
Analytical Study of Sources of Textile Waste for Its Upcycling

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ABSTRACT

In recent years, there have been increasing concerns in the disposal of textile waste around the globe. The growth of textile markets not only depends on population growth but also depends on economic and fashion cycles. The fast fashion cycle in the textile industry has led to a high level of consumption and waste generation. Textile waste is a material that's supposedly unworkable for its original purpose by the proprietor. Textile waste is produced in every phase of the cloth manufacturing process like spinning, weaving, dyeing, finishing, garment manufacturing and indeed at the consumer end. The textile industry has two sections, the study has been conducted one is the textile industry and second is the apparel industry. This paper consists of information about the textile industry, textile waste, garments waste. Also, the reason behind this problem has been discussed in this paper and how it can be resolved for the least harm to the environment. Various methods to reduce textile waste are also discussed such as Prolonging the life of your clothes, preventing textile waste starts with buying less, Repair, Upcycle, Swap, Donate, Recycle and Buy less and make it last. Data was collected from the study that has been conducted through the secondary sources by studying the research paper related to textile waste titles. 5 Garments Export Houses were interviewed for this research paper. A brief understanding of upcycling of textile waste and discarded garments is discussed in this paper.

Key Words - Textile waste, Industries, Garment waste, Upcycling, Apparel Industry, Waste prevention

1. Introduction

The textile industry is one of the largest and most complex manufacturing processes in the manufacturing industry (Srebrenkoska et al., 2014). Increasing demand of fashion by the consumers and the trend of fast fashion have radically increased the production and consumption of apparel, which generates a substantial amount of waste in every step of manufacturing, including spinning, knitting/weaving, dyeing, apparel making, and finishing process (Koszewska, 2019). In various studies it has been estimated that the global textiles industry generated approximately 92 million tons of waste in 2014, of which a minimal amount is reused or recycled, and a significant amount ends up in landfills or incinerated (Akter et al, 2022).

The fashion and textiles industry is widely criticized for a detrimental environmental impact (e.g. generating waste, consumption of resources, carbon footprint) throughout its supply chain operations (Niinimamp, 2020).

Global production of clothing and textile consumption has increased in the past 50 years. With time, clothing has gained more importance as people associate every occasion, mood, season and status with clothing. It has become a way of making an impression and non-verbal communication. Textiles is the 2nd biggest polluting industry. The average lifespan of a garment is roughly 3 years, and so, a huge amount of textile waste is generated. 5% of all global landfills are being dumped by textile waste (Wang, 2010).

It is not possible to avoid wastage during textile production. Besides, a sensible analysis on the shopping behavior and life cycle of a product among the consumers is essential. The huge quantity of textile waste dumped in landfills and incineration can be reduced to a great level by understanding the dimensions of a product and its compatibility with nature. Textile waste is produced in every phase of the textile manufacturing process like spinning, weaving, dyeing, finishing, garment manufacturing and even at the consumer end.

We can classify them as,

- Soft waste: It is generated from the processes of combing, drawing and spinning.
- Hard waste: It is generated after spinning and twisting, weaving and knitting.

The most commonly generated waste is in the form of fabric pieces in varied colors. These are generated during the garment manufacturing and are found in a variety of colors and fiber content. That can be to create an innovative surface ornamentation (Shah,2018). Recovery from the waste stream includes reuse of a product in its original form, a common practice for clothes, and recycling to convert the waste into a product (Wang, 2009)

1.1 The major classification of textiles waste is as follows:

The textile waste lifecycle model depicts three categories of textile and apparel waste:

- Post-producer waste generated by manufacturers,
 - Pre-consumer fabric waste
 - Post-consumer garments waste
 - Industrial textile waste
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- Pre-consumer fabric waste: It is also called production waste and is generated from the first phase of the supply chain. It includes scraps, damaged or defective material samples, fabric selvages and leftover fabric from the cutting process. Pre-consumer waste. Pre-consumer waste is generated by retailers primarily in the form of unsold merchandise. Although considered waste it is not completely valueless to the retailer since it can be sold to an outlet, jobber, or consolidator. The textile waste lifecycle for this segment provides more disposal options and thus is more integrated and complex (Domina,1997).
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- Post-consumer garments waste: Nationwide, over four million tons of post-consumer garments enter the waste stream every year (Steuville& Goldstein, 1993). Of the post-consumer textiles that are recycled, the majority are donated to non-profit organizations, although a growing portion is sold at garage and yard sales, or brought to resale and consignment shops. Recently another option for post-consumer textile waste recycling has been made available to consumers through retailers(Domina,1997).
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- Industrial textile waste: Industry waste. Although total amounts of post-consumer solid waste, including textile waste, impacts the solid waste stream, it accounts for only 2% of the nation's total annual output of 11.7 billion tons(Kron, 1992). The vast majority of the solid waste stream is contributed by post-producer waste from industry. For textiles, it is estimated that between 1.5 and 1.9 billion pounds of new fiber and fabric wastes are generated annually by fiber producers, textile mills, and fabric manufacturers. Of this total, apparel manufacturers contribute 450 to 600 million tons annually in the form of apparel cuttings (Kron, 1992).

The clothing industry is based on extremely fast cycles of fashion and consumers' unsustainable desires; hence it is a good example of the planned obsolescence existing in the current industrial system. Accordingly, low quality, short-term use, frequent clothing replacement and increasing textile waste cause an environmental burden. An increasing amount of textile and clothing waste has led to the development of using the textile waste, i.e., reuse and recycling e which is sometimes called the eco-efficiency approach. These approaches have faced the critique that they do not face the real sustainability problems: the increasing consumption, the growing waste problem, the environmental impact of increased textile production and the social sustainability problems of the textile and clothing industry(Niinimäki, 2011).

The use of new technologies that reduce environmental pollution, energy saving, and waste reduction is necessary because of the negative impact on the environment done by the textile industry (Milerienė

2014). This industry is one of the industries with the largest recycling potential and innovative recovery, upcycling innovations, but it is not exploited enough:

- If the fashion industry wants to achieve the highest and most effective level of waste management - prevention, then the formation of fabric scraps should be decreased at the design stage. Disposal of fabric scraps during the design process is zero waste modeling.
- Creative recycling is a new concept for many manufacturers, designers and users and it helps to find effective solutions to gain added value at the recycling of waste. Such ideas can be a good starting point for small businesses, because they do not require special skills, without major investment in production (Milerienè 2014). Textile wastes that are unsuitable for reuse can be recycled using mechanical, biological, chemical, thermal or all-together technologies.
- Only textile waste that is unsuitable for recycling or incineration can be disposed of in landfill. The amount of textile waste, which is disposed of in the landfills, can be reduced in accordance with the following hierarchical scheme oriented to sustainable textile resources and its waste management. It is evaluated that by cutting and sewing of textiles, approximately 15 percent of the fabric is disposed of to the landfill but could be reused. Direct reuse keeps materials at an equal or higher quality and requires less energy as an input than recycling, while prevention and reduction decreases the creation of waste and need for additional resources and energy overall (Danielle 2017)

1.2 Reason for textile wastes

The various reasons for waste generation are the following:

- i) Attitude towards textiles
- ii) Fast fashion
- iii) Frequency of shopping
- iv) Lack of awareness on sustainability
- v) Lack of eco-friendly practices
- vi) No strict government policies
- vii) Lack of quality materials
- viii) Less popular second-hand clothing
- ix) Consumers' lack of knowledge on textile care and maintenance
- x) Industrialisation

A hierarchy of the waste valorization procedures (Cobo et al. [2018](#)) was established, namely

- a) Reuse of the products;
- b) Recycling of materials;
- c) Incineration;
- d) Landfill.

The processes have to be applied starting from procedure (a), to procedure (d), the environmental impact usually increasing also from (a) to (d). A similar classification is mentioned by (Cucchiella et al., [2017](#)); the hierarchy for a proper waste management being as follows: prevention, reuses, recycle, recovery, and finally landfill.

2. Research Methodology

This research is based on both qualitative and quantitative research methods.

Qualitative is in the terms of first to find out the parameters which are applied for the study of finding the sources of textile waste existence in the garment production and textile industry. To find out these parameters study has been conducted through the secondary sources by studying the research paper related to textile waste titles. The textile industry has two sections, the study has been conducted one is the textile industry and second is the apparel industry. The study has been conducted to find out how much textile waste is generated annually and what are the existence methods of its treatment and how it can be used for the Upcycling purposes by knowing this. In the garment production industry also there a lot of waste is produced also as a byproduct and how that has been managed and used.

The parameters were found by the use of a qualitative method by doing a survey based on the open-ended questions directly from the industry and one from the NGOs who are reusing/upcycling the waste of the garment leftover manufacturing. The second part of the study has been conducted quantitatively where the survey has been conducted on the scale of 5 to know the findings such as percentage of old clothes should be donated, production of textile waste annually.

3. Findings

According to the Indian Textile Journal, it is estimated that more than 1 million tons of textiles are thrown away every year, with most of this coming from household sources. This amounts to 0.79 kg of textile waste per capita (Aggarwal,2021).

Field visits and interviews of 5 Garments Export Houses have been conducted to understand the measures of textile waste produced and the methods to treat it properly.

After doing the primary research, it was found that:

- Production of textile waste annually
- Textile waste treatment
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- Treatment of textile waste
- The percentage of textile waste that is been thrown away
- Production of Garments annually
- Leftover garment production can be reused for making clothes
- The percentage of old clothes should be donated
- Reuse Jeans with holes
- Reuse belts purses and other accessories
- Reuse children’s cloths (worn/ torn)
- Various methods to reduce textile waste
- Existence and understanding of the term Upcycling
- Garments and textile waste can be used for upcycling

i. Production of textile waste annually

Study shows percentage of waste produced annually has a very higher rate. According to the survey, the percentage lies between 5%-20% of the actual garment produced annually.

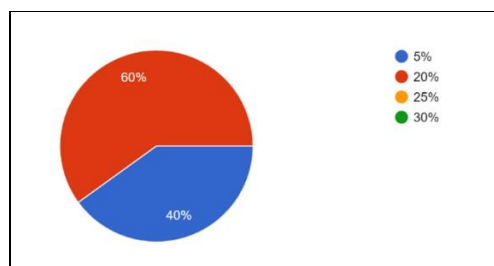


Fig. 1, Production of textile waste annually

ii. Textile waste treatment

There are various methods to treat the textile waste properly, but in numerous areas textile waste is just contributing to the environment harmfully. According to the survey, 20% agree on the statement that textile waste is treated properly and 80 % disagree on the statement that textile waste is treated properly as it goes into the landfill, or to the garbage.

iii. The percentage of textile waste that is been thrown away

The usual method of treating textile waste is that industries just throw it away in the garbage unknowingly about how much harm it can cause to the environment. As per the study 40% industries

throw away 100% textile waste, whereas 40% of industries throw away 50% of the textile waste and donate the remaining 50% of textile waste to the NGOs that are working for the purpose of reusing the textile waste. Remaining 20% industries throw away 20% of the textile waste and try to reuse the remaining 30% and donate the 50% of the textile waste to the Donation Bins.

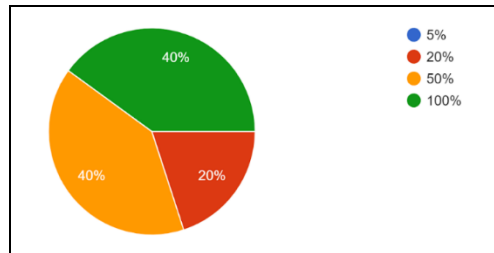


Fig. 2, The percentage of textile waste that is been thrown away

iv. Production of the garments annually

In the fiscal year 2020, the estimated total cloth production was around **63 billion square meters**. In comparison, the total cloth production across India was approximately 71 billion square meters during the fiscal year 2019. The South Asian country is the world's largest producer of textiles and garments. Due to the present era of fast fashion garments production is at a very high scale. According to the survey 60% of Garments Export Houses are producing more than 50 lakh garments per year, and the remaining 40% of Garments Export Houses are producing upto 10 million garments.

v. Leftover garment production can be reused for making clothes

As per the concept of recycling, reusing, and reducing applied on textile waste. The most common term reusing of textile waste has become common. As per the study of the leftover garment production can be reused for making clothes on the scale of 5, 40% believed the statement that leftover garment production can be reused for making clothes, 40% says it can be done but it's difficult to process it as because of the dissimilarity in the piece of textile waste, and the ideas. Remaining 20% disagreed on the statement that leftover garment production can be reused for making clothes.

vi. The percentage of old clothes should be donated

Nowadays many organizations are working on the purpose of providing clothes to the ones who can't afford it. Many sources have also been developed for the people to donate their clothes via donation bins, home pickup services, etc. According to the study to know the parameters of the statement that old clothes should be donated on the scale of 5, everyone strongly agrees that it is a good cause and contribution to the environment as well that that garment waste will go in the needy hands rather than in landfills.

vii. Reuse Jeans with holes

There are various methods to reuse jeans with holes such as turn it into short pants, upcycle it into a bag, upcycle it by applying patches on the holes, etc. Based on the survey 40% of interviewed people agreed that jeans with holes can be reused, remaining 60% disagreed and said it is not such a good idea to reuse jeans with holes.

viii. Reuse children's cloths (worn/ torn)

The most common method to reuse children's worn or torn clothes is to donate it to the needy or pass it on to friends and family, and donate it to a children's hospital. The other way is to reuse it with some DIY ideas and bring it in use. As per the survey taken on the scale of 5 to know if it is a good idea to reuse children's old clothes or not, the parameters show 60% somehow agree that it is a good idea to reuse children's old clothes, whereas the remaining 40% disagreed.

ix. Various methods to reduce textile waste and garments waste

A study has been conducted to know the parameters of existing various methods to reduce textile waste and garments waste on the scale of 5 where 1 represented strongly agree and 5 represented strongly disagreed.

Following are the existing methods to reduce textile waste and garment waste.

- Prolong the life of your clothes. Preventing textile waste starts with buying less.
- Repair.
- Upcycle.
- Swap.
- Donate
- Recycle
- Buy less and make it last.

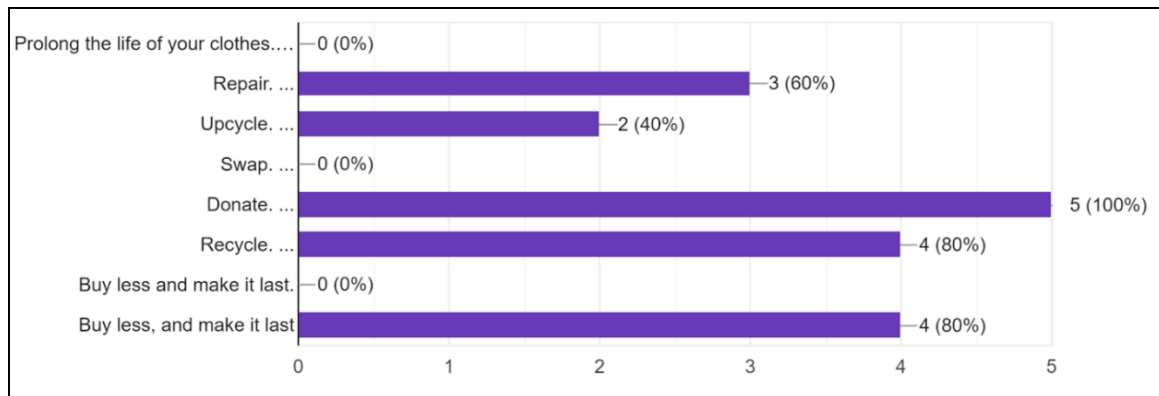


Fig. 3, Various methods to reduce textile waste and garments waste

x. Existence and understanding of the term Upcycling

Upcycling means reuse (discarded objects or material) in such a way as to create a product of higher quality or value than the original. Upcycling represents a variety of processes by which “old” products get to be modified and get a second life as they're turned into a “new” product. Many are known to the terms of Recycling, Reusing, and Reducing but the term Upcycling is rising day by day. Based on the survey 80% knows and understand the meaning of Upcycling. The Remaining 20% don't know about this term and how it is beneficial in many fields in the textile industry.

xi. Garments and textile waste can be used for upcycling

Much of the garments and textile waste can be used for upcycling, which means the process of upcycling with new emerging ideas can give a new life to the discarded garments and textile waste. According to the survey 40% says 100% of the textile waste and discarded garments can be used for upcycling any garments and apparel. 40% of the interviewed people say that only 50% of the discarded garments and textile waste can be used for upcycling. The remaining 20% say it is a difficult task to do so but still somehow 20% of discarded garments and textile waste can be used for upcycling.

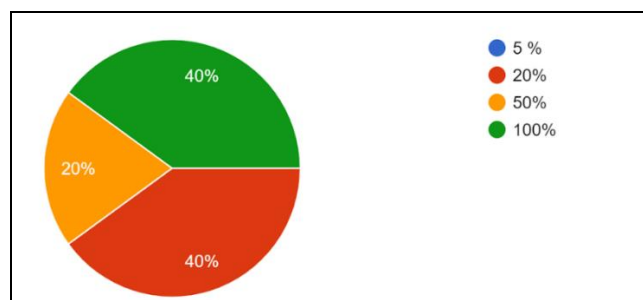


Fig. 4, Garments and textile waste can be used for upcycling

4. Upcycling of Textile Waste

Upcycling, by description is to take old or waste textiles that are useless or unwanted and turn them into a commodity more useful, better quality and of further value than they firstly were. To produce an advanced product from discarded waste.

In our consumer driven world, we're tutored that all products have a shelf life, that once they're worn out, they're of no use presently. This isn't the case, and this station desperately needs to change. If we've the imagination and creativity to design and produce these products also we've the same capability to repurpose them.

As well as upcycling and recovering waste textile, it should also be looking at the products that were buying in the first place. Purchasing particulars that are made from reused textile and/ or sustainable textile and products that are erected to be disassembled and reused and that are energy effective.

Upcycling is occasionally a hobby or commodity that people do as a fun design once in a while, it's a necessity for the earth and feeds into a veritably important mindset that all of us should borrow.

Upcycling rejected fabric and cloth into new fashion collections help to address some of the major issues concerning inordinate resource use and cloth waste in the global fashion industry. Water and Energy consumption in the creation of new garments, are also largely reduced by the upcycling action.



Conclusion

Textile industry has a large potential of waste recycling and reuse; however, analyses of scientific literature disclose that the greatest share of industrial textile waste is disposed of at landfills. The research described at this paper is based on the garment production company and the data of 5 Garments Export Houses. It was observed that many industries throw away all the discarded materials of fabric. Methods such as Repair, Upcycle, Swap, Donate, Recycle and Buy less and make it last can play a vital role in reducing the textile waste that's supposedly unworkable. On an average almost 80-90% of the discarded garments and textile waste can be used for upcycling with some new emerging ideas, technologies and sources.

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