

Advances Towards Sustainable and Eco-Denim Fashion

Sneha Bhatnagar

National Institute of fashion Technology, Mumbai

Abstract:

Denim presently is the most widely accepted textile product and shows it hold even in the future with its growing popularity. Trend forecasts continue to showcase denim as a wardrobe staple. Denim today is diversified in all different product categories. Although denim is considered an expression of youth and demonstrates durability and comfort, denim raises sustainability issues. Sustainability refers to an understanding and practice of a lifestyle in which humans can live in their natural surroundings without harming or causing any damage. Humans have a relationship with the environment and eventually with ourselves and future generations. Few eco-conscious fashion brands are involved in developing ideations and modifications of denim as a fabric or product into diversified sustainable fashion. The indigo denim shows strong potential to adapt to new trends and recovery. Recycling denim waste will set an innovative development of green eco-friendly denim. Through this research article, the researcher aims to address the possibilities of denim fashion promoting environmental sustainability through creativity, awareness, recycling, and artisan appreciation. In conclusion, blue denim fashion will continue to evolve and eventually transform into green denim in the future, nurturing values of both quality and sustainability.

Keywords: Denim, Eco, Fashion, Recycling, Sustainability

1. INTRODUCTION

Global demand for premium jeans has reached a value of \$64.5 billion in 2021. Denim is considered as an essential garment in all wardrobes and has ability to transcend beyond age, gender and location. Primarily high-speed air-jet looms are used to weave denim fabric. Various loom manufacturers offer several modifications to weave a fault-free high-quality fabric. Traditionally denim is 3/1 right-hand twill fabric. Currently, 2/1 twill, broken twill, zig-zag twill, reverse twill, and herringbone twill weaves are used in denim fabrics. Due to its rising popularity and extreme comfort constant innovations and variants are developed in denim. Denim fashion has as strong social economic appeal and hence it has recognized itself as both streetwear and premium fashion fabric. Rising employment, increase in women workforce, emerging economics and diffusion of casual wear in work place are factors boosting growth in the global market for denim jeans. Aggressive promotions of innovative and diversified product range in denim garments are further driving growth of denim in market. Trend forecasts continue to showcase denim as a wardrobe staple. While sun-bleached washes offer a new take on worn-in denim, consumers worldwide still love bleached, stonewashed jeans, jeans jackets, vests and skirts. Shannon Reddy, a Designer and Trend Forecaster at Denim Dudes reported that there is an increased focus on raw materials and their intrinsic properties and fibres like hemp and linen are becoming popular for year round use for sustainable benefits. It is conveyed at the Denim Premiere Vision 2022 held in Berlin that the industry is streaming

ahead to find and implement more sustainable solutions with the rise of natural fibres and sustainability will be crucial for denim brands to withstand the global environment.

The denim manufactures are aware of adverse effects of excessive use of water and potentially toxic dyes and chemicals and hence focus on environment friendly processes. The benefits of a world where humans aren't polluting all the time and the obvious economic inequities that are endemic to the apparel supply chain are both emphasised by the pandemic. A Levi Strauss spokesperson stated that consumers now crave both "value and values". Similarly consumers are realizing that they can detach from the routine of buying every season and can thus align their decision on factors such as durability and conscious consumption. Today when fast fashion is dominating there is a silent but conscious wave and growth of slow fashion. Designers and brands that think and apply their understanding of ethical and sustainable fashion methods that bring no harm to our natural environment, today represent the best that fashion and design can offer.

2. EVOLUTION OF DENIM

Although one of the oldest yet denim is the world's most iconic fabrics. The denim jean has advanced as a symbol of fashion and culture the all over the world and denim is popular across national and cultural boundaries. Denim fabric has remained in wide use in jeans since the 1850s. The city of Genoa rapidly became the world's biggest producer of *serge de Nimes*. Since the French name for Genoa is "Genes," hence the name "jeans" however the fabric gained renewed popularity during the American Gold Rush. Gold miners preferred the durability and reparability of denim-weave cotton, and though other dye colours were widely available in the American West, manufacturers like Levi Strauss continued using the indigo blue dye that Genoa fabric merchants originally resorted to out of necessity. Europe, the United States, and Japan are the major consumers of denim, while China and India, being comparatively younger economies, and are witnessing a firm rise in demand for denim.

Indigo denim, stretch denim, crushed denim, acid-wash denim, raw denim, sanforized denim are six variants of denim. Indigo denim is achieved by dyeing the warp threads with indigo dye and white threads are used as the weft. As a result, most blue jeans are blue on the right side, as the fabric is warp facing, and the interior is lighter blue, almost white. Stretch denim weaves has spandex or another elastic component to give the fabric some added flexibility. Stretch denim is often used for skinny jeans. Crushed denim is treated so that it has a wrinkled look. Acid-wash denim is treated with chlorine and a pumice stone to create a marbled look. Raw or dry denim is fabric is that is not washed after it is dyed. This creates a rougher and stiffer texture. Sanforized denim is treated so that it doesn't shrink in the wash. The denim washing technique softens the raw denim and gives a faded look. It develops effects like colour fading, crinkles, seam puckering, hairiness, de-pilling or softening and feels, etc., as well as stabilizing the product's dimensions because of the shrinkage of the fabric. Since denim constitutes the largest portion of the garments that are washed, the term 'wash' has come to mean the finishing of denim garments. With emergence of Asian countries as denim producer today denim is not any more an American product. Denim is no longer confined to only cotton yarns and indigo colour. Versatile materials, innovative wash effects and colour variants are changing the look of denim. Denim is the only textile that is intentionally scraped so as to look old and faded. Recently stretch denims are preferred and denims now are also manufactured on knitting machines.(Akter, Didar and Hamja, 2015). Although the cotton-only jeans is the most preferred choice however 1% or 2% stretch provides a little extra comfort, and yet maintains all the qualities that cotton lends to classic denim jeans¹. Studies have shown that industrial practices in jeans production have affected the health and the future belongs to sustainable manufacturing. Literature has

proved that current alternatives like burning and landfills harm humans and the environment. Designing and manufacturing are carried out for new product development, and today sustainable product development has become the focus.

3. TREND FORECAST FOR DENIM

Constructing jeans is over a more complex process than the average consumer thinks; it requires special equipment and technology, complex skills mixed with a high degree of creativity, and exceptional knowledge. Many designers create exclusive designs every season and this creative field of design attracts many designers each season and consumers interested in this global product. It gives renewed meaning to the old denim each new season. The designers, brands and manufacturers are now reconsidering and updating denim to suit the consumers evolved choices as they enter the new normal post pandemic. As reported by experts from Denim Dudes on the upcoming Fall/Winter 2023-24 season the consumers are now focus on comforting silhouettes, loose fits and sustainability woven naturally into design. The collections are simultaneously 'rigid and flexible', 'static and dynamic' and 'natural and synthetic'. The manufactures are using natural dyes derived from clay, plants and food by-products to achieve the delicate grey/blue colour. Incorporating zero-waste policies, using scraps to make denim ribbon and labels are few steps taken by the organizations. Strong efforts are taken for developing regenerative cotton and traceable cotton by the denim producing mills. Accordingly to Trendalytics 2020, top trends report noted that online searches for "sustainable denim" and "sustainable jeans" have ticked up 123 percent and 195 percent year over year, respectively and eco-friendly denim shows increasing acceptance.

4. DENIM BRANDS/ DESIGNERS PROMOTING SUSTAINABILITY IN DENIM

The acceptance of denim by all and the diversification of denim products has however created a problem for the environment. The people involved in the various process of denim industry also face health issues. The practice of sandblasting jeans to get that trendy faded look are exceptionally harmful for the denim workers health and safety. In the past, however, the denim industry has been a large consumer of water, insecticides, pesticides, and energy and uses harmful chemicals in the dying/finishing processes. The industry must look for solutions support clean up the process and build a more sustainable supply chain. With the combination of circular economy principles, the denim industry can become the sustainable, circular leader and lead a textiles revolution. Amsterdam hosted 'Denim Days, in April 22' a series of industry events, trade shows, seminars, and a denim festival centred on the classic indigo blue fabric. Jade Wilting, Project Coordinator Circle Textiles reported at The Blue Print Festival on the future of denim and explored the question, is there a future for denim without circularity? While the denim industry has yet to become circular, competitive companies are moving in the right direction, with some frontrunners already firmly rooting their business models in circularity. Fortunately, denim brands are functioning towards environmentally conscious production methods by using less water and chemicals.

In 2012, Levi's® brand collaborated with Water.org to raise a question that if everybody would be interested in giving somebody a cup of water. Across 1,300 cities in the globe more than Thousands of people were interested in taking the Go Water<Less challenge. Since the inception of GO WATER<LESS Levi's® has saved 13 billion litres of water till 2020. They claimed this to be just an initial beginning to save water and work for the benefit of the ecology. To reduce consumption and advance towards circularity in denim Levi's® is working with Ellen McAuther Foundation Redesign project. They aim to

bring the denim industry a step closer to achieve circularity in scale. Levi's® has adopted the screened chemistry approach thus restricting substances and serves as a method to screen every formulation before it enters our supply chain. This means Levi's® identified better alternatives and eliminate hazardous substances before production begins. It reflects the company's ambition and ingenuity, particularly in building environmentally sustainable production methods.

The iconic American apparel brand *Lee*®, recognized for its timeless denim style and innovative apparel solutions, launched the brand's first global sustainability platform in 2020. For *A World That Works*™ unites the brand's legacy of innovation and purpose with a responsibility to build a stronger, more sustainable world. Agreeing with the new sustainability platform, the brand launched *Indigood*™ Denim, a signature denim collection that eradicates water from the denim dyeing process, producing a more sustainable jean.

Mud Jeans proved that emerging brands can micro-manage each part of their supply chain and adapt rapidly. Consumer education regarding garment care significantly extends sustainability efforts past the purchase of denim products. Mud Jeans is known for its efforts to adopt the circular model in the category of denim products. The brand is known for its efforts to recycle denim products and practice cradle-to-cradle certified dye formulations that are not harmful to humans or the environment (Reddy, 2021).

Arvind Mills is India's largest denim manufacturer apart from being the world's fourth-largest producer and exporter of denim. They cater to GAP, 7 of all Mankind, Target, Aeropostale, Nautica, and Tommy Hilfiger. The denim market is constantly redefining and reinventing itself with new designs, texture, comfort, washes, cuts, and embellishments which keep the consumer interested and the demand high. The innovation starts from the spinning stage and value is added along the supply chain, with fabric being a major contributor to the 'value'. The newly launched Neo denim uses hardly any water in its dyeing process and is made from organic cotton, recycled polyester, coffee grounds plus 100% natural vegetable dyed denim using energy-efficient and water efficient processes. Arvind aims to educate farmers and extend support so that they switch over to more sustainable farming practices. Arvind aims to achieve a sustainable & healthy ecosystem that is beneficial to all. Since Arvind's foray into sustainable agriculture in 2007, the organic agriculture practices and Better Cotton Initiative have not only preserved the environment but have also empowered farmers with over 18% better yield and fair pay. Arvind buys the organic cotton and organic cotton seeds, which is approximately 50% of the farmers' produce, and help them find market for the other organic rotational crops that they cultivate. Arvind ensures 360-degree water for industrial & municipal projects by providing a wide range of customised water reuse & recycle solutions. Their Mechanical Vapour Re Compression technology saves up to 80% energy at Zero Liquid Discharge (ZLD) Plant. Zero liquid discharge is an advanced water treatment process which purifies and recycles the wastewater at the end of the industrial process with zero liquid waste at the end.

James Flemons, the designer behind Los Angeles-based label Phlemuns, is a master mix-and-matcher and creates a futuristic-vintage feel like style. Phlemuns latest capsule collection heavy on the recycled denim were powered with thrilling silhouettes and patchwork wildness. Phlemuns made a name for himself with his debut S/S 16 collection of refurbished jeans, which he independently created from cut-and-pasted pieces of vintage denim with meticulous tattered and shredded panels.

Sarah Ahmed, the founder of Warp + Weft, has made an impression on the apparel industry with its ultra-inclusive range of sizes and inseams. It is also the world's cleanest vertically integrated Denim Company and owns its factory. Warp + Weft is transparent about its manufacturing process, highlighting elements

like responsibly sourced cotton, eco-friendly dye, water-saving techniques, and solar power. It also allows a visit to the manufacturing unit.

An innovative London-based menswear designer Christopher Shannon's is known to experiment with denim. Inspired by 1990s styling, the designer offered up denim in four hues, from palest chambray to deep indigo, which he patched into trucker jackets, jeans and tightly fitted sweat suits. He's possibly one of the best menswear designers in the world.

Re/Done is recognized for repurposing used denim. The brand began upcycling vintage Levi's in 2014 and has since turned over 225,850 landfill-bound garments into upcycled pieces. Re/Done is extending its interest in stretching a jean's life cycle into every aspect of its business. Recent eco-minded initiatives include shipping orders in reusable and returnable packaging and offsetting carbon emissions from every order, past and present.

5. RECYCLE AND REUSE

Recycling and reusing products and textiles is necessary for better environment. Denim apparels have become an inevitable part of every individual's wardrobe. Old and used denims can be innovatively recycled into incredible, artistic, and valuable products. Recycled denims are attractive and the energy spent in recycling old materials is lesser comparatively over the energy spent in converting raw materials into products. Old denims can be recycled into insulation materials used for homes, offices, hotels etc. These insulation materials are made up of 85% factory scraps consisting of cotton fibres, and natural denim. They buy scraps from the manufacturers directly. The insulation material made out of these scraps is 100% recyclable approximately 300 tons of waste denim generally used for landfill can be transformed into insulation material. 500 pair of jeans can completely insulate one home.

Levi Strauss & Co. has recently launched a \$100,000 denim insulation fund to reuse unwanted denim while keeping it out of landfills. Denim is an essential in nearly everyone's wardrobe, but it shouldn't be a staple in our landfills, said Jill Nash, vice president of corporate affairs, Levi Strauss & Co. By encouraging our consumers to donate unwanted jeans and then promoting recycled denim as insulation in buildings, we encourage consumers to extend the lifecycle of every pair of jeans. Redone is a movement that aims to create sustainable fashion that is unique to every wearer. Launched in LA, Redone deconstructs vintage Levi's jeans then puts them back together to create up-to-date styles.

Old denims now have found their way into the next generation Ford Focus cars. Recycled cotton materials from used blue jeans are used as a part of carpet backing and sound absorption in Ford cars. Post-consumer use the cotton obtained for a car is approximately from two pair of jeans. Recycled content is a way to divert waste from landfills and reduce the impact of mining virgin material says Carrie Majeske, product sustainability manager of Ford. Using recycled materials in the production is a step in the right direction, and is a huge factor in saving water and reducing the impact. Manufacturers, brands and denim upcycling businesses are transforming the culture and production of jeans and making great progresses to change the way in which denim can become more sustainable.

Denim manufactures are aware of both beneficial and adverse effects developed due to bio polishing on cotton fibres. The greatest challenge facing denim recycling is the problem of pollution at all levels of manufacture, and if this can be reduced, it will be a great effort to save the environment. Cellulose enzymes are used in this process and unfortunately they reduce the strength of the fabric. Use enzyme treatments

on denim fabric enables process integration and enzymes are eco-friendly, nontoxic and fully biodegradable compound (Gokarneshan N, 2018). To improve the functional performance of denim fabrics various functional finishes are applied on them. Effective efforts have been made to develop diverse blends of silk denim fabrics. The silk denim garments are soft to the touch, light in weight, and comfortable to wear in all seasons. The silk denim is smooth to feel and blends with luxury. Denim is now also manufacture on knitting machines to add more comfort and flexibility. Since mechanical recycling technique is a challenge in the process, recently, new techniques have emerged to use denim jeans and other cellulosic materials as a source/raw material. Companies like Re: newcell, Infinited Fibres, and Nanollose are taking second-hand garments, applying fibre separation and turning cellulosic part into liquid. Some of them include fermentation, and as a last step, they turn the liquid into the material. The process resembles regenerated cellulosic fibre process. The use of fermentation appears to be a promising step into bio design for textiles, and this also eliminates all the negative sides of mechanical recycling. The denim manufacturers can reinvent the popular distressed styles, unique patterns and even images by using laser technology. The real benefits of this technology are in its ability to make denim go green, yielding impressive environmental and worker safety benefits and increased production. Laser technology is another name for sustainable finishing in the denim wash sector and it will change the future of this market.

Slow designing or practicing traditional craft techniques or combining age-old hand-crafted skills and crafts with technology is the best example of sustainability and creativity. The make-and-do culture of mending, repairing and redesigning, and developing or converting unwearable products into items of clothing, and most of the time, the output is more affluent than the desired or the original piece. Re-use, Re-pair and Re-cycle has become the dialogue to sustainable fashion. Giving new life to old jeans is increasingly popular among youngsters. In fast fashion, redesign is the ultimate expression of slow fashion and the path towards eco and sustainability.

Denim jeans succeeded throughout the ages as it was adaptable, easy-going and flexible to suit the different needs of the ever changing cultures. Recycling programs are important due to economic, social and environmental reasons. Waste disposal programs are more expensive when compared to recycling packages. The cost of manufacturing products has become very high due to scarcity of natural resources making recycling more rewarding than new product production. Giving clothes to a second-hand store or adding a vintage label for extending the use of a product forms an integral part of reuse. Upcycling has been carried out in many under-developed and developing countries, but this technique has opened many avenues for young designers, creative artists, manufacturers and retailers, and this concept is spreading all over the globe in its attempt to create products with an image of sustainability. Currently, many retailers give discounts in new purchases for return of old garments; hence, the problems of acquiring the garments instead of landing in garbage bins are avoided.

CONCLUSION

Denim fabric is both a fashionable and a performance-driven fabric. The popularity and acceptance of various denim products have increased the manufacturing of denim fabric and denim fabric-based products. Denim fabrics are designed with novel finishes. Consumers widely accept denim blends. The apparel industry raises environmental concerns, and addressing them with sustainable solutions is the need of the hour. Being one of the mainstream sectors in fashion industry, denim mills are now steadily implementing circularity in their production processes. Denim manufactures are taking strong steps in a

direction towards creating more responsible denim fabrics that reduces the gap between fashion and sustainability. A detailed sustainability check during denim manufacturing will help identify the flaws and prevent them. The focus in denim recycling will be to shift consumer behaviour to make recycling clothing a norm, and all phases of the product life cycle are to be considered. Collecting old clothing and sending it for recycling only means that one has not participated in the recycling process but only helped facilitate it. These fabrics can be crafted into a luxurious and versatile garment collection for eco-conscious consumers. Global Denim brands are making rigorous efforts to develop environment-friendly processes and products. Denim is the definite champion of the fashion industry, with workwear, casual wear, and premium wear with social values woven into its character. Development of sustainable denim produced is proving to be a very successful diversification in the denim world. The demand and the market for sustainable denim will signify social and environmental change for both industry and denim culture.

REFERENCES

1. Chua, J. M. (2021, August 24). *Why It's Now or Never for Sustainable Denim – Sourcing Journal*. Sourcing Journal; Sourcing Journal. <http://sourcingjournal.com/denim/denim-innovations/now-or-never-sustainable-denim-covid-circularity-guess-gap-outland-293064>
2. Dazed. (2017, April 6). *Phlemuns Dazed 100 | Dazed*. Dazed. <https://www.dazeddigital.com/projects/article/35433/1/phlemuns-designers-biography-dazed-100-profile>
3. *Denim | Types of Cotton Fabrics | Cotton*. (n.d.). Cotton.
4. *Denim trends projections for Fall/Winter 2023-24 | Apparel Resources*. (2022, June 29). Apparel Resources. <https://apparelresources.com/fashion-news/trends/denim-trends-projections-fall-winter-2023-24>
5. *Environmental Initiatives - Sustainability in Fashion | Levi's® CA*. (n.d.). Jeans, Denim Jackets & Clothing | Levi's® Official Site.
6. *Fashion & Apparel | Businesses | Arvind Ltd*. (2017, June 22). Arvind Ltd. <https://www.arvind.com/businesses/fabric-apparel>
7. Ismael, A. (2021a, September 21). *7 Denim Brands That Make Sustainable Jeans — Best Sustainable Denim 2021*. Insider; Insider. <https://www.insider.com/guides/style/sustainable-denim-jeans-brands#warp-weft-3>
8. Ismael, A. (2021b, September 21). *7 Denim Brands That Make Sustainable Jeans — Best Sustainable Denim 2021*. Insider; Insider. <https://www.insider.com/guides/style/sustainable-denim-jeans-brands#warp-weft-3>
9. *Kontoor Brands, Inc. (KTB)*. (n.d.). Kontoor Brands, Inc. LeSavage, H. (2021, October 28). *The 11 Best Sustainable Denim Brands to Know (and Shop)*. Harper's BAZAAR; Harper's BAZAAR. <https://www.harpersbazaar.com/fashion/trends/g38081896/best-sustainable-denim-brands>
10. *Levi Strauss Home - Levi Strauss & Co : Levi Strauss & Co*. (n.d.). Levi Strauss & Co.
11. R. and M. (n.d.). *Denim Jeans: Global Strategic Business Report*. Research and Markets - Market Research Reports - Welcome. *Not Found :: Kontoor Brands, Inc. (KTB)*. (n.d.). Kontoor Brands, Inc. <http://www.kontoorbrands.com/news-media/press-release/41/lee-launches-new-global-sustainability-platform>
12. *Recycled Denim, Recycled Denim Fabric, Recycled Denim Jeans, Recycled Denim Clothing, Recycled Denim Shoes - Fibre2Fashion*. (n.d.). Textile & Apparel Business Solution & Marketplace - Fibre2Fashion.

13. Sewport. (11 C.E., November 2019). *What is Denim Fabric: Properties, How its Made and Where / Sewport*. Sewport; Sewport. <https://sewport.com/fabrics-directory/denim-fabric>
14. *Silk Denim, Natural Silk, Silk Denim Fabrics - Fibre2Fashion*. (n.d.). Textile & Apparel Business Solution & Marketplace - Fibre2Fashion.
15. Smith, P. (n.d.). *Value of the global denim jeans market 2022-2030 | Statista*. Statista.
16. *Sustainability*. (n.d.). Shop Latest Menswear and Women Clothing Online at Levis India. *Sustainability Report - Levi Strauss & Co : Levi Strauss & Co*.
17. *The Future of Denim - Insights - Circle Economy*. (n.d.). Circle Economy - Practical, Scalable Implementation of the Circular Economy.
18. *Understanding Denim Recycling: A Quantitative Study with Lifecycle Assessment Methodology* Velasquez, A. (2022, April 18). *Everything You Need to Know About Amsterdam Denim Days – Sourcing Journal*. Sourcing Journal; Sourcing Journal. -people-amsterdenim-mud-337283
19. *Zero Liquid Discharge (ZLD) | Arvind Envisol*. (n.d.). Arvind Envisol | Powered by Arvind.