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RESEARCH PAPER

Sustainable practices of fabric waste among small-scale garment enterprises in the Kumasi metropolis

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Abstract. In recent years, fabric waste has become an important sustainability issue that raises concerns and attracts attention from stakeholders in the fashion industries and the media. Over the past 15 years, the production and consumption of clothing have increased substantially, driven by the rise of demand for fashionable style and the proliferation of fast fashion. This study explores the fabric waste generated by the garment operators within the Kumasi metropolis. A qualitative research design, guided by a phenomenological approach, was employed. Data were collected from six zones using a purposive sampling technique to select respondents. Interviews and observations served as the primary data collection methods, and data were analysed thematically using NVIVO software. The findings reveal that the use of single-ply and bulk-ply cutting techniques in garment construction led to the generation of tons of fabric waste, particularly among small-scale garment producers. It is recommended that garment operators adopt effective strategies for reusing and responsibly disposing of fabric waste. Furthermore, the use of biodegradable fabrics is encouraged, as they have a lower environmental impact.

Keywords: Fabric waste; Environment; Sustainability; Reuse; Garment production; Garment operators.

1. Introduction

Sustainability has become a global concern, prompting various industries, including the clothing industry, to move towards sustainable practices. However, the clothing industry remains a significant contributor to economic development in many countries (Peters & Simaens, 2020). A well-established clothing industry provides employment opportunities, thereby improving the economic and social welfare of the population (Peters & Simaens, 2020;Hileman et al., 2020). However, the operations of the fashion and textile industries, especially in production, have raised important concerns in relation to social and environmental impacts. The garment industry alone produces and sells approximately 80 billion garments annually (Niinimäki et al., 2020). The fast-

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growing nature of this industry has contributed to the "take-make-dispose' linear economy model, which benefits many businesses economically. Clothing consumption has become a defining aspect of modern human activity, serving as a major source of revenue for the industry (Niinimäki et al., 2020). Nevertheless, the activities of the fashion industry generate substantial waste. Waste, in this context, refers to material that is no longer useful in the production of consumption cycle (Shirvanimoghaddam, et al., 2020).

Garment production has contributed to the generation of fabric waste, with over 21 billion tonnes estimated to have resulted from production processes (Chen, et al., 2021; Rotimi et al., 2021). This cost has been attributed to the high demand for clothing products (McArthur, 2017). The amount of waste produced is closely related to both revenue generation and consumption patterns. Fashion designers rely heavily on fabrics for production, and off-cuts or fabric waste from the production line often have limited value. As a result, they are discarded as waste. In addition to this, fashion consumption, particularly among young people, is influenced by fast-changing social media, and the pressure to meet peer expectations by constantly updating their wardrobes (Karaoglu et al., 2019; Muturi, 2024). This lifestyle has altered clothing demand and increased the expectations regarding the quality and variety of fashion products. However, it has also led to a significant increase in fabric waste generation (Shirvanimoghaddam, et al., 2020).

In this article, fabric waste refers to pieces of fabric intended for discard before, during, or after garment production. This includes thread remnants, paper cutting, pieces of Vilene, and other material obtained for garment production that are ultimately discarded (Abraham et al., 2017; Tekper, 2021). The fashion industry is considered the second largest producer of waste globally, surpassed only by oil and gas sector (Gupta et al., 2022). The current production system used by small-scale garment producers is entirely linear, negatively impacting environmental sustainability. The use of fabric in garment production has increased in recent years, influenced by media and social media influencers, which has driven higher production volumes, returns, and profits in the industry. The European Union has reported that approximately 9.35 million tonnes of textile waste are disposed of annually. On average, a European consumes 26 kilograms of clothing each year and discards 11 kilograms (Horvat & Vendramin, 2021). In Ghana, the city of Accra and Kumasi generate substantial volumes of textile waste due to their large populations (Acquaye et al., 2023). Over 70 tonnes of textile waste are discarded in a landfill site daily (Parkkonen, 2023). Fashion designers are seen as key contributors to this waste, largely due to linear methods employed in garment production. This paper examines the practices of garment manufacturers, especially in relation to how their operations contribute to fabric waste generation within small-scale industries. The authors are especially interested in how this waste is managed.

2. Theoretical background

The fashion industry operates as a global business within a highly competitive market. Currently, it employs approximately 60-70 million garment workers worldwide, with China and the United States being the largest apparel producers (ILO, 2021). The apparel industry, particularly the garment sector, is a lucrative business that offers numerous business opportunities for entrepreneurs and other stakeholders (Hossain et al., 2022). However, the industry's negative environmental impact is not limited to effluent and emissions; the garment manufacturing process itself also generates significant amounts of fabric waste. The growing quantities of fashionable clothing styles in the global market is driven by rising demand for the latest trends. Lean manufacturing principles focus on reducing waste and increasing efficiency within garment manufacturing processes. While many consumers prefer to spend minimally on clothing, fashion-conscious individuals frequently allocate a larger portion of their income to purchasing new and trendy clothes. This growing demand for fashion products has led to the rise of fast fashion, where manufacturers produce large volumes of garments to quickly meet consum2013er expectations (de Perthuis & Findlay, 2019; McArthur, 2017).

Unlike the circular economy, the linear model is closely linked with fast fashion, where brands such as Zara and H&M use a rapid production process to deliver clothing to consumers. Fast fashion brands and the mass production of cheap clothing have contributed to the unsustainable consumption of garments (Cataldi et al., 2017). This linear production model has led to the generation of substantial amounts of waste. Over 21 billion tonnes of waste have been reported as a by-product of production activities. The production of these clothing articles follows a take-make-dispose approach, creating nauseating environmental impacts such as pollution, waterborne diseases, and damage to aquatic ecosystems (Niinimäki & Durrani, 2020). Developing countries, such as Ghana, heavily rely on the fast fashion model, where the latest fashion trends are produced quickly and inexpensively, allowing consumers to frequently update their wardrobes (Kujala, 2016). This trend of frequent wardrobe changes compels fashion designers to increase their production, thereby generating more fabric waste, which often becomes challenging to manage. Designers typically discard fabric waste as rags after using the main portion of the fabric for the intended garment. The cutting room is reported to generate more waste than any other section within the garment manufacturing (Aus et al., 2021). Effective waste management yields social, environmental, and economic benefits. Conversely, improper waste management practices can lead to environmental pollution and clogging of drainage systems, which eventually increases the risk of adverse health-related diseases (WHO, 2022). The negative environmental impact of fabric waste is also linked to the depletion of natural resources.

One of the major challenges in clothing manufacturing is transitioning to a cleaner production model. This includes the collection, sorting, reduction, reuse, and recycling of fabric materials. Despite the availability of relevant technologies, most garment companies have not adopted circular economy principles, particularly in managing fabric waste. Fabric remains the most valuable material in garment production, constituting more than half of the final product (Enes & Kipoz, 2019). Micro-scale garment manufacturers, who typically focus on bespoke production, generate significant waste, varying between 10% to 15%, which not only reflects inefficiency but also adds to the growing volume of global textile waste (Cooklin et al, 2011). The waste production occurs throughout the production chain, from the design stage to the packaging stage, making bespoke manufacturers key contributors to fabric waste in the manufacturing processes (Cuc & Tripa, 2018).

The small-scale industry plays a vital role in the economic development of Ghana. These enterprises are instrumental in providing jobs for different skill levels and offer training for skill acquisition (Oluwaleyimu, 2020). The production system within the small-scale garment industry typically involves fabric inspection, laying and cutting, manufacturing/production, and waste disposal. The fabric is laid out on a table, pressed, and marked with tailor's chalk using the client's measurements. It is then cut, fusing where necessary, and the components are assembled and finished with pressing (Patnaik & Tshifularo, 2021; Zebua et al., 2024). This process inevitably generates unwanted fabric cut-offs, which require proper handling to contribute to sustainable production within the sector, hence the focus of this study.

3. Material and method

A qualitative research approach was used for this study, using a phenomenological design. The research design enabled the exploration of the lived experiences of the small-scale garment operators and their perceptions about garment manufacturing. To develop meaningful inferences, the research population consisted of small-scale garment manufacturers within the Kumasi metropolis. The study specifically targeted small-shop (kiosk) garment operators to allow for generalisation of the findings. Participants were grouped into six zones: Old Tafo, Suame, Moshie-zongo, Afful-Nkwanta, New Tafo (Krofrom), and Buokro garment manufacturers. The researchers' accessible population included those engaged in bespoke garment production, operating their firms, registered under their respective zones with the association of small-scale industries (ASSI), and possessing formal education.

The study adopted a purposive sampling approach, a non-probabilistic technique, to select interview respondents from the accessible population. At the time of the study, over 200 members had been registered with the association. A total of 30 respondents were selected to gather specific qualitative data aligned with the study's objectives. Of these, 26 respondents were representatives of zonal executives from the garment production division, and 4 respondents were officials from the Environment and Sanitation Department of Kumasi Metropolitan Assembly (KMA). The main instruments used for the data collection were interviews and observation. The researchers properly transcribed the audio recordings obtained from the field and cross-checked them with the field notes to ascertain their accuracy and authenticity. The thematic content analysis was used, which increased traceability and allowed verification of the analysis by thoroughly reviewing each transcript. Data was initially annotated with relevant keywords, phrases, and sentences, which helped in identifying and labelling relevant data types and patterns for effective organization. The data were then aligned with identified themes through the creation of categories and sub-categories, linking those relevant to the analysis. Each theme was defined clearly and assigned an appropriate name. The final analysis was selected based on its relevance to the research objectives. Since the study deals with the confidentiality of persons, the researchers adhered to ethical protocols, including ethical clearance and informed consent from all participants.

4. Result and discussion

The results of the findings of the study showed that garment operators have knowledge about sustainability. However, respondents were aware that their activities, especially the generation of fabric waste, have adverse effects on the environment. Sustainable practice is a shared responsibility among all key players in the garment industry. For the purpose of anonymity, respondents were ascribed as ZE and ES, respectively.

4.1. Knowledge of sustainability

Understanding the concept of sustainability provides a meaningful approach to the garment manufacturing business. The use of materials and other equipment is subject to manufacturing efficiency. Fabrics and other supportive materials like Vilene are regularly subjected to heat before and during construction. Knowledge in garment manufacturing provides a wide range of control over equipment, supports the selection of appropriate manufacturing materials, and helps to maximize and accelerate production. McArthur (2019) stated that knowledge on sustainability helps in managing ecological aspects (such as material flow) and other industrial systems, contributing to the development of a closed-loop process through interdisciplinary methods that reduce waste. To gain a clearer understanding of sustainability, staff from the environment and sanitation department (personal communication, 2023) explained that sustainability is about ensuring that one's workplace and the environment become a better place now and in the future. They further explained that sustainability involves using fabric and managing waste in a way that does not disturb the environment.

Emphasizing the importance of sustainability knowledge, ZE 2 remarked: "*Sustainability is about controlling the cut-out fabric pieces and other materials like papers in the workplace from scattering and getting into drains. This can be done by using containers with covers to prevent them from being blown by the wind".*

These explanations serve as a roadmap for achieving the Sustainable Development Goals (SDGs), which the United Nations aims to accomplish by 2030. McArthur (2017) emphasised that sustainability involves meeting the needs of the current generation without compromising the ability of future generations to meet their own needs. Preserving the future requires a thorough understanding of the work environment and what it required to ensure its safety and the continued viability of the garment manufacturing business. Sustainability entails a collective effort to use resources and materials to reduce the exhaustion of the environment and protect human

well-being, while also preserving them for future generations (Velenturf & Purnell, 2021). Since one of the key expectations of the SDGs is the implementation of strategies for long-term sustainable practices, the researchers opine that greater emphasis should be placed on educating the garment designers and manufacturers, particularly at the informal and local levels, to deepen their understanding of sustainability goals and to promote sustainable production practices.

4.2. Fabrics used for sustainable production

The four types of fabric selected to assess designers' level of sustainable practice are natural, regenerated, synthetic, and blended fabrics. These serve as the basic raw materials to produce garments. The purpose was to understand how garment operators apply the concept of sustainability to their manufacturing processes, particularly in terms of fabric selections. This implies that garment manufacturers are expected to choose eco-friendly fabrics for their production. Natural fabrics are biodegradable and eco-friendly by nature, and do not require many years to decompose. Subsequently, ZE 7 reiterated, *"I prefer using cotton fabrics for production because they conform to bending and can be renewable and eco-friendly".* This means that biodegradable fabrics have a lesser impact on the environment. This revelation is in line with Harmsen and Scheffer (2021), who stated that fabrics that decompose easily are eco-friendly and beneficial to human life.

Regenerated fabrics are textiles produced through chemical processes, normally generated from cellulosic resources such as wood-pulp. regarding fabric selection, ZE 5 (personal communication, 2023) noted that regenerated fabrics are suitable for production due to their organic origin. This finding affirms the claim by Harmsen and Scheffer (2021) that regenerated fabrics of natural origin require less water during production and are more easily recyclable. This means that regenerated fabric has minimal environmental impact. On the other hand, synthetic fabrics were identified as the least preferred option for sustainable production. These fabrics are chemically synthesised from various polymers and are known to cause significant environmental harm because of their nature and the extensive time they require to decompose. This observation is consistent with Joung (2014), who stated that synthetic fabrics can take over 300 years to decompose, which is considered detrimental to the ecosystem.

Blended fabrics are textiles composed not from a single source, but from a combination of different fibres to create one fabric. Nevertheless, such combinations can result in high-quality fabrics suitable for sustainable production. However, due to their multi-material fibre composition, recycling blended fabrics becomes highly complex, as the fibres need to be separated before they can be recycled. Harmsen and Scheffer (2021) stated that the use of blended fabrics may not be an ideal choice for sustainability, because of widespread use of mixed fibre combinations.

4.3. Production of garment

The operations of the small-scale (micro) garment enterprises are mainly run as one-person businesses operating from small kiosks. The manufacturer owns the business and carries out all tasks independently. The manufacturer or designer often undertakes fabric sourcing, laying, cutting, construction, and sometimes even sales. ZE 1 (personal communication, 2023) noted that inexpensive tools and equipment are used in their operations. These entrepreneurs are involved in every section of the operation, which makes it difficult to meet the demand of the competitive market or implement a proper management system to evaluate their performance. ZE 6 (personal communication, 2023) further explained that their type of business does not require sophisticated equipment; rather, the essentials include a sewing machine, an iron, scissors, and a space for cutting and pressing. This finding supported the argument by Quartey (2006) and Seneyah (2018) that small-scale garment industries require only simple and inexpensive machinery, tools, and equipment for production. Personal accounts from industry players indicate that most kiosk-based garment producers have limited knowledge of total quality management and are therefore unable to compete in the international market.

The Total Quality Management (TQM) system, along with the equipment, materials, and procedures used in production, highlights a significant challenge within the sector. It is evident that any manufacturers have improvised their own quality management systems, often relying on customer feedback and observing the production methods of their competitors. This informal approach has affected the quality and scale of production, limiting them to producing garments solely for local consumption. Asare (2019) supports this claim, stating that the lack of proper total quality management in garment manufacturing has restricted small-scale garment producers to serving only the local market.

4.4. Supportive materials for production

The materials used in garment production include fabrics (natural, regenerated, synthetic, and blended), assorted threads, zippers, hooks and eyes/bars, needles, and brown paper. The regional chairperson of the small-scale garment producers (personal communication, 2023) stated that materials are sourced from the local market. He further explained that they often rely on second-hand fabrics, claiming that some of these are of high quality. It was also observed that many of the second-hand fabrics contain inscriptions written in indelible ink, which manufacturers cut off to avoid incorporating them into the final products. These cut-off pieces of fabric create additional fabric waste. According to the regional chairperson (personal communication, 2023), although members are encouraged to use local fabrics and African prints, they often have no choice but to blend local and second-hand fabrics in their manufacturing process. Although the researcher observed a considerably high demand for second-hand fabrics, this has contributed to a decline in the production of locally made fabrics. This situation poses a threat to the growth and sustainability of the local textile industry. This finding is supported by Sarpong et al. (2011), who asserted that the presence of illegal textile materials in local markets places pressure on domestic industries, making it difficult for Ghanaian textile producers to grow and sustain their operations.

4.5. Waste generation and sustainability

The study assessed the production procedure of garment manufacturers and the extent of waste generation resulting from the use of bulk and single-ply cutting methods, and how it affected their production. Respondents were asked to what extent they strategize pattern planning for single and bulk ply-cutting during manufacturing, and how these methods produce waste.

The garment manufacturing industries produce tonnes of waste, which affects the economy of the country, because resources are spent daily to control the waste. Fabric waste is considered a significant portion of waste production. The application of single-ply-cut and bulk ply-cut for construction leads to the generation of waste. ZE 3, a small-scale garment manufacturer (personal communication, 2023,) asserted that both cut-out plies produce waste, especially when handling fabric with motifs, which often leads to the generation of more waste. This assertion supports the point of UNEP (2021) that waste emanating from fashion industries has serious effects on human life and the environment. Globally, it has been estimated that 11.2 billion tonnes of solid waste are generated each year. The changing trends in fashion and garment production have led to the generation of more waste. Niinimäki and Durrani (2020) opined that fast fashion contributes to the consumption of more clothing, but the production of durable and renewable garments supports a circular economy.

The study revealed that following the proper procedures of garment construction and preparing pattern pieces before cutting out the fabric reduces waste generation. Reusing the pieces also helps to reduce tonnes of waste that ultimately end up at landfill sites. However, the researchers observed that the procedure for cutting out fabric generates more waste, as many garment manufacturers use more yardage of fabrics for single ply-cutting without using pattern pieces. Both single and bulk ply-cutting produce a lot of waste, as was observed in the shops of garment operators.

The management and storage of fabric waste, as observed by the researchers, were not conducive. Most often, garment producers put their fabric pieces in sacks or bags, and sometimes in polyethylene bags for storage. This situation makes the management of fabric waste difficult, as it continues to accumulate, making the shops look unattractive to customers. An observation was also made on fabric waste during and after cutting; the required patterns from the fashion fabrics are often not properly prepared. Some of the operators do not sort out the fabric pieces to differentiate those to be used immediately from those to be kept for future use. Proper determination of this helps the manufacturer select the best fabric pieces for another production cycle.

4.6. Level of fabric waste generation

ZE 2, a small-scale garment manufacturer (personal communication, 14th January 2023), asserted that quantifying the exact amount of waste produced daily would be difficult, as they often collect the waste into a basket, polyethene bags, and sacks, only discarding it when full. The researchers observed that some garment manufacturers could produce more than 50 kg of fabric waste in a week. These fabric waste generations contribute to existing waste management challenges in the Kumasi metropolis.

The results reveal that respondents applied the concept of the 3Rs at each stage of construction in their production line. The garment manufacturers understood the meaning of the 3R: reduce waste, reuse generated waste, and recycle the leftovers. It was evident that all participants were able to clearly explain the concept when their views were sought during the face-to-face interviews, but applying them in practice was problematic. Some garment operators used fabric waste to produce pillow covers, fillings/stuffing, patchwork, garments, and craft projects. These findings are in line with the Enes and Kipöz (2020), who state that the cut-and-sew fashion industry values fabric waste as a key material within conventional clothing manufacturing processes, supporting the perspective that reducing fabric waste is essential to addressing persistent fabric waste issues.

4.7. Implications of fabric waste management

The study also discovered that garment operators were aware of the implications of waste management. It was revealed that poor waste management could affect both the health of workers and the environment. Proper planning and the use of pattern pieces during fabric cutting help reduce waste generation, which in turn lessens negative environmental impacts. The garment manufacturers often cut fabrics on any available table, leaving the cut-off pieces scattered around the work areas. According to this study, poor work area planning could lead to fabric pieces clogging open gutters and drains, thereby causing flooding. Fabric waste in gutters can trap water and create stagnant pools, providing ideal breeding grounds for mosquitoes and other pests. Kalyanakumar et al. (2021) assert that the impurities coming from garment industries can block the drainage system, creating breeding sites for pests and rendering metropolitan areas unhealthy.

It was also revealed that waste materials generated during pattern making are equally poorly managed after pattern adaptation. These waste materials have several implications for the environment. The dyes, chemicals, and other pollutants contained in the fabrics can harm aquatic ecosystems, contaminate local waterways, and degrade water quality in streams and rivers. The weight of accumulated fabric waste in gutters can put strain on drainage systems, and its attachment to the buildings can potentially lead to structural damage.

5. Conclusion

This paper sought to examine the activities of garment manufacturers, especially their operations concerning the generation of fabric waste within the small-scale industries in the Kumasi metropolis of Ghana. The study revealed that the garment operators exhibited a high level of knowledge on the implications of fabric waste, indicating that its environmental impact should

be minimal. Understanding the properties of materials and products helps to select suitable production materials for sustainable garment manufacturing. Additionally, knowledge about sewing and pressing equipment, along with their efficiencies, provides greater control over production processes, thereby enhancing productivity.

Nonetheless, the findings highlighted several challenges related to handling fabric motifs and waste generation during garment manufacturing. Natural fabrics were identified as the most suitable option for sustainable production, although ethical or eco-friendly fabrics were considered very expensive given the nature of the garment manufacturing business. As a result, garment manufacturers often use a mix of natural, regenerated, synthetic, and blended fabrics. Biodegradable fabrics, such as natural and regenerated types, tend to have a lesser effect on the environment. It is recommended that small-scale garment manufacturers familiarise themselves with the circular economy approach and adopt current technologies, especially machinery can enhance production efficiency and support more sustainable practices and operations.

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