

Circular Economy in Fashion and Textile Industry Via Different Stakeholders: A System Towards the Environment Sustainability

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(Received 18 February, 2023; Accepted 4 May, 2023)

ABSTRACT

Fashion industry has been working on a linear economy model since its inception. Linear economy model leads to generate a lot of waste and creating pollution. Fashion industry needs to be slow and circular in order to maintain its sustainability. The transition from linear to circular economy can neither happen immediately nor individually. There is need of strong will, out of box researches, technological advancement, effective industrial collaboration, strict governmental policies and appropriate awareness among consumers to make this transition easier. There is a dire need of multidisciplinary approach as well as inter industry collaboration for gaining complete circular economy in fashion industry. This paper discusses about how each stakeholder from manufactures to consumer are responding and taking action towards this transition from linear to circular. This paper also analyses the challenges and the way ahead for these challenges.

Key words: Circular fashion, Waste management, Sustainable fashion, Covid, Circular economy, Textile and fashion

Introduction

Fashion industry is one of the top industries in terms of providing employment and contributing to national income of any country (Sharma and Narula, 2020). Despite its positive impact on nation's economy, it is considered as one of the most polluting industry and source of various harmful emissions. Fashion industry have gained the second position in the world for consuming water. A set of cotton jeans and t-shirt takes about 2700 gallons of water (UN, 2022). It is not only utilising the non-renewable resources inappropriately but also indulge in producing lots of waste (Bick 2018). Several recent environment conventions like COP26 also emphasised the harmful impact of textile and fashion industry (UNFCCC, 2019). Various government

organisations of the world are coming with stronger policies (Ghatak, 2019 and Guyen, 2021). The United Nations Environment Program have released a charter for fashion industry which have a very strong commitment to reduce and to reach the net zero the emissions by 2030 and 2050 respectively (UNEP, UNCCC 2021). Recent pandemic COVID 19 also gives an indication to rethink about the strategies and planning of textiles and fashion industry. It has been reported that 83% orders had been wholly or partially cancelled due to pandemic, means lots of waste generation (Khurana, 2022). G-20 workshop discussions also concluded that how COVID 19 pandemic amplified a need to transition of linear model of fashion industry into more circular model (European Union, 2021). Incorporating circular model in fashion industry helps to attain the goal of

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sustainability as it is covering several SDG goals directly or indirectly (UN, 2015). Unlike Sustainability, which covers both the social as well as environment dimension circularity covers only environment aspect. The idea of circularity firstly appeared in 1966 while the term circular economy firstly coined in "The Economics of Natural Resources" journal. (Ghorbanpour and Hossinpour, 2021). The concept 'circular fashion' was firstly used in 2014. The market size potential of circular fashion was estimated \$5 trillion in a circular fashion summit. Circular fashion works on the principle of cradle to cradle while linear fashion works on cradle to grave approach. Cradle-to-cradle refers to a production process where products are developed for closed-loop systems in which every output ingredient is safe and beneficial. The main concept of circularity lies in using renewable organic and recycled material. This also requires a technology upgradation. As we suddenly cannot replace these yearlong practices of manufacturing textile and garments and designing textile to reshape the industry but we can apply some basic principles of circular economy i.e., Reduce, Use of biobased material, Reuse, repair, Upcycle, recycle, recover. The steps to make textile industry completely circular we have to include all areas of textile and fashion industry start from fibre to the final disposal of the garments. The fashion industry mainly covers the 4 major industries i.e., textiles industry, apparel/garment industry, fashion retailing and fashion marketing. As a single entity fashion and textile industry can be categorised in 6 stages in terms of material processing, designing, product development, retails, consumption and post consumption stage. It can also be categorised in 2 broad categories Material design and product design. Materials design includes fibre preparation, yarn preparation, weaving, knitting and other wet processes such as colouration and finishing of fabric while product design caters the fashion industry such as designing, pattern cutting, and garment construction, distribution, retails and use, collection and sorting. To obtain this circular economy model, there can be two type of factor, i.e internal or external factor, which can hamper or accelerate the movement towards achieving the circular economy concept in fashion industry. The internal factor which is generally in under the control of the factory is called the internal factor such as designing, Selection of raw material and price range while the factors which generally out of control is called as exter-

nal factor. Government regulations, political regulations economic and environment cons, cultural difference comes under the external factors. Circularity in textiles and fashion can be achieved through different set of goals. Some can be of short-term goal and other can be of long-term goals. The goals for achieving circularity can be divided in the short term as well as long term goals. Short term goals can be effective use of resources in terms of recycling and upcycling, use of biobased material. While change in machinery and mechanism, behaviour changes of the consumers can be considered as long-term goal. Dream to achieve circular economy in fashion and textile industry can only be achieved, if different stakeholders of the industry like government, researchers, private business model (brands and designers) and consumers should work together. This review paper discusses about the steps for incorporating circular economy concept in different stages and via different stakeholder of fashion industry. This Paper highlights the stakeholder of each segment of fashion and textile industry such as fibre industry, yarn industry, fabric industry, garment industry. This paper also covers the role of government, researchers and designers and brands individually.

Circular economy concept in textile Fibre industry

It has been reported that more than 100 million tonnes of fibres produced for textiles and more than half of it goes to the landfill with a little fraction recycled (Anonymous, 2022). Synthetic fibres have a major share in textile fibres market, i.e. 69%, whereas natural fibres comprise a very small share (Muthu, 2020). Some companies related to fibre processing have taken the initiative to move towards the circular economy concept. "A new cotton" initiative is using the fibre regeneration technology for regeneration of fibre (New cotton project 2022). Recovery of chemical related steps during synthetic or manmade fibre manufacturing is also important for moving toward the circular economy. recovery can be done at different stage. Some of the research institution conducting the researches on recovery of dyes, chemicals and waste heat. Effective technologies must be assessed and executed (TIFAC, 2022).

Circular economy concept in Yarn manufacturing industry

Yarn is the linear assemblage of fibres. After fibre production through spinning process natural yarns

are made while for synthetic yarn production dope solution is used. Some researches argues that yarn cannot be recycled because a new set of yarn cannot be obtained from a waste yarn (Greenorb, 2022; Rinkesh, 2022). But there is different perspective for applying circular economy concept for yarn manufacturing units. Yarn cannot be recycled, but recycled yarn can be produced by recycling fabric and garments. Yarn manufacturing companies can coordinate with garment industry. From where they can collect waste and recycle it for the new garment production. Various researchers are picking up this aspect of collecting waste and recycling it to usable yarns (Jamshaid *et al.*, 2021). Usha Yarns Ltd company is conducting such kind of initiative. They are using the waste from garment industry (pre consumers garment cutting waste, polyester from recycled pet bottles) and proceed it in to new coloured knitting yarn having no need for dyeing (Usha Yarns, 2022). This processed yarn can be used to make new fabric and other textile products. Thus, the waste is reclaimed into new coloured yarn with no dyeing, which is acceptable by different national and interactions fashion brands to make fresh garments. This kind of recycling initiative and responsible thinking help to close the loop thus offer a circularity.

Circular economy concept in Fabric manufacturing industry

Wastage of Fabric during production process can be occurred in two ways. One is during cutting process and other is due to the defects found in fabric which cannot be rectified. It has been reported that in the financial year 2021, 1.8 thousand MT waste has been generated in the pre-production stage (European Council, 2018; CTR, 2018; TWD, 2013 Collective, 2018). Thus, it is necessary to utilise this kind of waste in an innovative manner. Some companies are working in this direction. They are partnering with other companies to initial segregation the waste by colour and composition. Then shredded and recycled with a small amount of polyester then spinning these fibres into yarns (Damayanti *et al.*, 2021). This helps in saving 95% in each garment's water footprint, and 25% in carbon (Superdry, 2022). Marker plan can also be used to minimise the pre-production waste (Enesa and Kipöz, 2020).

Circular economy concept in Wet Textile Process (Bleaching, Dyeing and Finishing)

Wet processing of textile includes bleaching,

colouration (dyeing and printing) and finishing. Besides incorporating aesthetic and functional properties to the garments these processes also generate a large amount of waste and polluted water. Lots of companies have started to replace conventional dyeing process with Zero liquid discharge plant concept. In this regard carbon di oxide can be used as a solvent. The main advantage of this concept is to remove the need of using water but also reduces the need of chemicals. Dyeing of fibre instead of dyeing of fabric is more sustainable spin dye technology helps to attain this concept to achieve the principle of circularity. Several research works are ongoing to utilise plant waste and natural resource for developing natural dye but cost, reproducibility, use of mordant and fixating agent should be considered. Researches are also in progress using natural resources for textile finishes. A researcher reported Utilisation of plant waste for adding functional properties such as UV protective properties into the fabric (Pargai and Jahan, 2018). But commercial aspect of these natural products has still required some explorations.

Circular economy concept in Garments and Apparel Industry production

In the garment and apparel production stage, pattern making and garment construction are the important process. Traditional Pattern making is a very time-consuming process and traditional method also leads to the lots of fabric wastage. Draping the pattern directly on avatar provides various properties like colour material, fabric, comfort, fit simultaneously. Use of these pattern making software Software's like CLO 3D (earlier marvellous designer), Tuka tech 3D, V-stitcher by browser, Style 3D and Optitex PDS etc. not only saves the time but also maintain the accuracy of the pattern without wasting the fabric on multiple toiles. In garment industry various steps could be taken to incorporate circular economy concept like use of marker plan (for avoiding pre-production waste), development of digital showrooms, use of swatch cards for colours, increasing resale, garment bank concept. Improvement in quality also ensures the circular fashion as faulty products often lead to landfill. Improvement of quality mean extending the life of garments, buying only what we need. It has been reported that if the life of a garment has been extended to only one year this can be done by securing buttons using button whipping machines and must

use of care labels. Faulty fashion products can also be collected by some organisations and should be resold to the needy ones.

Role of Fashion Brands for transition towards circular economy

Fashion companies have yet to re-imagine their production processes from cradle to cradle. Several renowned fashion brands have started working on attaining the goal of circular fashion Brands are choosing out a way to utilise the waste without being sacrificing the design and style. They are trying to explore the dimensions of circular fashion like use of biodegradable material as well as recycled material, producing durable products using recycled material. Even several brands have started to donate their funds to clean up the ocean and reforestation. Some brands like ABCH are working on eliminating waste in overall three stages i.e. pre-user, user, and post-user phases (ABCH, 2022). It has been reported that more than 10 million shoes have been produced by Adidas using recycled ocean plastic as well as from use garments (Adidas, 2022). G Star Raw Denim uses bionic yarn which is developed using recycled bottles (Star denim, 2022). MUD Jeans Ocean project of Ecoalf is based on upcycling of marine waste into high quality thread by collaborating with Fisherman (Mud Jeans, 2022). Aoife bags and handcrafted also based on regenerated material from fishing nets and discarded fabrics (Aoife Bag, 2022). Some brands offer discount on the next purchase on donation of old items. Náz, a Portuguese label partnered with other factories to utilise the discarded textiles and garments. Naz basically worked on single-fibre rescued yarns which is biodegradable and more adaptable to utilise for further uses (Naz, 2022). Etiko involves in fair trade practices and offers a take back program for its footwear. They are giving discount on next purchase and created furniture from the waste (Etiko, 2022). H&M is also trying to change its philosophy from fast fashion to slow circular fashion. It is totally changing its model even stores accept old garments and provide a credit for that (H and M). Puma also offers the circular shoe wear. Puma also launched its first Mile collection which is also based on plastic waste recycling which is truly sustainable as it also caters the local people living (Puma, 2022). Ten trees apparel also provide a cradle-to-cradle certification and plant 10 tree for every purchase (Ten Tree Apparel, 2022). Some brands are working on

Made on demand model which removes the inventory waste issue. Made on demand model can be adapted to make economy circular in textile and fashion industry. R collective mainly work on this made on demand model They also work on top quality waste material such as cashmere, lyocell and super-soft nylon (R Collective, 2022). Some brands like Minimalist are working on keep the no. of components in each garment as low as possible. Its emphasis is on make Complete design process suitable for Supporting local factories (Minimalist, 2022). Seven-day brand also limits the release amount of chemicals water and waste. Utilise the waste fabric and all for its new creation (Seven day, 2022). Prada is also covering the sustainability aspect while collaboration with local art and culture group (Prada, 2022). Fast fashion can be discouraged to target durable clothing with higher quality enabling long term use through brand commitment and policy. Some brands like are working in this direction. Some Brands imparting several services such as take back, renting, repairing and donating to maintain the cyclability of the products (Levi, 2022; Funky Kalakar, 2022; Etiko, 2022; My wardrobe HQ, 2022). Brands such as Inditex, Gap, OVS, H&M and VFC are claiming that they have implemented different techniques for conserving water such as conserving rain water. They are also doing regular testing of waste water in terms of chemical composition in compliance with international laws. Tommy highflier brand also claimed that its denim garments is being manufactured using lower impact finishes. Brands are doing wonder job to provide smoothness in this transition but green washing should be avoided in this regard, where false data and terminologies can be provided to look more sustainable.

Role of Fashion Designers for transition towards circular economy

Fashion designers can play a major role in transforming the economy from linear to circular economy. A study reported fashion designers could take up three roles in the transition process: *preventing (sustainable design)*, *facilitating (Co-design)*, and *advising (Transformation design)* (Dan and Østergaard, 2021). It is required to develop the necessary skills and knowledge of circular economy. As designers have social power and status to change the decision power of consumers help to realise and contribute towards the full potential towards circular economy. It is necessary to sensitise and prepare

the future designers for the new upcoming roles in incorporating circular economy concept in fashion industry. Fashion designers can work as a role model to create awareness among consumers in this regard. Some designers like Mc cartney, Silverstein, Eileenfisher, Hearst and Fiedler are working on circularity aspect (Mccartney, 2022; Silverstein, 2022 and Eileenfisher, 2022).

Role of consumers attitude and behaviour for transition towards circular economy

Efforts of all stakeholders can become a wastage if there is absence of awareness and sensitisation among consumers. There is a need of change in the attitude of consumers towards the fashion regarding usage of clothing. Production is always proportion to the demand as the consumer demand for cheap and fresh fashion products have been created a large amount of waste. For engaging the consumers towards circular consumption systems, it is necessary to create environment sustainability awareness (Giovana *et al.*, 2022). Transition towards circular economy includes behavioural changes and understanding of all the aspects of circular consumption. (Botelho *et al.*, 2016; Calvo and Levy, 2020). KPMG 2019 reported that consumers give preferences to price, value, size, quality style rather than on environmental factor. If anything, attract the consumer, they generally don't want to think about the production process chemical use and pollution (KPMG, 2019). The cycle of fast fashion can only be broken by conscious choice of consumers. But Recent covid pandemic give insight to the consumer and give a new perspective to the choice of consumer from now onwards they as well enhance their interest towards sustainable fashion and adoption of sustainable practices. KPMG, 2022 reported that consumers are becoming aware about the sustainability aspect and it also becomes an important criterion while purchasing the products (KPMG, 2022).

Role of government initiatives for transition towards circular economy

Government interventions is always required for adoption of any system at larger scale. Government can play an important role in transition from linear to circular economy. Government can also regulate the policies related to designing, production, consumption and Usage (Dissanayake and Weerasinghe, 2021; Hina, 2022). Government prior actions such as stringent regulations and law such as

tax on unsustainable practices and use of virgin materials can divert the new business models towards the circular economy system. Similarly rewards from government such as decrease taxes on secondary raw materials can be introduced for adoption of circular economy practices. Government can also encourage different stakeholder for introduction of new technologies and technique for effective transition to circular economy. Setting of high technical standards is also required field to encourage the organisation to make necessary changes as per the requirement (World Economic Forum, 2021). Government should be supportive specially to micro and small level units in this regard as this transition could create a lot of administrative burden to them (García *et al.*, 2017). Various training facilities and awareness campaigns can also be conducted and monitored in this regard.

Role of researchers for transition towards circular economy

As the penetration of circular economy into the fashion and textile industry is not very old. Thus, there is a demand of lots of research data as well as search towards new technology to implement it successfully. The modification in existing system can also be done through different researches. There is no. of aspects such as economic, waste generation (recovery and recycling) and consumer behaviour which can be covered through researches. Under economic aspect researches can be done on costing such as cost of collection, sorting, transportation, and machinery. What will be the final benefit for the particular region in terms of employment. Researches can be done on analysis of waste generation and compositions in terms of chemicals and microfibers. Researches can also be conducted to minimise waste. In this regard researcher have been conducted on creating a marker plan for garments industry to minimise cut and sew waste problem (which is also called as waste during production time). Marker Plan can be made by considering several factors such as symmetry, type and width of the fabric (Enesa and Kipöz, 2020). Researches on study the behaviour of consumers regarding consumption, usage (timing) disposal behaviour (Eléonore and Dalhammar, 2019) be done to create awareness among consumers. Several companies like VFC, H&M, gap, OVS are working on reducing hazardous chemicals, single use plastic as well as using of water saving techniques. Researches on different

topics such as separation of different categories of fibres, advancement of AI and robotics to identify and sorting of products according to the category are ongoing (Chauhan *et al.*, 2022). Researches on how to maximise the product life as well as how to minimise the washing by using anti-soiling finishing has started on experimental level (Cooper and Claxton, 2022).

Conclusion

Recent pandemic and conventions on climate change create an urgent need to reshape the fashion and textile industry from circularity point of view for its sustainability. Every stakeholder from industrialist to researcher of the fashion and textiles industry could play a very significant role in this regard. Not only the conduction of researches on technology and design upgradation for circular economy is enough but the creation of new business models is also necessary to expand the circular economy. The greenwashing practices and generation of false data should be avoided by the brands to realise the actual transition towards economy. There should be a cohesive legislation for checking this type of misleading practices by brands or designers. Consumer are also an important stake holder in the transition of fashion industry towards circular economy. The main idea is about to change the consumer behaviour regarding their buying, wearing and discarding a textile or fashion product. Transition toward circular economy is only possible by conducting innovative, contemporary researches while maintaining the high-quality design standards among all stakeholder of fashion and textile industry.

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