

Designing Sustainable Multifunctional Children's Wear based on Zero Waste Concept: A Study in Context with Indian Children Wear Market

Pramod Kumar^{1*} | Neeraj Rawat Sharma²

¹Ph.D. Scholar, Banasthali Vidyapith, Rajasthan, India.

²Assistant Professor, Department of Fashion Design, Banasthali Vidyapith, Rajasthan, India.

*Corresponding Author: pkp091174@gmail.com

ABSTRACT

Children's clothing is a noteworthy area of the fashion business that contributes significantly to environmental degradation because of the fast growth rates that require frequent garment changes. As a result, more resources are used and more textile waste is produced. Innovative strategies that blend sustainability with pragmatism are needed to address these issues. In order to reduce environmental effect and meet the changing requirements of kids, this research study investigates the design and development of sustainable, multipurpose children's apparel using zero-waste principles. Children's quick development leads to a high garment turnover rate, which adds significantly to textile waste. Traditional methods for designing and making clothes can result in large amounts of fabric waste, which exacerbates environmental issues. In response to these concerns, sustainable fashion has surfaced, focusing on waste minimization, ethical production, and environmentally favourable materials. Specifically, zero-waste design, which removes textile waste during the design phase, has drawn interest because to its potential to lessen the environmental impact of clothing manufacturing. Nonetheless, not enough research has been done on the use of zero-waste concepts in children's apparel. Furthermore, adding multifunctionality to children's clothing can increase its usefulness and benefit customers in both practical and financial ways. By creating multipurpose, sustainable children's apparel designs that follow zero-waste principles, our research aims to close these gaps.

Keywords: Children's Clothing with Sustainable, Eco-Fashion, Zero-Waste, Multi-Function, and Convertible Designs.

Introduction

The children's wear area of the Indian garment industry is regarded as one of the most design-focused sectors. The need for children's apparel is fast escalating, as parents often purchase items every three to four months for their offspring. The demand for children's clothing is rising due to increased parental income, rapid urbanization, improved living standards, and, most significantly, children's awareness of branded apparel in today's digital age, prompting them to request garments that align with their preferences and tastes. Creating multifunctional children's garments may contribute to sustainability objectives, so aiding in environmental preservation. The versatile children's garments that can be recycled and decomposed at the conclusion of the outfit's lifespan. The design of multipurpose Children's garments are versatile items designed for multiple uses, enhancing functionality to extend their lifespan and reduce waste, thereby addressing the issue of excessive consumption in the children's apparel industry. The Eco-Fashion design standard may be applied in the creation of children's apparel by employing recyclable resources (natural and organic materials) and incorporating zero waste multifunctional elements, allowing an old outfit to be reused and repurposed into convertible gear. A garment outfit can be designed as a jacket with or without sleeves, a sleeveless vest, overalls, shorts derived from pants, a dress, or even a carrier bag, all aimed at promoting environmental conservation, health considerations, practical and aesthetic needs, and also ensuring sustainability.

Literature Review

The current situation has led to a huge migration of local and multinational retailers and manufacturers to India, the second-largest country in terms of population, particularly among children. This has caused the country to emerge as a global hub for children's clothing. The children's clothing market is booming, thanks to the efforts of several well-known brands and designer labels. The most recent trend in India's apparel sector is a shift away from disorderly setups and toward more structured retail. [1] Several causes in India have contributed to the surge in demand for children's wear apparels. Living standards rose across the country as a whole as a result of parents' greater income, from metropolitan cities to semi-urban areas and rural areas. Nowadays, kids are more savvy about branded apparel because of the continuous digital era and rapid urbanization. Parents no longer have the power to force their preferences on their children.

On the children. Consequently, there has been a meteoric rise in the demand for children's clothing in India during the past 20 years. [2] In order to attract children's attention and meet their biological and psychological demands, children's products should be produced and designed based on their actual needs, creative concepts, and unique looks. [6] Advocacy from parents and peers, in addition to brand names, has a significant influence on the clothes and apparel purchasing behavior of girls aged 10 to fifteen. Community support is the next step for the girls in this age group when it comes to choosing an outfit. [4] Color is one of the most influential variables in children's purchasing behavior, it's important to use vibrant colors while creating so that they can feel happy and fulfilled.[8] The materials used in children's garmenting must include phthalates and formaldehyde due to color dyeing, and several researchers have discovered further connected concerns with this practice. All trim attachments, and buttons in particular, should have sharp edges and at least two stitches for safety. Embroidery or any kind of printing might be practical alternatives to beads and sequins for toddlers (children up to 2-5 years old). Avoid using drawstrings or cords on children's clothing until they are at least six or seven years old.

Zero Waste Fashion Designing

The perception of 'Zero Waste' is related to producing items that leave no extra additional material to unwanted leftover, and therefore minimizing the amount of waste materials from the production process that repeatedly end up in landfill and subsequently add to the pollution of the globe. Eco-fashion and sustainable fashion is the creation and development of fashion products utilizing recyclable, reusable, natural materials that might have a less negative ethical and social impact as well as an environmental one. [11] Zero-waste is the state of an item or manufacturing process that eliminates waste products. Zero-waste apparel or cloth is meticulously created in the fashion clothing and apparel production sector to prevent and remove wasting materials so that no fabrics and textiles are thrown of.[19]

Main Needs for Zero Waste Fashion Design

A greater understanding of the importance of ethically sourcing clothing and accessories manufactured from sustainable materials is being fostered by the growing eco-fashion and sustainability movements. [23] The negotiation of the zero-waste fashion design process is governed by five primary criteria: aesthetics, fit, fabric waste, cost, and manufacturability. These are contingent upon context. Different criteria may be suitable in various circumstances, and their significance may vary based on the context and the phase of the design process. Nonetheless, the reduction of fabric waste must not serve as a rationale for compromising aesthetics or fit, nor should it lead to an excessive rise in manufacturing cost.(24)

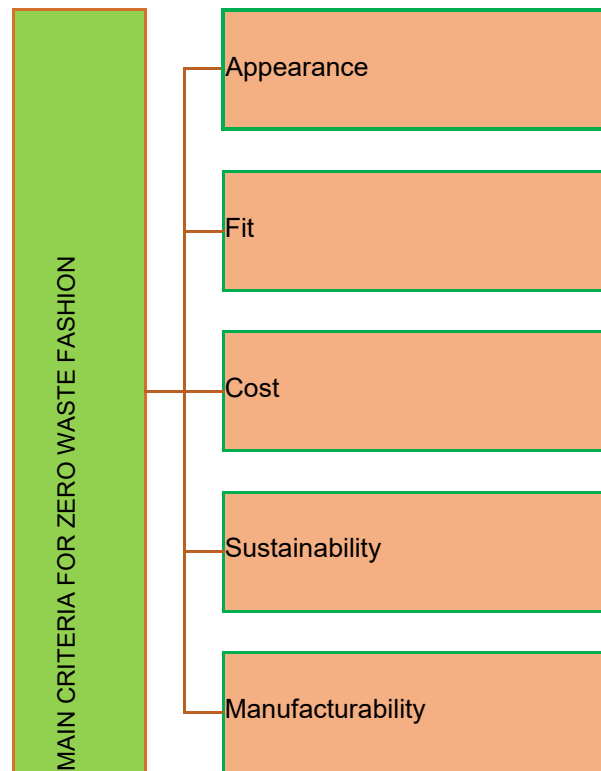


Figure 12: Timo Rissanen, Holly McQuillan

- **Aesthetic Appearance:** The garment appearance should be aesthetically pleasing to the consumers.
- **Garment Fit:** The garment should be fit and comfortable according to the body size.
- **Garment Cost:** Cost of the garment should make the retail price of it more feasible for the customers.
- **Sustainability:** The concept of sustainability in Zero waste fashion design need to move beyond singular solutions and integrate with other solutions to enrich and engage the experience of fashion for everyone, from the industry to users of fashion.
- **Manufacturability:** Zero-waste fashion design has the potential to bring the fashion design and manufacturing industries closer together. New problems emerge from the current fashion industry when designers think about ways to reduce fashion waste. With zero-waste fashion design, the fashion system's hierarchies might be transformed, which could have good effects on design and manufacturing.

The Multifunctional Outfits Design

The concept of designing clothes and outfits in such a manner that they may be worn and used in a variety of different ways and under a variety of conditions was known to as the multifunctional garments design. This design concept aimed to increase the usability of the clothing and outfits. These clothes and apparels are capable of being transformed and converted according to the requirements of the wearer, and they may also be utilized for a variety of activities. The concept of multifunctional design not only makes clothing and attires more interesting, but it also extends the lifespan cycle of the garments. The proper functional closures, like as zippers, Velcro, buttons, snap-button closures, and other fasteners, can be used in the components of the garment to build or deconstruct the garment in order to give it a novel aesthetic look and to provide comfort to the person who is wearing it. [13]

Multifunctional clothes consist of many clothing components that can be worn in multiple configurations and fulfill diverse extra functions. These clothes are designed to function more effectively

with fewer components. Garments are enhanced with material straps, ties, buttons, and closures, facilitating diverse wearing options. [15]

In producing multifunctional children's clothes, numerous crucial factors must be considered during the design process. The fabrics, crafted from sustainable raw materials and employing appropriate production techniques, possess the capacity to significantly enhance the creation of multifunctional clothes. Comfort and fit primarily address the end-user's needs and desires, influencing the conceptual design, material selection, and garment silhouette development. This individual perspective on apparel creation significantly contributes to the overall well-being of the wearer. Ergonomic fit pertains to the ease of bodily movement, which is essential for ensuring optimal mobility during the garment production process. Comprehensive design research regarding user needs is essential for understanding contemporary fashion trends, consumer behavior, and responses to multifunctional garment designs, which will aid in the selection of suitable raw materials and facilitate specifications in the design of new children's items. The assessment and evaluation of all ideas and alternatives are crucial for achieving superior outcomes and avoiding frequent pitfalls in the development of design concepts. The prototype design will be executed through trials that meet all specified requirements, leading to the final formal designs. All relevant specifications regarding design, materials, and other factors will be documented to facilitate mass manufacturing of the design. [11]

Research Objectives and Problems

The children's clothing industry in India has grown to a \$16.4 billion worth in the past fifteen years. Until the end of the fiscal year 2026, experts anticipate the children's clothing market will reach \$22.53 billion, thanks to a CAGR of about 5.87%. (9) - TSRR 2016 published. There is no sector of India's children's wear market that has grown at a faster rate than the children's wear market in recent years. There are 375 million people in the country under the age of fifteen, which is a large portion of the population and one of the main reasons why the children's clothing market is growing. The demand for children's clothing has been on the rise in recent years, thanks to parents' increased purchasing power brought about by robust economic expansion. [17] The proliferation of mass media like satellite TV and the proliferation of organized retail stores have raised middle-class consumers' awareness of fashion and brands across the country, from major cities to smaller towns and even rural areas. The annual production of clothing units has risen to around 100 billion, which is equivalent to thirteen times the world's population. Customers' purchasing habits have shifted due to the fashion revolution. Due to the rapid changes in fashion, the majority of consumers discard their clothing after only a few uses. When it comes to the amount of materials used, the fashion sector is second to none when it comes to industrial pollution and its negative effects on the environment.

This study has the potential to shed light on the creation of multipurpose children's clothing that adheres to eco-fashion design standards, maximizes the use of apparel and garments for longer periods of time, and reduces cloth production and product dumping. This study primarily seeks to

- To determine what components make up children's multifunctional apparel that adheres to the zero-waste idea and makes use of sustainable raw materials.
- Using criteria such as ease of use, practicality, adaptability, and comfort, choose the best design for children's multipurpose apparel.
- To learn how well-informed the end-users (kids and parents) are regarding the idea of multipurpose clothing.
- Creating a line of eco-friendly, multipurpose children's wear utilizing sustainable materials.

Research Methodology

Multifunctional garments that adhere to eco-fashion design standards and the zero-waste idea have been the subject of quantitative research. The research goals and objectives were met by collecting and analyzing all relevant primary and secondary data. Through these data collecting, we sought the consumer's opinion on their understanding of multifunctional clothes, designing to meet demands, and the newest fashion trends and styling. The final product realizations were aided by the obtained data. Using a set of questionnaires, researchers were able to collect data on consumer awareness (parental and children's) regarding the practicality, aesthetics, and technical aspects of children's multifunctional clothing. A total number of 112 respondents were surveyed (online and offline). Feedback and surveys were administered both online and offline to a variety of malls, shopping centers, and other gathering places to gauge the extent to which respondents understood the zero waste idea as it pertained to children's clothing and the importance of eco-fashion standards in the design process. The final steps in

developing the product range included sketching up designs, toile draping, first pattern drafting, and developing prototypes using less expensive fabric options. This allowed us to achieve our product goals and produce high-quality research results.

Data Analysis and Outcome

An evaluation of all the data that was collected as well as other observations that were related to it was carried out, and the findings revealed that consumers (parents) are not very knowledgeable about multifunctional clothes, and that only a few brands are selling them. The result also demonstrates that the majority of consumers are concerned about excessive consumptions of products that have a negative influence on our world and environment, and they want to express their support for the notion of sustainability. Furthermore, they have demonstrated their interest in purchasing more multifunctional products. Clothing for their children, given that the outfits are aesthetically pleasing and useful, that they can be worn easily, that they provide better comfort, and that they are within their financial means to purchase. The majority of the people who participated in the survey were males, and the majority of them had at least three to four times a year that they went shopping for their children. There were either one or two children in their families.

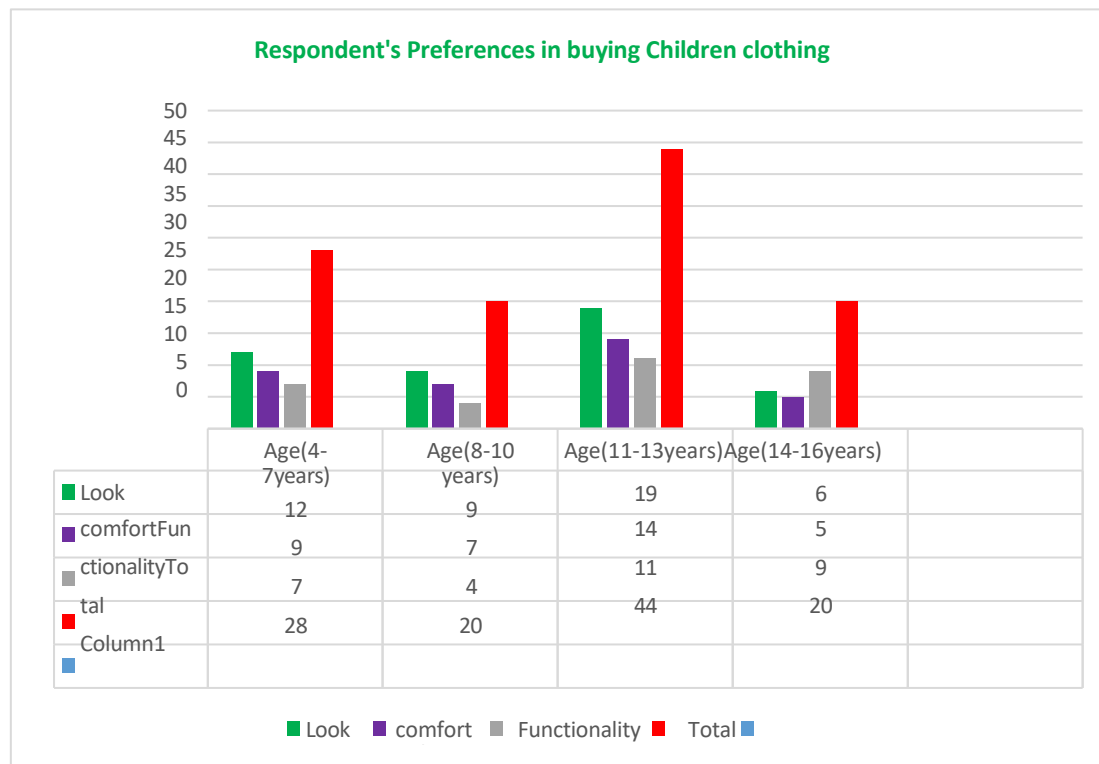


Figure 1 illustrates the preferences of respondents about appearance, comfort, and functionality in garments while purchasing clothing for their children.

The results of the study, which are depicted in Figure 1, also demonstrate that parents and children between the ages of four and thirteen years place a greater emphasis on the aesthetic looks of the garments than they do on the comfort and functionality of the garments. On the other hand, adult children and their parents prioritize functionality over comfort and the aesthetic look and appearance of the garments when they are shopping. The majority of the 27% of respondents who have information and awareness regarding sustainability, the notion of zero waste in fashion, and eco-friendly fashion design have gained this knowledge and awareness from reading fashion magazines, newspaper articles, and the internet. There is a possibility that the findings of the study will encourage more people to purchase more multifunctional clothing for their children, as well as to encourage them to contribute to the preservation of the environment, the preservation of nature, and the saving of the world for future generations.

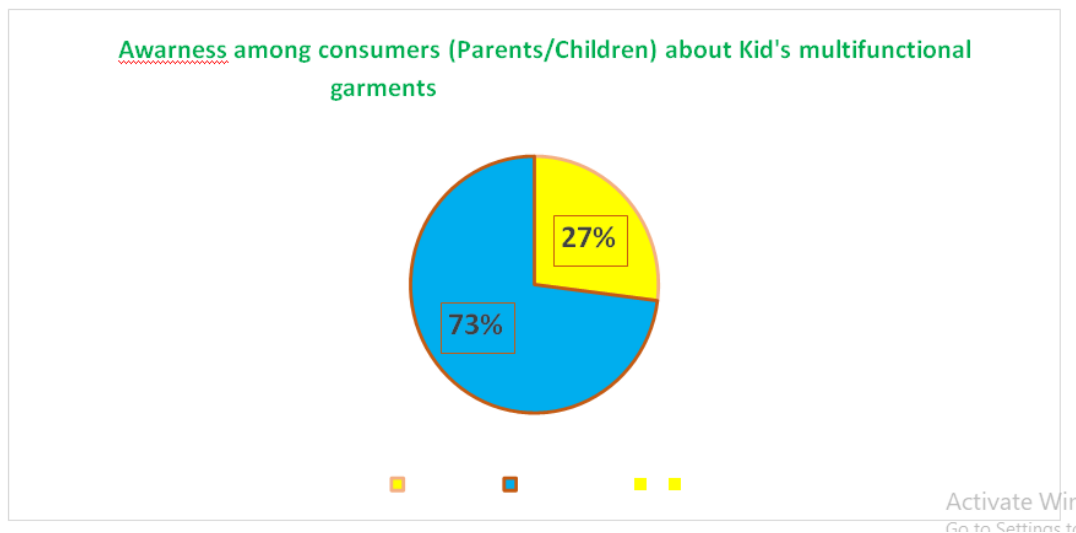


Figure 2: Percentage of Respondent's Awareness about Multifunctional Children's Clothing

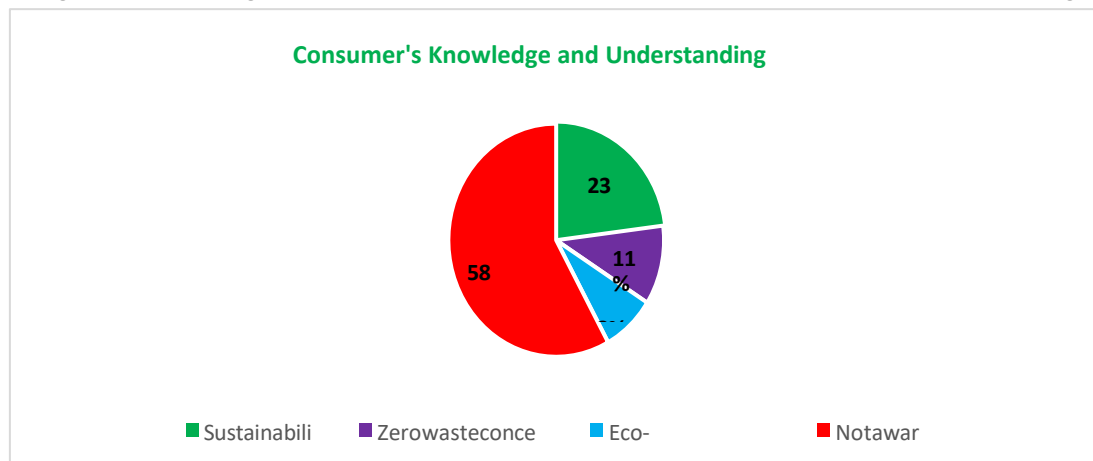


Figure 3: Proportion of respondents' awareness and comprehension of sustainability, eco-fashion standards, and the zero waste idea in children's garment design

Product Line Design and Development

The development of the product line commenced with the researcher's initial conceptual sketches, which sparked the design development process. Initial flat sketches were created using standard measurements and sizes. Construction details, embellishment details, trims and accessory details, and fabric details were worked out for the final garments that were developed based on these sketches. Pattern-drafting and draping techniques were used to bring the conceptualized designs to life. The girl's outfit and jacket were mostly constructed from 100% organic cotton fabrics, with the linings made of 100% cotton. The four distinct multipurpose options were created for both sexes. This versatile pant design is perfect for boys aged 6-7 years old. It features a detachable zipper for easy on-and-off wear, making it perfect for everyday wear. Short pant as needed by removing the bottom portion of the pant. Its prototype was a twill fabric made entirely of organic cotton. Similarly, the voile fabrics used to make the pocket bags were 100% cotton. To further enhance comfort and wearability, snap metallic buttons are added to a slit. In order to give the designer a better concept of how it would look as a finished garment, a technical sketch was also created.



Picture-1 (A)

Image 1: The detachable boy's pants can be transformed into shorts utilizing a zipper, crafted from 100% organic cotton fabric



A (Dress)

B (Skirt)

C (Top with adjustable Height)

Picture 2: Girl's dress can be worn as a dress, skirt, and tank top as shown in images (A B & C)

The second piece of clothing is the Girl's dress, which allows the wearer to wear it as a dress, morph it into a skirt and a tank top, and wear it as daily wear clothes. Cambric cloth has been woven from organic cotton that has been printed in its whole. The structure of the dress includes the use of self-fabric straps, plastic buttons, and a concealed zipper attached to the side. A final look was achieved by applying the techniques of draping on the dress form in order to achieve the desired fit and appearance. Linen fabric made of 100% cotton voile is used in the construction of the dress.

The boy's detachable long jacket, depicted in picture-3, can be converted into a waist-length jacket using a zipper and snap buttons. The lower portion of the jacket is removable and can be reattached by the wearer as needed for different occasions or situations. The jacket was constructed from 100% bamboo fiber fabric, while the inner lining was made of lightweight 100% cotton poplin fabric. The interior of the jacket is constructed with a cotton fiber sheet utilizing a quilting technique. The jacket features a plastic zipper and side snap buttons for closing. The garment design is unisex, suitable for both boys and girls.



Picture 3: Unisex Jacket



Picture: 1A (Front)

Picture: 1B (Back)

Picture: 1C (Bag)

In Picture 1 A, the multifunctional girl's skirt, crafted from 100% organic cotton twill fabric, is created for girls aged 10-12. It may be worn as a skirt and converted into a clutch bag for storage purposes.

Table A: Materials details used in Girl's Skirt

Garment Component	Fabric compositions	Remarks
Skirt's Shell Fabric	100% Organic Cotton	Recyclables
Skirt's Lining	100% Cotton Cambric	Recyclables
Trims	Plastic &Metalic Zipper, MOP buttons, snap-buttons, fasteners, cotton-tapes, cotton threads	Recyclables

The entire collection of four children's clothes was designed and produced based on a zero-waste idea with eco-friendly, recyclable materials. The surplus fabric remnants were utilized in the straps and ties of the tops and dresses. In garment manufacture, CAD pattern design and draping techniques were utilized to minimize unnecessary waste in the process.

Conclusion

The research intends to design and investigate a variety of multifunctional children's clothes by changing various garments with distinct roles and features. Diverse strategies will enhance design conversion and adaptability. The multifunctional design strategy will promote the reuse and recycling of clothing rather than their disposal. To improve the garment's flexibility, usefulness, and user-friendliness, numerous design strategies may be employed, including draping, paneling, and folding. Appropriate garments for several occasions and events can be made in accordance with contemporary fashion and trends. The convertible and removable garments will offer consumers numerous alternatives to customize their clothing according to their practical attributes. The issue of waste can be mitigated by the wearer through the combination of multipurpose clothes in various styles. Multifunctional children's apparel can be recycled and reintegrated into the economy, so reducing landfill space, cutting carbon footprint, and positively impacting the environment and our future. The eco-fashion design standards will assist the garment design team in identifying recyclable, reusable, and less detrimental materials that minimize harm to nature and the environment. Fashion designers must to prioritize the utilization of recyclable and reusable materials in the creation of multifunctional apparel for children. Fast fashion firms and their manufacturers should prioritize the design of multifunctional garments within their extensive product ranges and educate and inspire their consumers regarding sustainability and environmental preservation.

My Acknowledgements

I would like to express my sincere gratitude to my advisor, Dr. (Mrs.) Neeraj R. Sharma, Assistant Professor, as well as to my family and all others who have contributed, directly or indirectly, to the completion of this research work.

References

1. Prakash M., Ambica, Tripathy V.M., Chaturvedi Nishant ISSN : 0731-6755, Volume XII Issue IX SEPTEMBER 2019.
2. Das and Avik (22.8.2019). "Children's now Change Clothes up to four times in a day" Times Business. Times of India. Pp11.
3. Jill Ross, Rod Harradine. (2004), I'm not wearing that: Branding and young children. Journal of Fashion Marketing and Management: An International Journal. 8(1).pp. 11– 26.
4. Isabel J. Grant, Graeme R. Stephen (2005). Buying Behaviour of teenage girls and key societal communicating factors influencing their purchasing of fashion clothing. Journal of Fashion Marketing and Management: An International Journal. 9(4), pp: 450–467.
5. Pandya, Mehal (2016). Consumer buying behaviour for children apparel: A critical review, international journal of Management, 7 (5), pp 188-199.
6. Riddle, L. & Koksai, M.H., Consumer behaviour and preferences regarding children's clothing in Turkey, International Journal of Fashion Marketing and Management. , 11(1), pp. 1-12, Mar. 2007.
7. Bezerra, G., Carvalho, M., Rocha, M. & Xu, B. Anthropometry for children's clothing: difficulties and limitations, IOP Conference Series: Materials Science and Engineering, pp. 1-8, 2017.
8. Radeloff, D.J., Psychological types, color attributes, and color preferences of clothing, textiles, and design students, Clothing and Textiles Research Journal, 9(3), pp. 59-67, Mar. 1991.
9. TECHSCI RESEARCH REPORT 2016.
10. Nadia Rosli (2018). Today's trends, tomorrow's trash. New straits Times. <https://www.nst.com.my/lifestyle/pulse/2018>.
11. IBRAHIM M.S.R. & Md. Tajuddin (JSSH) vol.5 no. 1, 76-87 April 2021 "Zero waste concept in Multifunctional clothing.
12. Jalil M.H. and Shaharuddin S.S. J. Vis. Art & Des. Vol. 13 No. 1 35-47 multifunctional Children Cloth design On Eco Fashion Design Model 2021.
13. Cunha, J. & Broega 2009, A. Designing Multifunctional Textile Fashion Products. AUTEX 2009: 9th World Textile Conference, pp. 1-10, 2009.
14. Koo, H.S., Dunne, L. & Bye, E., Design Functions in Transformable Garments for Sustainability, International Journal of Fashion Design, Technology and Education, 7(1), pp. 10-20, Jan. 2014.

15. Gong, M & Rahman, O Sustainable Practices and Transformable Fashion Design– Chinese professional and Consumer Perspectives, International Journal of Fashion Design, Technology and Education, 9(3), pp. 233-247, Sep. 2016.
16. Farr, Gam, H.J., Cao, H., C. & Kang, M., Quest for the Eco-apparel Market: A Study of Mothers' Willingness to Purchase Organic Cotton Clothing for Their Children, International Journal of Consumer Studies, 34(6), pp. 648-656, Nov. 2010.
17. P. Poaps & Kang, J. and Park-Poaps, H. (2010), "Hedonic and utilitarian shopping motivations of fashion leadership", Journal of Fashion Marketing and Management, Vol. 14 No. 2, pp. 312-328.
18. GUPTA L. & Harminder K.S. 2020: Achieving sustainability through zero waste Fashion A review DDJM, PAU, Ludhiana India.
19. Ross, C. What is zero Waste fashion design is all about. 26 December Edition 2017.
20. HOGLAND, W., Jani, Y., Hogland M., el (2017): Beyond the zero-waste concept.
21. Hills, C. Gordon, 2015, Sustainable fashion, Present, Past, & Future, Bloomsbury London, United Kingdom 2015.
22. Hethron & Ulasewicz (2015), Sustainable Fashion: Why now? A conversation exploring issues, practices, and possibilities, Fairchild books Inc, New York, p. 207-232
23. E. KABUKCU, E. M. ENSARI, Eco-Concepts & Ethical Issues In Sustainable Fashion Industry: Bemateks-Kids Fashion, Vol. 5 No.-6, March 2016.
24. Timo Rissanen, Holly McQuillan, edition published 2018, Bloomsbury Publishing Plc, 2016, Page 44-52.

