

## RESEARCH PAPER

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# CIRCULAR APPROACH TO ENVIRONMENTAL IMPACT OF APPAREL PRODUCTION IN GHANA: A NARRATIVE REVIEW

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### ABSTRACT

*An integral aspect of the garment industry is production. In Ghana, the linear model of production largely persists. There have been environmental concerns about the industry's overreliance on virgin raw materials globally. The associated waste encompasses pre-production, production and post-production waste, which requires attention in Ghana. Although garment production culture varies from advanced fashion economies, waste generation and its negative impacts are universal and call for sustainable practices worldwide. Adopting a narrative review approach, this paper examines the various stages of garment production in Ghana, focusing on negative environmental impacts. The review highlights the adaption of models in the Circular Economy (CE) approach as a means of reducing the overreliance on virgin raw materials, and the tendencies of CE to curb the excessive waste associated with garment production when adopted. The economic benefit of adopting CE, enhancing the per capita environmental impact of cities, especially in Ghana, highlighted.*

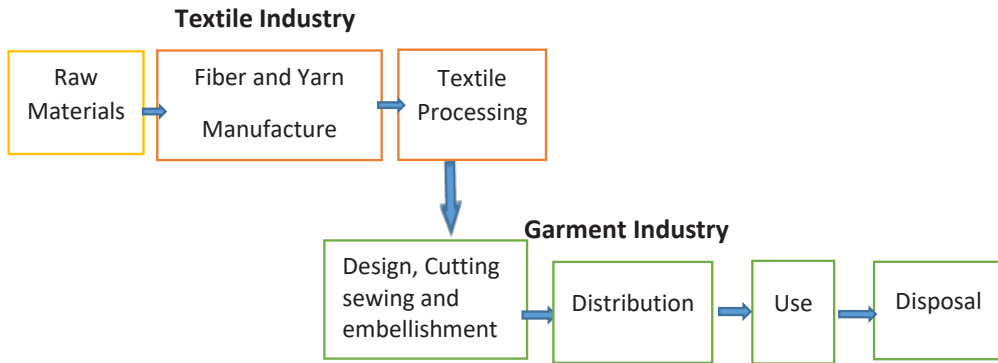
**Keywords:** Garment Industry, Garment Production, Environmental Impact, Sustainable Fashion, Circular Economy

## INTRODUCTION

The United Nations Sustainable Development Goal (SDG 11) is focused on: making cities and human settlements inclusive, safe, resilient and, sustainable. Under goal 11, the 6<sup>th</sup> target of the United Nations Environmental Program (UNEP) is that, by 2030, there will be a reduction in the adverse per capita environmental impact of cities, including paying special attention to air quality and municipal and other waste management. The World Bank (2017) highlighted the rapid urbanisation of African cities and the fast degrading of the natural capital of its cities including Ghana and added that ‘there is a significant risk that Africa’s cities may become locked into a “grow dirty now, clean up later” development path that may be irreversible, costly, inefficient, and reducing citizen’s welfare. Newman (2006) laments the continuous and rapid growth of cities and the associated negative environmental impacts, thanks to the increasing population. The desire of many, especially in rural Africa to settle in urban communities, coupled with the rise of young urban professionals is evident, especially, in Ghana. As a basic necessity of man, clothing provides a means for identity creation (Niinimäki, 2010) and in the process, volumes of clothes are produced, used, and discarded (Bick et al., 2018; Yalcin-enis et al., 2019). Global environmental impacts have been associated with manufacturing industries, and textile and fashion are considered one of the major sources of environmental pollution (EPRA, 2018; Mukherjee, 2015; WRAP, 2017).

Again global impacts are usually connected with highly industrialized nations (Allwood *et al.*, 2006; Bick et al., 2018; EPRS, 2019; Fuchs, 2016; Lewis *et al.*, 2017). However, developing countries in their attempt towards industrialisation will have footprints that need to be curbed before they become costly (World Bank, 2012).

Garment production globally is associated with a high waste generation which has been observed to have a negative environmental impact. Clothing is the fourth pollutant of the environment after food, transport and, housing (EPRS, 2019; WRAP, 2017) Mukherjee (2015) stresses that, due to the large quantities of products manufactured, used, and disposed of, the textile and apparel industry has a big environmental impact in every phase of the product life cycle. The traditional production model of the industry globally; take-make-dispose as defined by the Elen MacArthur Foundation (2013) has been criticised for being responsible for current environmental waste and its negative impacts. In Ghana, the linear model is predominantly the case hence the need to interrogate the application of the linear model in light of the advocacy to preserve the environment for future generations. Environmental assessment in the garment industry applies the Product Life Cycle (PLC) model (Bhamra *et al.*, 2013; Hur and Cassidy, 2019; Payne, 2015; Kozlowski *et al.*, 2012) in the identifying negative impacts. Figure 1 is an illustrates the phases of the Product Life Cycle (PLC) in the garment industry.



**Fig 1: Product Life Cycle in the Garment Industry adapted from Kozłowski et al. (2012)**

Ozdamar-Ertekin (2017) highlights environmental concerns about the true cost of fashion to including any hazardous impact of the fashion industry on the world and opines that it is “the second-largest polluter of the planet after oil”. Major environmental impacts include; resource consumption, greenhouse emissions, land use, toxic production processes and, landfills (Environmental Audit Committee, 2019; WRAP, 2017). The processing of garments along the value chain impacts the environmental and social dimensions irrespective of whether an industry is developed or developing. No matter how insignificant the volume of production in Ghana, is unsustainable practices are embedded in the process and hence contribute to negative environmental impacts. To avert these impacts, the Elen MacArthur Foundation (2013) proposed the adoption of the Circular Economy (CE) approach, which promises regeneration and restoration by closing up the loop. Adopting the CE ensures that garment life is extended through its core principle of 3R (Reduce, Reuse and Recycle.) considered as waste reduction models. The 3R is associated with alternative business models with sustainable strategies some of which could be integrated into local fashion firms. The effectiveness of the CE lies in the identification of the negative impacts in the various stages of production

aided by the Product Life Cycle tool, and the adaption of culturally feasible CE strategies to promote environmental sustainability. Garment production has general processes followed to arrive at the expected product. However, depending on the company size and cultural environment some processes are relegated. There appears to be a gap in research on sustainability and the fashion industry in Ghana, as most published articles lean towards garment production methods. The review highlights garment production and waste generation considering the advocacy for a sustainable fashion industry worldwide.

## The Review

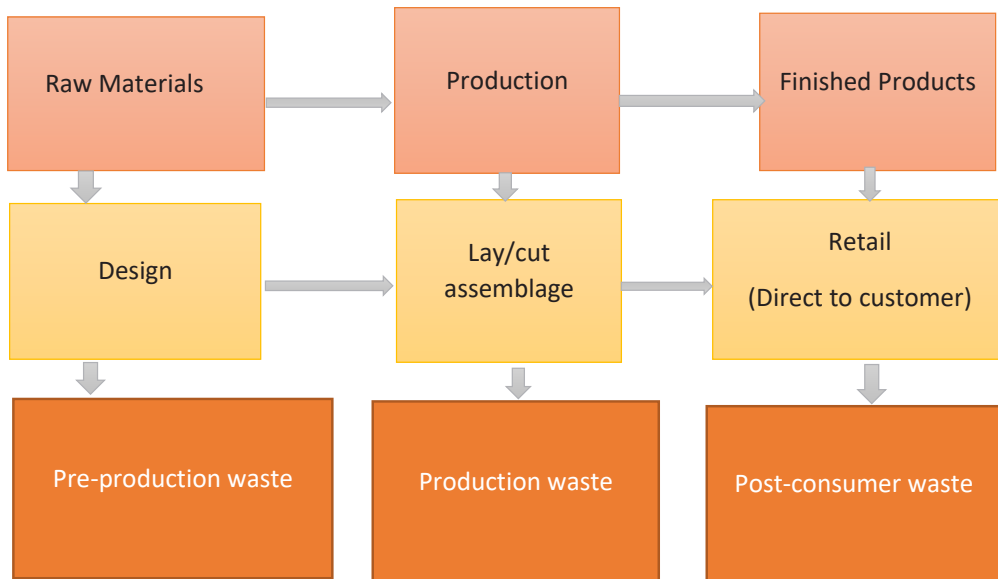
The fashion industry in Ghana is at the developing stage and experiencing a surge in interest, evident in industry activities and the educational landscape in Ghana. Fashion shows, red carpet activities, and the rise of educational institutions offering technical and degree programmes in fashion call for attention to global issues regarding the fashion industry. Research has been predominantly focused on garment production methods. As a developing industry with basic equipment and processes, we must look at the possible waste associated with its activities in light of global concerns. The review is sectioned into three parts: garment production processes predominately applied in Ghana along with

their environmental impacts; a review of what the authors deem to be culturally friendly CE models; and how the adoption of these models by local firms could enhance the per capita environmental impact of cities in Ghana to wealth.

### Processes in Garment Manufacturing in Ghana and associated Environmental Waste

Garment production goes through stages; pre-production, production, and post-production (Yalcin-Enis et al., 2019). The

approach depends on whether a firm or an enterprise engages in mass production, niche or custom-made garments. Garment production generally considers raw materials, design, production and, finished product ready for use. These stages have accompanying waste. The illustration in Figure 2 explains garment production processes as pertained in the context of Ghana. The product life-cycle model forms the basis for identifying waste associated with the stages of garment manufacture.



**Fig 2: Stages in garment production and waste categorisation adapted from Jahan (2017) and Yalcin-Enis et al. (2019)**

#### Raw Materials for Garment Production

An important stage in garment production is considering raw materials, which is the fashion fabric. In Ghana, most textile firms engage in cotton processing, and most of the fabrics produced are sold on the local market. This was confirmed by the Head of Marketing of Ghana TexStyle Company Limited (personal communication 2018) asserted that the Company’s decision to produce cotton fabrics stems from local environmental

conditions. Inferring from Fig. 1, the local textile industry is predominantly a convertor rather than a mill. Cotton production starts from growing and cultivating fibre. The land area required for cotton growing deprives humans and society at large of other usages. Land preparation comes with deforestation which is at variance with afforestation efforts and biodiversity. Accompanying the large acres of land are the chemical contents that are deposited during fibre growth leading to

soil nutrient depletion that makes reclamation near impossible. The Global Fashion Agenda (GFA, 2018) opines that the fashion industry will use 35% more land for fibre production by 2030. This invariably affects available land area for biodiversity and crop production, giving that the human population is increasing. These alarming projections amidst consumerism and overproduction raise future critical concerns. In Ghana, volumes of cotton used to be grown and cultivated for processing in textile mills. Hampered with bottlenecks, the growing of cotton has declined which makes land available for food crop production. However, the unavailability of cotton fibre on the local market means that cotton raw materials are imported. Raw material inputs for textile production; from fibres, yarns, mercerisation of greige goods to dyeing and printing have a negative environmental impact due to their processing. According to the Elen MacArthur Foundation (2015) textile production is a major contributor to climate change. It produces an estimated 1.2 billion tonnes of CO<sup>2</sup> equivalent (CO<sup>2</sup>e) per year - more than international flights and maritime shipping combined. Emissions from production plants at the various stages of processing, energy type used and, the transportation of materials back and forth between production and onward distribution to markets have a huge impact on the climate. Jacometti (2019) emphasises high fuel consumption and significant emissions of greenhouse gases associated with transportation. The Elen MacArthur Foundation (2015) projects that if fashion continues its current path, it could use more than 26% of the global carbon budget associated with a 2°C pathway by 2050. The textile industry in Ghana by the importation of raw materials and local cotton processing is contributing to greenhouse emissions, no matter how insignificant that may be.

### **Material Processing and Water Consumption**

Natural fibres especially cotton and man-made fibres like polyester, both predominately popular fibres for garment production require volumes of water for processing. Cotton fibre cultivation especially involves the use of water for plant growth. Volumes of water are equally used during spinning, weaving, dyeing and, colouration as well as finishing treatments (WRAP, 2017). Cotton is viewed as the thirstiest fibre associated with water depletion (Sandin & Peters, 2018; WRAP, 2017) Although local cotton fabric producers like Textstyle Ghana and Akosombo Textile Limited (ATL) do not engage in cotton cultivation, it is obvious their engagement in cotton processing has a huge environmental impact that must be addressed sustainably.

### **Synthetic Fibre Production**

Synthetic fibre overwhelmingly dominates apparel fibre consumption. Chief among them is polyester, which is made of fossil fuels and is non-biodegradable and, accounted for 16 % of the fibre used in clothes according to the European Clothing Action Plan (ECAP, 2019). Textile factories in Ghana do not engage in the manufacturing of artificial fibres but again like cotton, import yarns for processing into fabrics for the local market. In contrast, the fashion sector imports artificial fashion fabrics for garment production. The challenge here is, apart from the impact due to textile processing, the fabrics either by the local textile industry or imported ones pose a threat at their end of life. It is famously known that synthetics are not biodegradable and the associated problems with the non-biodegradability are well documented (ECAP, 2019; Fuchs, 2016; WRAP, 2017). Ghana at the moment lacks the technology for industrial recycling, coupled with the fact that these fabrics may be blends of other fibres (Braungart & McDonough, 2002 cited in Fuchs, 2016). How then does Ghana take care of garments made from synthetic materials to

avoid being dumped, which remain obviously on the soil surface for many years, burnt or, end up in the sea? There is a need to look at sustainable models to address this challenge. Material processing comes with effluents as highlighted by Khairul (2012) and Sandin and Peters (2018).

**Textile waste:**

During fibre processing, and in this regard, natural fibres, a large amount of dust and fibre by-product is generated as waste. Khairul (2012) reports that out of various activities in the textile industry, chemical processing contributes about 70% of pollution. The waste stream generated in this industry is essentially based on water-based effluent generated in the various activities of wet processing of textiles. According to Sandin and Peters (2018) wet treatment processes (dyeing, finishing, printing, etc.) are major sources of toxic emissions. Spinning of yarns and weaving/knitting of fabrics most often rely on fossil energy use, causing emissions such as CO<sup>2</sup>. Volatile organic components (VOCs) emerge during curing and drying in the coating, curing, drying, and chlorine and chlorine dioxide produced in the dyeing and bleaching stages. These processes are undertaken in local textile firms. Suppose the local textile industry's over-reliance on cotton contributes to such a negative impact and triggers environmental concerns. In that case, it is time to innovate strategies that promote sustainable practices and foster local industry sustainability.

**Garment Production**

Garment production goes through standardised processes however, environmental conditions may affect accepted procedures, leading to negative impacts. While garment production globally generates waste, a critical look into the process in Ghana provides some insights from global perspectives.

**Garment Design**

The design of garments generates waste; however, the nature of waste depends on the design approach. The design of a garment could be hand-drawn or computer-aided. Environmentally, hand-drawn garments generate paper waste along with the application of other tools used in the drawing process. Computer-aided design (CAD) and computer-aided manufacturing (CAM) are the important information technologies used in design and manufacturing processes (Yan & Fiorito, 2007). The aim is to increase productivity and quality of design. CAD/CAM has a host of advantages both to the manufacturer and the consumer. For the manufacturer, the advantages include improved quality, greater and more efficient productivity, flexible manufacturing, process control, and the ability to link manufacturing with customer-service programs. For the customers, varied designs and better fittings with faster delivery stimulate their desire to purchase and enhance their satisfaction (Tabraz, 2017). Umetani et al. (2011) highlighted CAD products that provide various tools focusing on 2D pattern creation and 3D draping for garment design. All of these are aimed at cutting down on waste. However, the industry globally is notoriously known for small to medium-scale companies who cannot acquire such software or have the technical know-how to operate them; hence, the continuous accumulation of waste in Ghana is not an exemption. Computer-aided drawings eliminate to a large extent the use of paper, however, the type of energy used could accumulate some considerable levels of waste and negative impacts. In Ghana, an unpublished GIZ report (2018) on the skill gap of fashion designers show that, most of these designers rarely use software for design. Invariably, paper waste could be linked to the design practices of local fashion firms and lead to environmental concern. It must be noted that the garment design process in Ghana is



not as vigorous as pertained in other fashion jurisdictions where garments are produced on a large scale. A user-centered approach is predominantly applied to garment production in Ghana, whereby design for a particular customer dominates the process especially with micro to small-scale enterprises (Ghana Statistical Service, 2015) It must be noted that a user-centered approach to design will tend to reduce waste as compared with mass production, as garments are produced based on outcomes from interactions with the specific end-user. As a common practice in Ghana, customer-specific body measurements are taken, together with the flexibility of customers bringing their fabrics, and discussing customer preferred style. This goes a long way to reduce assumptions that could lead to technical defects, hence garment rejections accounting for waste. However technical challenges experienced by local firms may negate the effective implementation of this approach as waste is embedded in the process, exemplified by garment production, and hence require further study.

### **Garment manufacture**

Garment manufacture in Ghana is predominantly small volume production usually for individual consumers, even though there are a few large-scale firms especially in the free zone that produce for export. With single to small volume production, methods are less complex than mass production; hence, the culture of pattern making, pattern grading, lay and marker making, cutting, and assemblage among others, are different. A significant aspect of local garment construction is free-hand cutting, a process that has been viewed by many as contributing to excessive fabric waste. Some studies on free-hand cutting confirmed fabric waste (Gavor & Danquah, 2018; Forster & Ampong, 2012 ) as a negative aspect. Fabric cut-offs and fabric roll-ends have been identified to be a major source of waste , constituting about 20% (Gwilt & Rissanen,

2011; WRAP, 2017) during the production stage of garment manufacture, (EPRS, 2019; Pingki et al., 2017; WRAP, 2017; Yalcin-Enis et al., 2019). In Ghana, fabric cut-offs are the major waste generated during production due to the practice of drawing out garment styles directly on the fashion fabric with excessive sewing allowances ranging from 2 to 4 inches added, based on assumptions. Compared with mass-production methods, excessive sewing allowances will limit fabric usage and hence added cost. However, In Ghana, these excess allowances are added to aid adjustment in the event of a change in body and garment size so that garments can be worn for a longer time. The Ellen MacArthur Foundation (2013), and Cooper et al., (2013) have advocated for such considerations to extend garment life to minimise and preferably eliminate waste. While excess allowances could aid in body/garment size fit adjustments, the quality of fabrics used for production along with rudimentary production methods, affect garment quality and negate excess allowance which has minimal impact on extended garment life. Again, most garment producers use electricity (powered by water) as the energy source for production. High water levels are needed for electricity generation, although considered as cleaner fuel compared with crude. The local environment is blessed with abundant sunshine throughout the year. Are technologies available for sun harvesting for energy generation, and at what cost? These and many others are grey areas that need to be unearthed to better understand the fashion landscape in Ghana for adopting and implementing sustainable practices.

## **Finished Products**

Most garment producers in Ghana are outworkers, either working from home or have self-owned or rented space from where they produce garments for individual customer use. Apart from a few local producers (small to medium scale) who sell their products in retail space, the majority deal directly with the customer, eliminating the retail process. Research on demand and sale of ready-to-wear garments made and sold in local retail outlets is currently lacking. Hence it becomes a challenge to identify and discuss issues relating to local garment retailing and the environmental impact. The direct-to-customer approach eliminates bulk production with its associated waste. Vijayakumar *et al.* (2016) suggest that poor record-keeping, miscommunication with suppliers and clients and, irregular management decisions will result in elevated inventory levels. Again, the local industry 's predominantly business-to-customer (B2C) model may escape some of the issues mentioned. Still, customer rejections do occur due to miscommunication between producers and individual clients, thereby resulting in waste. Customer perception of garment quality can influence the use and lifespan of garments which could lead to wardrobe hoarding and accumulate as waste. Post-production waste which encompasses unsold goods and consumers' use phase of fashion garments have been documented to end up in landfill sites (Bick *et al.*, 2018; DEFRA, 2011; Fatemi, 2009; Fuchs 2016; Spring, 2017; Yalcin-Enis *et al.*, 2019). In Ghana, waste and landfilling have become a major concern to government and waste management agencies. Recently the government of Ghana unveiled one hundred and one (101) waste management trucks and twenty-five (25) disinfection trucks secured by a waste management company Zoom Lion as part of the first batch of five hundred trucks that are being procured to assist in the sanitation sector (Ghana Daily Graphic, 2021).

Ghana, like other countries is struggling with waste. The categories of waste as illustrated in figure, two are pre-production, production and post-production, and each category and associated waste has been highlighted. It is obvious that in Ghana, pre-production and production waste are major causes of environmental concern as supported by research as far as garment production is concerned. It is imperative to adopt ways to curb waste generation which brings to view the Circular Economy Approach.

## **Circular Economy Enhancing The Per Capita Environmental Impact**

The popularity of the concept of Circular Economy (CE) is credited to the Ellen MacArthur Foundation, which was formed in 2010 to inspire a generation to rethink, redesign and build a positive future. The Foundation believes that the circular economy provides a coherent framework for systems-level redesign and as such offers an opportunity to harness innovation and creativity to enable a positive, restorative economy (Ellen MacArthur Foundation, 2013). The call for circularity is underpinned by the linear consumption pattern, which results from of the increasingly affluent population influencing a rise in demand for goods and thereby exerting pressure on resources. According to Accenture (2016) climate change and the impending shortage of raw materials demand a shift from linear to zero-waste circular cycle. Some literature points to the overwhelming support of the Circular Economy (Accenture 2016; Fuchs 2016; Kirchherret *al.*, 2017; Koszewska, 2018 business people and authorities. The importance of the transition towards a more circular economy has also been noticed in the European Union. The new regulations provide the enabling framework for the circular economy to flourish. At the same time, although there is no standardised approach to creating a circular economy while defining appropriate policies, care must be



taken that they are suitable for particular industries. The limits of the present linear economy model (take-make-waste; Stahel, 2013) initiative are an attractive response to the call for sustainable fashion practices worldwide. According to global management consultancy Accenture, circular economy approaches can add as much as US\$6 trillion to global economic growth by 2030. Stahel emphasises that the circular economy is an umbrella term for business models and industrial processes which do not generate waste but rather, reuse natural resources repeatedly. In this regard the CE is focused on products that are designed to enable reuse; components can be disassembled, durable components can be reassembled into new products, worn out parts could be refurbished, and material could be recycled as well. By doing so, many materials are reclaimed for use instead of extracting virgin materials. This aligns with the Cradle to Cradle (CC) concept where according to Stahel (2013) goods are made, dismantled and re-made into new products. Is the concept of circularity practised in Ghana?

The Ghana fashion industry is characterised by micro, small to medium-scale garment producers, with the majority in the informal sector (GSS, 2015). Production processes are hampered by a lack of requisite tools and machinery which affects the quality of garments products. Again, skill gaps and shortages have been reported to have had a huge negative impact on the local fashion industry (Senayah, 2018). Characterised by basic tools and skills; and rudimentary processes, waste generation become a major feature of garment production in Ghana. Williamson et al. (2006) gave the market-based decision-making frames that permeate and dominate the industry in which manufacturing SMEs operate.

Since the environment is a pillar of corporate social responsibility (CSR) are of the view that with many small activities, their cumulative impact could be significant. Although CE has been touted to enhance environmental and social sustainability, its implementation requires skill, technology and technical know-how. In a production environment characterised by basic tools and skills, will adopting CE be plausible?

The CE's core values include reuse, reduce, and recycling (Ellen MacArthur Foundation, 2013). Although the CE has the prospects of enhancing the environmental impact of Ghana, a careful examination of the strategies is required, bearing in mind the basic tools and skill levels prevalent in the industry. Six major dimensions of CE models are identified to include: (i) repair and maintenance; (ii) reuse and redistribution; (iii) refurbishment and remanufacturing; (iv) level of recycling; (v) level of reuse; and (vi) organic raw material business model patterns (Lüdeke-freund & Boons, 2013). These models are considered effective in addressing environmental concerns. One of the proposals of CE, according to Stahel (2013) is keeping raw materials in use for an extended period through regenerative cycles of reusing and recycling. The feasibility of any of these strategies in Ghana will depend on fashion producers' willingness, consumers' attitudes and perceptions, and the external fashion environment. However, sustainability is an unexplored subject in Ghana and to make any contribution regarding to the adoption of CE will require further investigation into the peculiarity of fashion production in Ghana. Ongoing research by the authors, will bring to bear the feasible strategies for adoption in the Ghanaian environment to go a long way to curb environmental waste.

## CONCLUSION

Garment production and waste generation are traditionally unavoidable. The growing number of Urban Youth Professionals (UYP) in Ghana means that the issue of waste management may become a challenge to Agencies responsible for keeping the cities clean. The global call for revising production models will have a greater impact if garment producers in Ghana, at the early stage of developing the local fashion industry, embrace circular models. However, the models' adoption may be impeded by culture; hence, a further study to examine the local cultural environment to aid the selection of the most promising models will yield the needed result and enhance the per capita environmental impact of cities in Ghana. Also, energy for production must be considered in light of abundant sunshine which requires further research into the technologies and cost for harnessing for production. The gradual interest in producers owning retail shops will require research on the demand and sale of ready-to-wear garments, and the rise in local retail outlets to identify and discuss issues relating to local garment retailing and the environmental impact before it reaches its peak.

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## *Circular approach to environmental impact*

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