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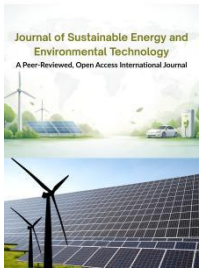

Research Article

Identification of Solid Waste Management of Textile Industry Gildan SDS International Limited at Nayarhut, Savar, Dhaka

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Abstract: The textile and apparel industry is a major contributor to industrial solid waste in Bangladesh, generating fabric scraps, packaging materials, sludge, and other by-products throughout production. This study evaluates the solid waste management practices of Gildan SDS International Ltd., Ashulia, Savar, with the objectives of identifying waste sources, assessing existing management systems, and evaluating sustainability performance. In the spinning stage, 127.4 kg of cotton fiber is required to produce 100 kg of yarn, generating 27.4 kg of waste and resulting in a material conversion rate of 78%. In weaving, 108.6 kg of yarn is consumed to produce 100 kg of woven greige fabric, producing 8.6 kg of waste and achieving a 92% conversion rate. Warping and sizing sections generate approximately 1.9% wastage due to poor material handling and inadequate expertise, while inspection and quality control sections contribute 1.8% wastage from fabric faults, spots, and shade variations. In apparel manufacturing, the cutting section generates the highest waste (10%), requiring 110 kg of fabric inventory for every 100 kg utilized and resulting in an 83% conversion rate. The inspection section adds 2.7% wastage due to measurement errors and poor handling. During wet processing, 121 kg of greige fabric is required to produce 100 kg of finished fabric, generating 21 kg of waste and achieving an 82% conversion rate. The company records a recycling rate of 12% and landfill diversion of 70%, with moderate occupational health performance and data transparency. Overall, SDS International Ltd. demonstrates relatively advanced solid waste management practices, supporting sustainable industrial development in Bangladesh.

Keywords: *Solid Waste Management; Textile Industry; Apparel Manufacturing; Waste Generation.*

1. Introduction:

Solid waste in textile industries consists of a wide variety of materials, including fabric scraps, yarn waste, packaging materials (plastic, paper, and cardboard), chemical containers, sludge from effluent treatment plants (ETP), and other hazardous and non-hazardous wastes. Improper management of these wastes can lead to serious environmental and public health issues such as soil contamination, water pollution, and greenhouse gas emissions. Therefore, effective solid waste management (SWM) has become an essential component of sustainable industrial operations. (Rahman, 2016). In the apparel industry the waste that is generated is known as 'Jhut' (Patnaik, 2021). Because of environmental impact, material waste is one of the top reasons as it creates the direct environmental impact (Sarkar, 2020; Uddin, 2021). Bridging the data gap on textile waste is like building a bridge over a mountain of discards. This step is essential to connect the present with a sustainable, circular future for the industry. (Shirvanimoghaddam, 2020). Bangladesh is a key manufacturing hub for global apparel and textiles products, and the industry plays a significant role in the country's socioeconomic development (Habib, 2021). Under SDG umbrella, a 10-year Framework Programme (10YFP) on Sustainable

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Consumption and Pattern (SCP) was adopted, known as SDG12, to accelerate practices of SCP and resource efficiency initiatives (UNDESA, 2014). The framework targets environmental sustainability to minimize resource consumption, waste generation, and pollution levels throughout the supply chain, from manufacturing to post-end use. The GOB took several steps to reduce waste by recycling and reuse (SDG Cell, 2018).

Textile product waste, stemming from discarded materials, represents a critical concern within the broader context of sustainability and resource management. The value of the material wastage in textile industry was USD 1.3 trillion only in 2015. It consumed approximately 53 million tons of textile fiber, of which 73% was landfilled or incinerated. Less than 1% of material is recycled for new clothing, representing a loss of more than USD 100 billion worth of materials each year (MacArthur Foundation, 2017). The major fibers that were used to manufacture apparel in 2018 were mostly synthetic fibers (~62.2%), followed by cotton (~24.4%) and others such as rayon and wool (~14%). (Khan, 2015). The production waste, produced during textiles and apparel manufacturing, includes fiber, yarn, fabric, and apparel. During spinning, short fiber stays on the machine which is readily familiar as 'cotton lint' (Meloy, 2018). Material waste from these stages consists of fly fibers and greige or unfinished fabrics (Sadi & Guha, 2016). The wet processing industry represents the dyeing, finishing, printing, and washing stages, where the greige fabric is colored and treated with the required chemicals for the desired quality of finished fabric (Khan, 2020; Uddin, 2015). Dyed or fabrics rejected due to quality issues become material waste from the wet processing stage (Pensupa, 2017). In garment section cut pieces generated which is mainly responsible for wastage (Kavitha, 2014). Due to fast fashion, the number of production and usages of apparel items is increasing day by day (Maeen, 2022), which generates a substantial amount of waste in every stage of manufacturing, including spinning, knitting/weaving, dyeing, apparel making, and finishing. There is also the issue of overproduction; only 30% of the clothing produced today is sold at the recommended retail price, another 30% goes in the sales and 40% remains unsold or even fails to reach the shops (Koszewska, 2018). Only in 2014, 92 million waste is generated by global textile industry, where merely a minimum amount being repeatedly used. (Pensupa, 2017).

Bangladesh is currently heavily reliant on the importation of textile fiber: in 2019, the country imported 1.63 million tons of staple cotton fiber for a value estimated to be US$3.5 billion. (Pavarini, 2021). Besides, global textiles waste is estimated to increase 60% each year between 2015 and 2030, generating an additional 57 million tons of waste every year, and reaching a total of 148 million tons annually (Niinimamp, 2020) The textile business is closely associated with fashion, shaping and reflecting contemporary trends and tastes. Fast fashion has taken off due to the quickening pace of fashion cycles, completely changing the ways in which clothing is made, worn, and discarded. Discussions over sustainability, working conditions, and the industry's effects on the environment have been spurred by this occurrence. Approximately 65% of a garment's climate impact stems from fabric production. With 53 M tons of fiber produced every year and 87% ending in landfills, the fashion industry is polluting and wasting precious resources (Cristina, 2023). The development of the convection industry is increasing due to the fast fashion trend. The impact of this increase is the accumulation of fabric waste because fabric is an inorganic waste that is difficult to decompose. It is necessary to explore waste materials as a form of concern for the environment through sustainable design. (Fanny, 2021) Recent reports have estimated that 75% of materials used in the production and after the use of clothing are landfilled or incinerated. 4,11 Approximately 23% of discarded clothing is collected for recycling, with less than 1% of the recovered fibers used to reproduce clothing, closing the loop in fiber-to-fiber recycling. (Rivalani, 2023). After China, Bangladesh is the second-largest exporter of readymade apparel globally (Hamja, 2019) with a strong production capacity, quality and growth (Miguel, 2021). It consists of more than 83% of Bangladesh's total exports, worth over 33 billion USD in 2019, and holds a 6%market share of global apparel exports (BKMEA, 2019). More than 4 million worker is in apparel sector (BKMEA, 2019) and again more than 5 million people is worked in textile sector (BTMA, 2019). In just 3 years back, more than four thousand factories found covering of 1487 textile companies, 432 spinning units, 809 weaving units, and 246 wet processing units (BTMA, 2019). The objective of the research is To identify the different types and sources of solid waste generated in various stages of textile production (knitting, dyeing, finishing, and garmenting); To examine the existing solid waste management system practiced at SDS International Ltd, including waste segregation, collection, storage, recycling, and disposal methods; To evaluate the effectiveness of current waste management practices in reducing environmental impact.

2. Methodology:

2.1 Study area: The study was carried out in Gildan SDS International Ltd a textile & Garments industry which is located at Nayarhut, Ashulia, Savar which is approximately 5 kilometers south of Dhaka Division of Bangladesh. The longitude coordinates of the area are 23.9326° N, 90.2784° E.

Figure 01: Study Area Map (Gildan SDS International Limited).

2.2 Data Collection Methods

2.2.1 Primary Data

- **Semi-Structured Interviews:** Conducted with key informants, including production managers, EHS officers, waste handlers, and local recyclers.
- **Site Observations:** Direct observation of waste generation, segregation, storage, and disposal practices within the factory premises.
- **Focus Group Discussions**: Engaged with workers and supervisors to understand operational challenges and perceptions regarding waste management.

2.2.2 Secondary Data

- **Company Records:** Analysis of waste inventory logs, production reports, and environmental audit documents provided by Gildan SDS International Ltd.
- **Industry Reports:** Review of sectorial studies, regulatory documents, and buyer compliance reports.
- **Academic Literature:** Synthesis of peer-reviewed articles, case studies, and technical guidelines on textile waste management.

2.3 Data Analysis Methods

- **Material Flow Analysis (MFA):** Quantified input-output flows of raw materials, waste, and finished products across production stages.
- **Waste Characterization:** Classified waste by type, source, and composition using standard protocols (e.g., ASTM D5231-92)
- **Statistical Analysis:** Descriptive statistics (mean, median, standard deviation) were used to analyze waste generation rates, conversion efficiencies, and economic losses.

4. Results and Discussion:

4.1 Spinning:

In the spinning stage, for every 100 kg of yarn produced, an average of 127.4 kg of cotton fiber is consumed, resulting in a material conversion rate of 78%. This means that only 78 kg of yarn is produced from processing 100 kg of cotton. The wastage in spinning results from a combination of process losses and quality-related rejections. Quality of fiber and production efficiency significantly impact material consumption. The discrepancy between yarn production and the quantity delivered to the next industry reveals a significant challenge in this stage.

4.2 Fabric Manufacturing:

The weaving process within fabric manufacturing sees an average consumption of 108.6 kg of yarn for every 100 kg of woven greige fabric, with an associated wastage of 8.6 kg, resulting in a material conversion rate of 92%. Various factors contribute to this wastage. Warping and sizing sections generate approximately 1.9% of wastage due to poor material handling and a lack of expertise in warping. The drawing-in section contributes a similar amount of wastage for similar reasons. The weaving section, which sees a relatively high 3% wastage, is influenced by yarn quality, material handling, and the type of loom used. Additionally, inspection and quality control (QC) sections are responsible for 1.8% of wastage, mainly due to fabric faults, spots, and shade variations.

4.3 Apparel Manufacturing:

Apparel manufacturing consumes, on average, 120.4 kg of finished fabric for every 100 kg of final products. Notably, the cutting section is responsible for a substantial wastage rate of around 10%, leading to a need for 110 kg of fabric inventory for every 100 kg used, resulting in a material conversion rate of 83%. Sewing generates a wastage rate of approximately 4.5%, with the

primary causes being faulty workmanship, poor material handling, and the use of low-quality fabric. The finishing section results in 2.6% wastage due to issues like spots, crease marks from poor handling, and poor dimensional stability. Finally, the inspection section contributes approximately 2.7% of wastage, primarily caused by measurement errors and spots due to poor handling.

4.4 Wet Processing (Dyeing/Finishing/Washing):

During wet processing, for every 100 kg of finished fabric, 121 kg of greige fabric is consumed. Material wastage in fabric dyeing stands at 21 kg for every 100 kg of fabric, resulting in a material conversion rate of 82% primarily due to uneven dyeing attributed to fabric faults and GSM (grams per square meter) issues. The main reason behind this wastage is uneven dyeing, shade variation, wash spot and so on. The findings of this study reveal a significant level of material wastage at each stage of textile and apparel production. The wastage is attributed to various factors, including poor material handling, issues with material quality, process losses, and rejections due to quality problems. Understanding these sources of wastage is critical for industry stakeholders, as reducing material wastage not only conserves resources but also improves production efficiency and reduces costs.

4.5 Waste Management Performance

The table compares Gildan SDS International Ltd, the Bangladesh average, and global best practices across key environmental and occupational indicators act as Table 02.

Table 01**:** Waste Management Performance (Comparison with Industry Standards)

Indicator	Gildan SDS International Ltd	Bangladesh Average	Global Best Practice
Recycling Rate (%)	12	10-12	25-30
Landfill Diversion (%)	70	65-70	80-90
Closed-Loop Recycling (%)	-	-	5-10
Occupational Health Score	Moderate	Low	High
Data Transparency	Moderate	Low	High

In Table 01 regards that Gildan (12%) performs at the upper end of the Bangladesh average (10–12%) but remains significantly below global best practice (25–30%). Gildan achieves 70%, aligning with the national average (65–70%), yet still trails behind global standards (80–90%). No data is reported for Gildan or Bangladesh, while global best practice ranges from 5–10%, indicating a major gap in circular waste management. Gildan is rated moderate, better than the low national average but below the high standard seen globally. Gildan shows moderate transparency, outperforming the low national level but still lacking compared to high global expectations.

5. Conclusions

Solid waste management in the textile industry is a complex, multi-dimensional challenge that requires integrated solutions spanning technology, policy, economics, and social inclusion. Gildan SDS International Ltd exemplifies both the progress and the persistent gaps in SWM within Bangladesh. While the company has established robust systems for waste segregation, monitoring, and compliance, significant opportunities remain to advance towards a truly circular and sustainable model. This thesis has examined the solid waste management practices of Gildan SDS International Ltd within the broader context of Bangladesh's textile industry. Key findings include: The company generates significant volumes of pre-consumer and post-consumer waste, with cutting and sewing processes being the primary sources; Current SWM practices are structured and compliant with national and international standards but are constrained by low domestic recycling rates and reliance on informal sector actors; Material inefficiencies result in substantial economic losses and environmental impacts, including greenhouse gas emissions, water pollution, and resource depletion; Health and safety risks persist for waste handlers, particularly in informal jhut clusters, highlighting the need for improved occupational protections; Opportunities exist to enhance circularity, value addition, and sustainability through technology adoption, policy alignment, and stakeholder collaboration. The transition to a circular economy—where waste is minimized, resources are conserved, and value is retained within the system—is both an environmental imperative and a business opportunity. Achieving this transition will require concerted efforts from industry leaders, policymakers, workers, and communities.

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Author Contribution

Md. Rubel Miah was responsible for the research design, data collection, data analysis. **Md. Mominul Haque** contributed to the conceptualization of the study, provided supervision, manuscript preparation and critically revised the manuscript for important intellectual content. Both authors approved the final manuscript.

Data Availability Statement

All relevant data are included in the manuscript and its supplementary information. Data will be made available on request.

Ethical Approval

The authors declare that the manuscript is original and has not been published in any journal.

Conflict of Interests

The authors declare that no conflict of interest.

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