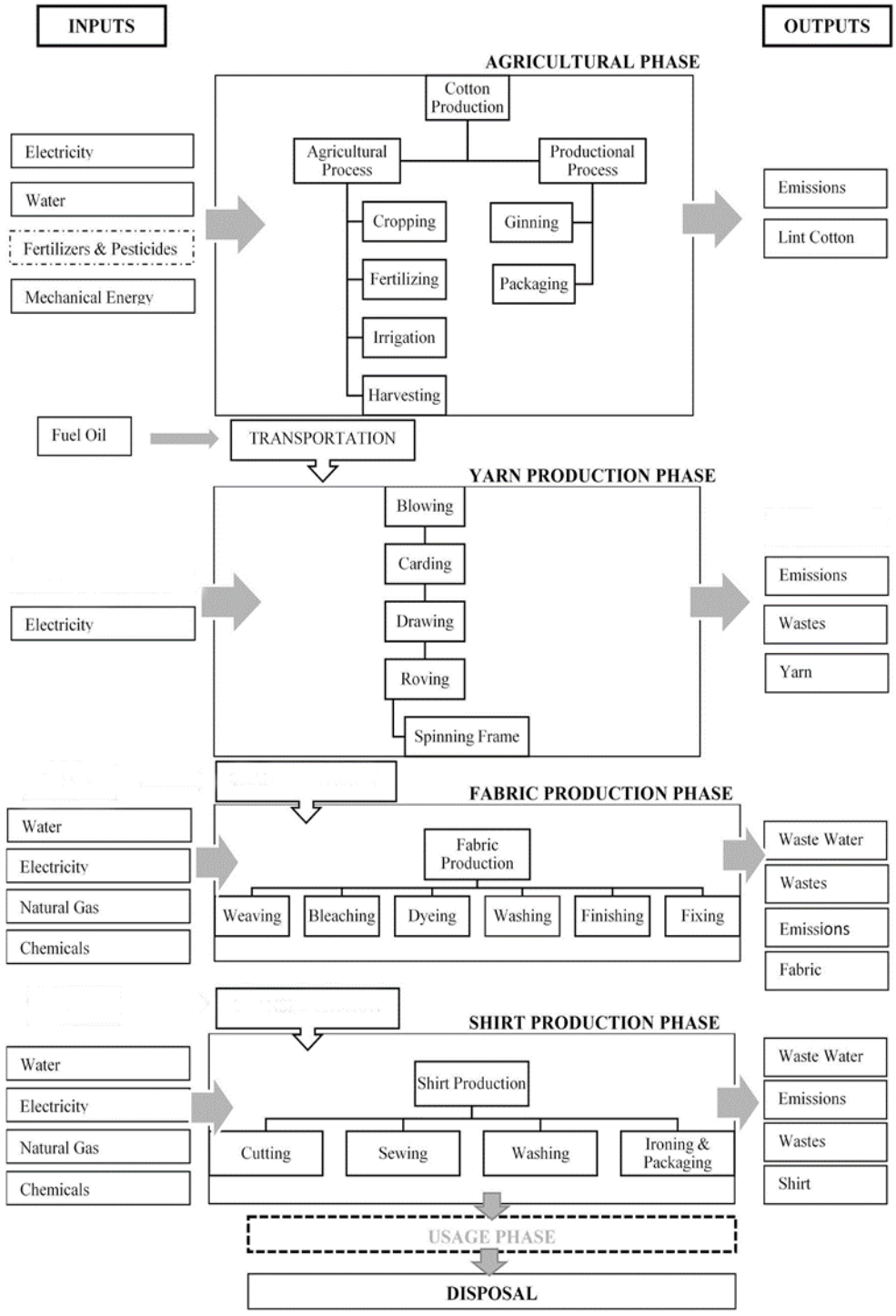

Figure 3: Cotton shirt—life cycle system boundaries

Table 1

Life Cycle Stage	Data Type	Source
Cotton cultivation	Cradle to gate cotton fibers ginned at firm.	Websites
Transportation & distribution	Transportation distance of cotton fibers and distribution distance of cotton woven shirt.	Websites
Yarn production	Energy and water used.	Websites
Fabric production (weaving, bleaching, dyeing)	Energy and water used.	Websites
Shirt Production (cutting, sewing, washing, finishing)	Energy and water used.	Websites
Use phase	Consumer behaviors of cotton woven shirt: lifetime, use, and habits of washing such as the Hand wash or machine wash. Energy, water use per washing.	Websites
Disposal	Through landfill.	Websites

4. Result

Water & energy consumption of a cotton woven shirt from its cradle to grave journey are given below-

4.1 Cotton Cultivation

Table 2

Water	The world average water footprint for 1kg of cotton is 10,000 liters. Even with irrigation, US cotton uses just 8,000 liters per kg [5].
Energy	Thermal energy needed for/meter of cloth is 4,500-5,500 Kcal and Electrical energy needed for/meter of cloth is 0.45-0.55 kwh [6].

4.2 Transportation & Distribution

Table 3

Water	Not Applicable
Energy	Not Applicable
Cost	Export cotton bale from port to textile factory distance 480 miles, total shipping cost 88.24 USD/ton, unit shipping price 0.18/USD/ ton/mile [7].

4.3 Yarn Production

Table 4

Water	Not Applicable
Energy	3.24-3.47 kWh/kg for spinning 0.0073 kWh/kg for warping &sizing [8].

4.4 Fabric Production (weaving, bleaching, dyeing)

Table 5

Water	According to USEPA a unit producing 20,000 lb./day of fabric consumes 36000 liters of water, bleaching 38%, and dyeing 16% [9]
Energy	1.58-2.24 kWh/kg for weaving 0.79-1.05 kWh/kg for wet processing [8]

4.5 Shirt Production (cutting, sewing, washing, finishing)

Table 6

Water	Not found
Energy	0.065-0.195 kWh/kg for woven shirt production [8]

4.6 Use phase

Table 7

Water	Total consumption of cotton products 764Mm^3/year [10]. Machine wash 303 kg of tap water, manual wash 136 kg during the whole use phase (1 year) [11].
Energy	The mean derived energy used transporting 1 tone supply to the consumer is 77.5 kWh. For the 14 892 tones forwarded to the consumer, this is similar to 1,154,000 kWh [11]

4.7 Disposal

In Bangladesh recycling arises from woven and knit clothes. Mirpur garments excess recycling market which is recognized as 'Mirpur Jhut Polli'. Mirpur Jhut Polli is recycling garments waste around 18.5 tons/month [12]. However, the average American household does approximately 400 loads of laundry per year, using about 40 gallons of water per full load with a traditional washer [11]. The final stage of life, which is disposed of, involves incineration. This is another method that frees harmful emissions or involves a landfill where cotton takes years to break down [11].

5. Limitation

We couldn't determine all inputs and outputs to production systems and that has to be set limits around the system-

- Raw material processing
- Transportation
- Air emissions calculation
- Water emissions calculation
- Land uses

6. Conclusion

Wastewaters with high chemical contents in wet processes, pesticides and artificial fertilizer issues in natural fiber productions, energy consumption throughout producing processes, and nephrotoxic materials square measure the most environmental issues within the textile trade [8]. LCA methodology has begun to be used for the analysis of environmental impacts throughout production. we tend to not get rid of it by 100% however we can cut it back. especially, water, auxiliaries, and electricity employed in making-up a cotton woven shirt supported the life cycle impact analysis (LCA) results. The manufacturer isn't concerned about the impact of the

method on the surroundings even the worker's health. People who work as a weaver should be conscious of the energy consumption and environmental effects during the production method were investigated during this study. The environmental footprint of a product from raw material acquisition through shopper use and disposal square measure water, energy, chemicals, air emissions, solid wastes, co-products, disposal. For a mean of 2 years, the cotton woven shirt is employed to create alternative house articles like- rags, etc. given to poor individuals or disposed of in a very lowland. the general connection contributes to global warming & environmental changes throughout the entire life cycle. Finally, enhancements in the property should be in analysis, application, and communication. Energy consumption and environmental effects throughout the production method were detected during this study. the most contribution most impact classes have returned from the producing method. These results square measure because of higher water consumption in dying. The dye is responsible for the high rate of water & solid emission. The required initiative ought to be taken by the government and environmental organizations for potential enhancements in the property.

7. Recommendations

Use of apparel goods are increasing too fast as the population of our universe increasing and by also the impact of fast fashion culture. Each and every apparel product that we produce has a significant impact on our environment. This is why it is high time we pay attention to this concern. More and more practical research is needed to be done to eliminate the number of resources utilizes for every apparel production. Also, for sustainable fashion practice we should carry out LCA of not only for cotton woven shirt but also for all kind of products that places a footprint on our environment. That's why we recommend vast study and research which is need to be done and practice in real production line to reduce environmental impact and make a greener universe for all.

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