TEXTILE WASTE MANAGEMENT AND RECYCLING OPPORTUNITIES AND CHALLENGES FOR AFRICA: A MINI-REVIEW

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ABSTRACT

Global fibre supply increased to 113 million tonnes in 2021, contributing to elevated energy and water consumption levels, agricultural pollution, and post-consumer textile waste. Introducing second-hand clothing as an alternative to mitigate textile waste is advantageous for providing affordable clothing. However, the disposal of substandard and unsold garments obstructs riverways and drainage systems, leading to flooding. Moreover, incineration produces heightened greenhouse gas emissions, exacerbating poverty and impeding development, particularly in Africa. Nevertheless, textile wastes present opportunities for establishing large-scale regeneration and recycling facilities, offering the potential for employment generation and skill development in Africa. This mini-review aims to underscore Africa's potential and challenges in textile waste recycling. The findings underscore the importance of recognizing African textile waste, both as an environmental hazard and as a valuable resource for the production of new clothing. Additionally, they emphasize how efforts to add value to recovered textiles are gaining traction, particularly in East, South, and North Africa. However, no formal textile recycling facilities were identified in West and Central Africa. This mini-review is constrained by data limitations, encouraging future researchers to broaden its scope by examining individual countries and recycling companies.

***Keywords**: textile, waste, recycling, Africa, sustainability*

INTRODUCTION

Each year, millions of tons of textile waste are produced worldwide, which is influenced by various factors, such as culture, population density, lifestyle, fashion, etc. [1]. In particular, the fashion business model, known as fast fashion (FF), has more than doubled compared to the global textile production output. Due to low price, style and low quality, the average time a clothing item is worn before being discarded has decreased by almost 40 % [2]. This decrease significantly leads to wasteful consumption, as 13 to 20 % of these FF products are discarded after no more than ten wears [3]. For example, China is the

largest exporter and leading consumer of textile products [4] and produces over 20 million tons of textile waste annually [5]. In contrast, the US and the UK generate 15.1 and 1.7 million tons of textile waste annually. These figures represent about 6 % of the annual municipal solid waste (MSW) generated in the three countries [1]. Similar wasteful habits of consumers can be observed in Hong Kong, where approximately 293 tons of textile waste is generated daily [6].

In addition to the wasteful behaviours of the FF consumers, the model also affects the environment since each stage of the life cycle of a fashion product presents potential environmental challenges [7]. For example, the production of FF textile products requires a large amount of water, energy, and chemicals [8]. Furthermore, recent estimates show that over 75 % of textile waste is incinerated or buried in landfills, while only 25 % is recycled globally [9, 10]. The landfill is the most adopted strategy for disposal of textile waste. Complex organic substances are decomposed into simpler compounds and inorganic materials such as carbon dioxide, water, and ammonia during the complete decomposition process. But in the case of an incomplete decomposition process, intermediate transitional products and new compounds of smaller molecules are formed, for example, amino acids, amines, methane, aliphatic and aromatic acids, substances and gases with unpleasant odours. Because of this, there is a high possibility that hazardous materials will be released into the groundwater and the soil in the surrounding areas [11, 12].

Although natural fibres in textile products often contain additional chemicals for various types of processing, which can make their decomposition difficult, for all types of natural macromolecules there are specific enzymes that enable their complete decomposition. Synthetic macromolecules are not necessarily biodegradable, which is a major environmental hazard [13, 14]. However, the decomposition of natural fibres takes weeks or years in landfills. Also, synthetic fabrics are designed to prevent decomposition. Because of this, there is a high possibility that hazardous materials will be released into the groundwater and the soil in the surrounding areas.

Communities are gaining a better understanding of the risks associated with the disposal of old textiles in landfills. As a result, consumers are developing strong desires for sustainable consumption through textile reuse and recycling, while also drawing attention to the potential value of textile waste as a renewable resource [15]. Second-hand clothing (SHC) is a reuse strategy and model that has matured tremendously over the last few decades, with an annual growth rate of over 11 % [16]. It is worth hundreds of millions of dollars and is essential to many ancillary commercial operations [17]. The SHC industry significantly influences the fashion industry, creating a critical link between the fashion supply chains of developed and developing countries. Most SHCs are imported from the United States, China, the UK, Germany, Korea, etc., for charitable donations and resale in developing markets [18, 19]. This is essential to deliver fashion products to consumers, especially in underdeveloped African countries [17, 20]. There is a soaring demand for SHCs across Africa, mainly because they are longer-lasting, trendier, and cheaper than locally made clothing [21, 22]. As a result, it is believed that more than 80 % of the African population consumes SHC [22, 23], while also creating job opportunities for hundreds of thousands of people across the continent [24, 25].

Although the SHC model is designed to reduce textile waste, while also providing affordable clothing options for poor Africans, the waste reduction appears to particularly benefit the Global North (GN), while leaving millions of tons of textile waste on the streets, dumpsites, marketplaces, rivers or sent to landfills in the Global South (GS). This textile waste negatively affects the already limited drainage systems in African countries. It also creates emissions during transport to landfills or when clothing is incinerated.

TYPES OF TEXTILE WASTE

Like in other textile producing countries, such as China, textile waste in Africa can be divided into two main categories: pre-consumer and post-consumer textile waste. The pre-consumer waste is waste from the production process resulting from fabrics and garment samples, excess stock, fabrics from the end of rolls, or materials discarded such as defective printing, dyeing and finishing of fabrics, and pieces of fabric left over after cutting out patterns. There is a particular concentration of pre-consumer waste in East Africa and Southern Africa, as these regions contribute a large percentage of global textile production. For example, garment manufacturers in Kenya generate about 400,000 tons of cotton waste annually, which often leads to the formation of hazardous dumps that contaminate the soil, nearby rivers, and waterways, endangering the lives of nearby residents and waste collectors.

In contrast, post-consumer textile waste consists of garments or household textiles that consumers no longer need and are ready to be discarded because they are worn out, damaged, or out of fashion. Most of these consumer textiles are imported to the African continent through the SHC trade. This category contains natural fibres and synthetic polymeric materials, such as cotton, wool, silk, polyester, polyamide, nylon, and polypropylene. The high amount of post-consumer waste produced in Africa is comparable to the fibre consumption rate on the continent. Post-consumer textile waste is difficult to decompose, takes up space, and represents significant challenge for African waste management systems. Due to poor waste management systems, post-consumer textile wastes causes infectious diseases, attract vermin, and contaminate the surrounding environment with unpleasant odours detrimental to the ecosystem [26, 27].

TEXTILE RECYCLING POTENTIAL IN AFRICA

The disposal of used textiles in landfills leads to losses of raw materials, energy, and human labour. Decomposing synthetic materials and natural textile waste is challenging and leads to carbon monoxide and methane production. This implies that the disposal of used textiles results in economic loss and environmental degradation [28, 29].

Compared to incineration and landfilling, reuse and recycling of textiles minimizes the impact of textile waste disposal on environment [30]. Recycling minimizes the demand for the manufacture of virgin textile fibres by promoting upcycling and total product remaking, both aimed at reviving and extending the useful life of textile items. They include reprocessing pre-consumer or post-consumer textile waste to produce new textile or non-textile goods.

In addition to value addition, recent studies have shown that textile waste is a potential source of renewable energy, especially for poor African countries with insufficient energy generation infrastructures [31 - 34], and is also seen as a vital step toward achieving circular economy goals [35]. Furthermore, a high potential exists for biobased textile wastes to serve as an alternative feedstock for biological products through bioconversion of the cellulosic part of the textile, which remains after the process of bioconversion as a purified product with added value [2].

The potential of textile recycling is intensifying across Africa [34, 36 - 40]. For example, in Kenyan recycling facilities, products created mainly from virgin polymers and natural fibres are replaced by recycled materials derived from fibrous waste materials. Some fabrics, such as T-shirts, are redesigned into polishing and cleaning materials, while others, such as high-quality textiles, are repurposed into second-hand clothing. Fibres obtained from used textiles and carpets are reprocessed into several textile products, the most common of which are nonwovens, mats, and soil reinforcement for enhancing soil

strength and stability. They are also used for concrete reinforcement to improve its shrinkage and toughness. The current textile reuse and recycling initiatives offer valuable environmental sustainability, particularly in East Africa.

TEXTILE RECYCLING INDUSTRIES IN AFRICA

There are many new uses for reclaimed textiles after they are recycled from previously used textiles and garments. According to industry estimates, the textile recycling industry has the capacity to divert about 2 million tons of post-consumer textile waste each year [41]. In addition, as a significant advantage over other waste processing industries, the textile recycling industry can recycle 93 % of textile waste without producing additional hazardous waste or other undesired by-products [42].

Despite the above-mentioned, there has been an alarming increase in the amount of discarded textile waste in Africa due to the accumulation of unwanted or low-quality bales of clothing. This provides clear evidence that the reuse strategy through second-hand clothing, as a sustainable and environmentally friendly option, is slowly eroding. As such, Africa is stepping up its efforts to seize opportunities in recycling discarded textiles through a constant search for sustainable products that include value-added components created from recycled fibres. Clothes that can no longer be used are collected for recycling, where they are either mechanically or chemically processed into value-added fibres. The mechanical process includes cutting and shredding, while methods such as enzymatic digestion, thermal decomposition, glycolysis, and methanolysis (employed by TakaTaka Solutions) are used in the chemical processes [42].

Fibre regeneration which involves recycling old cotton clothing using a closed-loop upcycling process (employed by Closing the Loop on Textile Waste, Sofrip & Re-woven) for cotton garments, is gaining attention across the continent. Recycling facilities across the continent use techniques for fibre regeneration that involve turning discarded cotton textiles into pulp, dissolving the pulp using a solvent, and spinning the dissolved pulp into fibres. The use of the solvent known as N-methylmorpholine N-oxide (NMMO) is safe for the environment and dissolves cellulose without causing any damage to the material. The discarded cotton fibres from waste clothing are reprocessed with wood pulp to produce fibres comparable in appearance to lyocell.

Despite these benefits, the disposal of cotton waste is still a challenges for waste management systems due to poor logistics and a lack of resources, which limits the greater conversion of textile waste into pulp. Therefore, composting is one of the most suitable methods for preventing the disposal of cotton waste directly at landfills. Composting is a bio-oxidative process that requires minimal operating resources and technology and is gaining attention as a flexible textile recycling method for African recycling facilities. It involves the biodegradation of organic waste, such as cotton waste, into a valuable soil additive. In the process of composting, a wide variety of microorganisms, such as bacteria and fungus, are used to break down more complicated organic waste into more simpler compounds. This composting helps East African farmers to restore soil fertility by increasing the amount of organic matter in the soil. It has a high nutritional content, and its advantages include increased crop growth and water retention, decreased demand for chemical fertilizers, and control of soil-borne diseases and pests, while having a positive impact on the environment.

Table 1 provides a summary of African recycling companies which this review was able to access.

Table 1. Textile recycling industries in Africa

No	Company	Website	Location	Description
1	Sofrip	https://sofrip.com/	Sfax, Tunisia	SOFRIP is a Tunisian and North African company involved in textile recycling. They specialize in collecting and recycling used clothing, shoes, wiping rags, and frayed clothing. Their recycled fibres are used in many sectors such as the automotive, construction, and production of mattresses. SOFRIP has a huge network of partners in Asia, Europe, Africa, and America and is regarded as a pioneer in promoting sustainability in the textile recycling industry.
2	Africa Collect Textiles (ACT)	https://africacollecttextiles.com/	Nairobi, Kenya Lagos, Nigeria	ACT is a social initiative that collects and recycles discarded textiles. ACT's model is based on the following principles: collecting and redistributing used clothing in order to provide decent clothing to vulnerable communities; laying the foundations for a circular textile and fashion industry by preparing large quantities of sorted materials that are suitable for repurposing and recycling; designing and developing products from textile waste. Shop tummies, kitchen sets, and shop carpets are some products made of recycled textiles. Recycled materials are sold online, and designs can be customized based on customer requests.
3	Re-woven	https://www.rewoven.africa/	Cape Town, South Africa	Re-woven uses mechanical processes to create 100 % recycled, quality fabric from pre-consumer textile waste. The wastes are shredded to make new fibres, mixed with recycled PET fibres, and re-spin and re-weave the blend into 60 % recycled cotton and 40 % recycled polyester fabric. The recycled polyester is used to reinforce the fibres so it can be used to create new clothing. Raw materials for recycling are obtained from off-cut fabric, end-of-roll fabric, unsold inventory, clothing rejects, and corporate branded uniforms. The company also aims to create economic growth and employment to eradicate poverty.
4	Tindwa Medical And Health Services (TMHS)	https://www.tmhstz.com/?page_id=3080	Dar es Salaam, Tanzania	TMHS develops strategies for collecting, transporting, treating, storing, and disposing of hazardous and non-hazardous waste. Its goals include providing waste management services to customers that are not only simple but also economically viable and fully compliant with the standards set by the regulatory authorities in Tanzania. Services include industrial waste, healthcare waste, domestic / residential waste, clinical waste, confidential documents disposal, and electronic waste. Textiles are collected as part of its domestic / residential waste stream. They are sorted, and those that are still useful are disinfected, sold, or given to charities.
5	TakaTaka Solutions	https://takatakasolutions.com/about-us/	Nairobi, Kenya	Waste management is a specialty of TakaTaka Solutions, a company that practices vertical integration. They are involved in collecting, sorting, recycling, and composting wastes. They work with customers to help them achieve their recycling goals, while also assisting them with data insights and concerns related to regulatory compliance. The collected wastes are sorted into 40 different waste fractions. Recyclable textile wastes are transferred to third-party recyclers that are specialized in textile waste recycling.
6	Closing the Loop on Textile Waste	https://p4gpartnerships.org/closing-loop-textile-waste-kenya#:~:text=The%20Closing%20the%20Loop%20on,Partnership%20of%20the%20Year%20award.	Nairobi, Kenya	Closing the Loop uses an innovative chemical recycling technology with support from PurFi. They turn waste textiles into high-quality products that can be reused to produce new textile materials. Their recycling technique consumes 90 % less energy, generates 90 % less greenhouse gas emissions, and consumes 99 % less water than other methods. The all-female sorting crew now processes 36,000 kg of waste per month and aims to increase this to 100,000 kg. The cooperation has been successful in selling a total of 100,000 kg of recycled textile cotton.
7	FabricAID	https://www.fabricaid.me/	Egypt branch, Cairo, Egypt	FabricAID is a social company based in Lebanon that was founded in 2017 to develop a value chain for the garment industry that is both socially and ecologically responsible. To accomplish this mission, FabricAID works to optimize the collection, sorting, upcycling, and resale of used clothing through socially conscious and sustainable brands.
8	Value Bekia	https://www.crunchbase.com/organization/value-bekia	Cairo, Egypt	Value Bekia collects waste from households, such as newspapers and books, used oil, electronic waste, glass, and sweaters. Value Bekia initiative seeks to improve the amount of recycling in Egypt. They create loyalty programs with strategic partners where clients can earn points by recycling materials utilizing their service. These points can then be redeemed for various rewards. They provide a platform that encourages a shift in cultural and social norms regarding recycling and environmental consciousness. They offer an innovative new approach to the problem of waste that Egypt continues to face.
9	EnviroServ	https://www.enviroserv.co.za/	Rietfontein, South Africa	EnviroServ provides comprehensive waste management systems that identify, categorize, and manage waste streams following environmental practices. As a result, less garbage is deposited in landfills. A waste management strategy (including textile waste) is designed and implemented to guarantee that the opportunities for advancement in the waste hierarchy are realized via waste reduction, reuse, and recycling.

OPPORTUNITIES FOR AFRICA

The growing sense of sustainable textile consumption presents many opportunities for Africa. It offers an understanding of how second-hand clothes can be creatively recycled or altered into new clothes, accessories, or completely different products [37]. Like other parts of the world, Africans are gradually turning to re-consuming fashion designed using recycled or upcycled materials [40]. This sense of consciousness advocates for the replacement of more resource-intensive production systems.

SHC recycling can also be seen as a way of adding African styles and values to used clothing. A formal education that teaches value addition and innovative techniques substantially enhance used clothing with a sense of Africanness [40]. These educational initiatives have already begun. For example, an upcycling design workshop by James and Kent [37] in Ghana highlights SHC recycling as a revival of the African textile industry.

With its status as the largest consumer of SHCs in the world, the market for recycled/upcycled fashion products has the potential to expand rapidly, particularly in poor African countries with low purchasing power [39]. In addition to supplying raw materials for textile industries in East Africa, this market could provide more affordable clothing to compete against imports from China and other Asian countries [17, 37, 43]. As these examples emphasize, enhancing sustainable textile consumption extends beyond providing knowledge for recycled clothing with Africanness to creating massive employment opportunities.

Textile waste accumulates in landfills, which has a negative impact on the environment. Implementing recycling programs will reduce the impact of textile waste on the environmental and create employment opportunities in Africa's energy, economic, social, and ecological sectors [44, 45].

As a cellulose fibre crop, cotton cultivation relies more on water and accounts for 11 % of all pesticides used yearly [7, 46]. Most pesticides used in cotton cultivation are hazardous, and the accumulation of these chemicals in the biosphere negatively affects the local wildlife [47, 48]. Due to inadequate infrastructures and agricultural equipment, African farmers suffer more from fertilizers, cotton stalks from cotton cultivation, and cotton dust, which can penetrate the airways and lungs during ginning. Therefore, recycling textile waste could contribute to water conservation, reduce wastewater, and limit emissions during cotton transportation.

Environmental degradation is directly related to poverty and affects the quality of life [49]. The systematic inclusion of ecological considerations [50] and the establishment of textile recycling programs would contribute to slowing down environmental degradation and positively impact poverty reduction strategies.

CHALLENGES FOR TEXTILE RECYCLING IN AFRICA

Unlike other products, such as plastic and paper, recycling textile waste is a global challenge [51]. The case is even worse for African countries, where effective circular waste-to-value initiatives aimed at increasing the value of textiles through recycling [52, 53] currently do not exist or are in the nascent stage. As a result, textiles are often recycled into inferior products with reduced applications in floor mats, cushion fillers, and insulation materials.

The bioprocessing of used textile materials presents a challenge for these startups, mainly because used textiles are made of various components, including natural and synthetic fibres that are not cellulosic. In addition, cotton accounts for the most significant share of the total amount of textiles available for recycling. Therefore, due to its refractory nature, achieving a maximum yield in processes such as hydrolysis and biogas

production is difficult for value-added processes [2, 6].

Textile recycling facilities in Africa also face the challenge of collecting and separating different types of textile waste. Because textiles come in a wide variety of fibres and colours, it is difficult to sort them [54]. The sorting process is also challenged due to the presence of various materials, such as plastic and metals [51]. The high content of chemicals and dyes in many textile products makes the entire recycling process more challenging, leading to lower quality and reusability of the recycled materials [55].

In addition, synthetic polymers with identical melting temperatures are difficult to separate for respinning [56]. Their valorisation process requires the use of a certain amount of chemicals, which leads to additional pollution [2, 57]. Also, although shredding is necessary for converting old textiles to raw materials, textile fibres are difficult to shred due to their strength [58].

Valorisation of textile waste also faces difficulties in generating income from the process itself. There is little demand for the reuse of most recycled textiles. This can be attributed to the widespread production of lower quality items made from recycled fabrics. Another contributing factor is the high costs incurred in the recycling process and transportation, resulting in a highly inflated price for some recycled textiles. These challenges severely limit profit generation in textile reuse, leading to low investment attractiveness in the textile recycling industry [1, 51, 59]. These challenges require economically feasible and efficient methods to detect and classify the various types of textile materials to increase the number of recycled materials [6, 60], which are lacking in the few recycling facilities across Africa.

The absence of technology for sorting textile wastes for recycling is one of the primary factors contributing to Africa's poor investment in textile recycling programs. Although technologies for removing colours and other impurities are a global challenge for textile recyclers [58], the situation is even more critical for several textile recycling facilities on the continent. Technological barriers to textile recycling in Africa are further increased by outdated systems, outmoded development concepts, uncoordinated marketing strategies, inadequate financial allocation, and misuse. In addition, the lack of investment focus in this sector in Africa could be attributed to the speed of technological advancement and the competitiveness of producing cheap and affordable fast fashion products.

A disorganized waste collection system also makes it impossible to recycle textiles effectively [61]. The lack of an integrated and well-coordinated policy framework severely affects African textile recycling efforts [62]. The lack of government policies and standards is also a challenge for the recycling sector. Many well-developed regulations promote the recycling of glass, wood, paper, plastic, and metal wastes in many countries across the continent. In contrast, the opposite is true for textile waste recycling. This could be due to the low public understanding and appreciation of recycled textiles. A lacking or ineffective textile waste management legislation also prevents consumers from accepting responsibility for the environmental degradation caused by improper disposal of textile products [63]. Inadequate dissemination of information intended to encourage consumers to contribute to recycling initiatives and the strategic placement of waste collection bins which leaves some homes inaccessible, are serious challenges that slow down recycling efforts [64, 65].

Also, according to [51], the market demand for recycled textiles is negatively affected when there is a lack of awareness about the composition of potentially hazardous components in recycled textile materials [51]. These awareness barriers include citizens' lack of knowledge about what can be recycled and a lack of dedication to recycling.

In the end, informal waste collectors mainly perform waste collection and sorting, with formal collectors work on a low scale.

Informal recycling is labour intensive and driven by rudimentary recycling technologies, resulting in much lower efficiency than formal recycling methods [32, 34, 35]. The limited competence and devotion of informal collectors, together with their sloppy collecting methods [66, 67], adversely affect the quality of textile waste. On the other hand, their exclusion from waste collection and recycling policies could result in friction between the informal and the formal sectors, disrupting waste collection and sorting processes [68].

SOME POLICY ACTIONS TO IMPROVE TEXTILE RECYCLING INDUSTRIES

Due to the large labour force and the abundant supply of second-hand clothing, there are compelling reasons to believe that recycling has the potential to rejuvenate local textile industries once again. With strong policy support, individuals and companies aware of their impact on the environment can turn unwanted textiles into valuable raw materials instead of throwing them in landfills. Therefore, this mini-review suggests several policy measures that all stakeholders should implement to maximize the potential for a vibrant textile recycling industry with revolutionary industrial opportunities.

The most important thing is to increase the diversion of textile waste for conversion into value-added products, which can be achieved by adopting effective strategies that will increase convenience of disposal and collection at collection points and expand awareness of recycling. There must be measures to expand the network of outdoor recycling bins, collection points in shops, corporate collection, residential units, public institutions, schools, and events. Motivating consumers to sort their garbage by providing free collection mechanisms, such as recycling bins, increases the likelihood of their participation. Door-to-door collection campaigns should be part of the textile recycling collection scheme. This will help consumers who cannot access strategically placed bins, as well as motivate those who are reluctant to go to the collection bins.

Efforts to increase recycling awareness could be enhanced through government-sponsored programs, non-profit, and private enterprises, partnerships, and other educational programs. Consumers should be educated about challenges of environmental degradation and their harmful consequences. These educational programs should also be reflected in the allocation of national and regional budget.

Designing incentive programs is key to getting more consumers in the recycling process and pollution control. Incentivized waste management approaches for plastic, paper, and other waste streams have already begun in Kenya, South Africa, Nigeria, Egypt, and Ghana. Such approaches can be implemented in the textile recycling sectors across the continent. Incentivized programs are also needed to enhance the local processing of shredded fibres to guarantee maximum returns. Furthermore, it is important that governments collect taxes that can be reduced if companies participate in recycling. Facilitating tax schemes for local and international enterprises importing recycling equipment could proactively encourage investments in Africa's circular textile economy.

Also, there is a need for government and private institutions to invest in technology and research to make the fashion industry sustainable, as more research is needed on natural dyes and techniques that require less water use. Finally, regulatory measures that hold people accountable for how they dispose of their textile wastes are also encouraged.

CONCLUSION

According to a Textile Exchange [69] report, in 2021 we witnessed a sharp increase in global fibre supply to 113 million tonnes. This means higher consumption of energy and water in production and higher agricultural pollution. With these challenges and the

unsustainable consumers behaviour, more textile waste is created.

Although the introduction of SHC as an alternative to reducing textile waste is beneficial in providing affordable clothing, shipment of poor qualities that cannot be sold further exacerbates poverty and hinder development, particularly in Africa. For example, the Gikomba market in Nairobi, Kenya, and Kantamanto market in Accra, Ghana, are the two largest African markets for used clothing. Every week, millions of used clothing appear on the markets. Almost half of it is considered garbage and disposed of in already overburdened landfills. Such an accumulation of textile waste creates health problems. It clogs riverways and drainage systems, leading to floods, contributing to harmful greenhouse gas emissions, and hampering other efforts, such as poverty reduction strategy.

On the other hand, these scenarios provide many opportunities for the development of large-scale regeneration and recycling facilities, which has significant positive implications. The fight for a growing textile industry in Africa is becoming more compelling with the potential for job creation and skills advancement. A circular fashion economy is the key to a vibrant, inclusive, and resilient fashion industry that needs African entrepreneurs, tailors, and designers to take the lead in developing the required skills and models.

This mini-review has found that value additions for recycled textiles are receiving some attention, but only in a few countries, mainly in East, South and North Africa. This finding highlights that textile waste in Africa needs to be rethought as a factor that degrades the environment and as valuable items that can serve as sources of raw materials for the production of new clothing.

The review also highlights that waste disposal in landfills is an economically inefficient option and a valorisation approach with many negative environmental impacts. These negative impacts require the establishment of larger-scale systems that collect waste textiles separately from other types of garbage for efficient recycling. These systems should involve all stakeholders, followed by more education on the importance of textile waste recycling.

A survey of textile recycling enterprises in Africa for this mini-review revealed that there are no formal textile recycling facilities in West and Central Africa, although Nigeria is on the verge of duplicating the Africa Collect Textile (ACT) model in Lagos. In addition, although Ghana has one of the biggest used clothing markets in the world, and education on fashion upcycling has begun in the country, this research did not identify a formal textile recycling facility. These shortcomings provide an opportunity for stakeholders, particularly in West and Central Africa, to rapidly develop recycling solutions to improve the environment and create economic gains. In addition, smaller regions that do not have capacity to engage in large-scale recycling activities compared to Kenya, Tunisia, South Africa, and other developed countries could recycle second-hand clothing or reprocess into new garments or decorative items to maximize the value that can be extracted from textile waste.

This study faced several obstacles due to major data limitations and a lack of statistical information on textile recycling. The data limitation prevented the mini-review from reporting the amount of textile waste produced per person and the quantity and quality of waste generated and recycled from households, commercial and manufacturers. Additionally, this mini-review is limited in scope. Future researchers are encouraged to expand the scope of the review to investigate individual countries and recycling companies. This would expand the limited literature on textile recycling in Africa and our understanding of waste generation and composition.

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