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Upcycling Textile Using Tie-And-Dye In Achieving Zero Waste Malaysia

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ABSTRACT

Upcycling, which relates to the ideas of sustainability and circular economy, has become one of the effective ways of mitigating the environmental impact of generating waste, and reducing of resources; in line with Sustainable Development Goal 12 Responsible Consumption and Production. Malaysia's upcycling challenge is being driven by fast fashion and low reuse capacity, causing household textile waste to end up in landfills, pollution and climate impacts. The purpose of this study is to propose upcycling using tie-and-dye method, with the aim of turning the post-consumer textile wastes into marketable products, in order to promote sustainable textile and fashion industries in Malaysia. A practice-based research upcycling tie-and-dye methodology was used, where post-consumer textiles were cleaned, tied into resist patterns, dyed in baths with light mordanting, then rinsed, shade-dried, and assessed for colorfastness, pattern definition, and surface renewal. The results show that addressing textile waste requires a shift upstream, where design, material strategy, and recovery systems are integrated from the outset rather than treated as end-of-life fixes. Upcycling, particularly through tie-and-dye, emerges as a credible circular pathway that extends material life, preserves value, and avoids energy-intensive recycling processes. In conclusion, it moves beyond a niche green practice by linking cultural craft, sustainability, and functional longevity into a single design strategy. When supported by aligned policy, infrastructure, and market mechanisms, upcycled tie-dyed textiles can contribute meaningfully to landfill reduction, decarbonisation, and a resilient circular fashion economy in Malaysia.

1. Introduction

Upcycling takes different forms of discarded garments or textile off-cuts and turns them into higher-value products that have longer life and new meaning. It works by redesigning and reworking old materials, as opposed to breaking down materials as with recycling. Zero-waste design involves

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avoiding fabric waste in the design pattern and layout to use up all of the fabric width with no waste. The fashion industry is one of the most important economic industries in the world and estimated to be worth between 1.7 trillion to \$2.5 trillion established by Fashion United [1]. The textile industry has been able to respond to the consumer desire for fast fashion since the quantitative restrictions on the international trade in textiles and apparel was removed. In 2013, OECD [2] found that the considerable rearrangement of the supply chains is to blame for this. Successful businesses nowadays rely on the supply chain with fast turnaround times covering the production of fabrics, sourcing of materials and the finishing processes. Due to the increasingly effective technology, development of a manufacturer's industrial development is adapted to less environmental impact. Studies on production and consumption by Niinimäki and Hassi [3], showed that the benefits of industrial development have reduced. Greenpeace International [4] reported that with an increase from 1 to 1.8 trillion dollars between 2002 and 2015, apparel sales may increase by 0.3 trillion dollars by 2025. Also, an investigation conducted by MISTRA [5] examined that the production process may take longer for slow fashion, but the design of the product should guarantee a long useful life. Various methods of increasing the sustainability of the fashion industry such as manufacturing upcycling processes need to be improved for fast fashion. Additionally, rapid fashion products should not favour high-quality materials instead use inexpensive, low-quality materials instead, such nonwoven are recommended.

The phrase “upcycling” is a neologism, the practice of turning discarded or used materials into more valuable or high-quality objects has been going on for thousands of years. A study by Lund [6], concluded prior to the Industrial Revolution, reuse and upcycling were widely used throughout the world, and since resources are limited in developing countries, they are becoming increasingly popular these days. Detailed examination of conventional perceptions of waste by an Eco-entrepreneur, Szaky [7], revealed it is turned into an opportunity for sustainability by redefining garbage as a resource and promoting circular approaches like reuse, upcycling and recycling to fight against the increasing waste problem across the globe. The study by Oladoja *et al.*, [8] offers resource extraction causes major emissions, biodiversity loss, and water stress, making circular economy strategies essential for climate neutrality and sustainable growth. The research demonstrated that upcycling in Lagos can be used to minimise material and energy consumption and provide environmental, economic and social benefits in the form of feasible processes and factory-scale implementation of upcycle. In the same view, Slotegraf [9] notes that upcycling gives waste materials a second life by turning them directly into higher-value products as opposed to recycling which usually deconstructs materials into raw forms and may result in a loss of quality. As well as, Goldsmith [10] points out upcycling as an emerging green trend that converts discarded materials into higher value products rather than into wastes. The study highlights how textile and fashion designers; and businesses are using creativity to reduce the amount of waste going to landfill, as well as saving resources, and re-engineering waste as an economic and environmental opportunity. One of the Sustainable Development Goals (SDG's) given by the United Nations is in line with the concept of upcycling which make direct contribution towards the SDG 12 Responsible Consumption and Production. Khajuria *et al.*, [11] found that by converting waste materials into valuable products, i.e. reduction of waste and increase the life span of materials in accordance with the call for reduction of waste in Target 12.5 (UN SDG 12 targets include reducing waste generation). It also helps in achieving SDG 13: Climate Action as keeping materials in circulation rather than producing new materials helps to save on resources through extraction and the climatic emissions involved in making new products, helping circular practices bind with climate action. However, other writers, Sodje *et al.*, [12] have argued that upcycling lacks a clear, agreed definition, which weakens claims about its sustainability. That matters because without clear criteria, it's hard to compare real environmental

benefit across industries or justify policy support. Upcycling sometimes gets lumped in with other strategies (reuse, recycling) without rigorous conceptual distinction, and that vagueness can mask limitations in practice.

In view of the environmental concerns facing the apparel industry, businesses are seeking to be more circular in their production procedures by adopting more innovative ways of production by their products. The IVL Swedish Environmental Research Institute [13] research programme emphasises the fact that current practices of dealing with used textiles are economically and resource inefficient. In addition, Dissanyake and Sinha [14] makes a similar point in their study that rapid trend turnover drives clothing overconsumption and textile waste, fashion remanufacturing can reduce landfill through reverse supply chains but scaling depends on strong collaboration and real commitment from major retailers and consumers. A research study by Bernoville [15], the researcher mentions one of the waste management usually used in the clothing industry known as the 6Rs: Reduce, Recycle, Recover, Redesign, Reuse and Remanufacture. The approach does consider the potential uses of each of the Rs during the product development process of product design. The Rs is an approach to handle the generated trash as it is thrown away and, as a result, increase the life cycle of the product. Remanufacturing replaces used goods for virgin goods as the raw material which Jawahir and Dillion [16] says remanufacturing is the process of extending a product's useful life after it has been discontinued. IVL Swedish Environmental Research Institute [17] claims that what a reverse supply chain enabler for remanufacturing entails is to convert mixed textile waste to sorted, quality-assured fibre fractions (ReFab) that can re-enter production. Furthermore, Krystofik *et al.*, [18] points out remanufacturing fashion items is viewed as a new economic possibility in the garment industry, however it now serves a relatively small market.

Through the use of tie-and-dye, old clothing can be transformed into unique and stylish pieces that are both fashionable and environmentally friendly. According to Chavez [19] by using natural dyes and eco-friendly materials, tie-and-dye upcycling reduces the reliance on chemical-laden dyes and minimizes the environmental impact caused by the textile industry. Additionally, tie-and-dye upcycling promote the concept of circular fashion, where materials are reused and repurposed rather than discarded. By integrating tie-and-dye into upcycling practices, creative expression is enabled alongside waste reduction, contributing to more sustainable fashion industry. In addition, through the application of tie-and-dye, discarded materials can be transformed into interesting artworks that are both visually compelling and environmentally responsible. Furthermore, Fletcher [20] found that when combined with dyes and eco-friendly materials, tie-and-dye upcycling reduce dependence on synthetic, chemical-based dyes while lowering the ecological burden associated with conventional textile production. This approach directly supports circular fashion principles by extending the life cycle of textiles through reuse, reinterpretation, and creative reinvention rather than disposal. Tie-and-dye upcycling enable practitioners to convert worn or unwanted clothing into unique artistic pieces, each marked by irregular patterns and layered colour interactions that cannot be replicated through industrial processes. These qualities elevate upcycled garments beyond functional apparel into one-of-a-kind textile artworks.

From Light 2 Art [21] study of art and sustainability, the practice represents a meaningful convergence of creativity and ecological awareness, where personal expression is inseparable from environmental responsibility. The labour-intensive, heritage-based nature of tie- and-dye further reinforces the value of craftsmanship and originality in an era dominated by mass production. By incorporating tie-and-dye into upcycling practices, textile waste is significantly can be reduced while cultural and artisanal knowledge is preserved. According to Gwilt [22], each transformed garment embodies a narrative of renewal, demonstrating how materials can undergo aesthetic and conceptual rebirth. This process not only diverts textiles from landfills but also challenges prevailing

consumption models that prioritise disposability over durability. In this sense, tie-and-dye upcycling functions as a form of sustainable art, where environmental ethics are embedded within material practice. The contemporary resurgence of tie-and-dye reflects a broader shift in fashion and design toward sustainability and tradition-driven innovation. Once associated primarily with historical or vernacular textiles, tie-and-dye has re-emerged as a symbol of environmentally conscious design, influencing both streetwear and high-end fashion. Beyond fashion, tie-and-dye aesthetics have expanded into other creative domains, including interior design and culinary presentation. In spatial design, tie-dyed textiles and surfaces introduce rhythms through colours that transform interiors into expressive environments. In culinary art, tie-dye-inspired visual compositions create multisensory experiences that blend colour, shape, and form. These cross-disciplinary applications demonstrate the adaptability of tie-and-dye as both a material process and an artistic language. Ultimately, tie-and-dye through upcycling represent a powerful strategy for sustainable creation. Indeed, the researcher asserts by repurposing existing materials into new artworks, the practice reduces resource consumption, lowers energy use, and minimises waste generation when compared to conventional textile manufacturing. Community-based workshops and participatory projects further strengthen its social impact, fostering environmental awareness while empowering individuals through hands-on creative engagement. As part of the broader upcycling movement, tie-and-dye offers a tangible alternative to the linear “take–make–dispose” model, promoting a circular economy grounded in creativity, responsibility, and respect for material life.

Malaysia faces certain challenges when it comes to upcycling because fast fashion has significantly increased over the past 20 years, with negative social and environmental impacts. According to The Waste Management Association of Malaysia [23], the issue is growing with the rise of fast fashion, leading to increased textile waste and unsustainable production practices. Also, Syed Abdul Khalid [24] maintains tackling textile waste requires changes in everyday behaviour across all segments of society to reduce waste generation and lessen the environmental impact of textiles, as large volumes of clothing and fabric continue to end up as trash, making shared responsibility and conscious action essential to addressing the problem. Free Malaysia Today [25] reports that large volumes of unwanted clothing and fabric in Malaysia continue to end up in landfills due to limited textile reuse options, highlighting textile waste as a growing national concern. As well as, The Star [26] reports that Malaysia’s fashion industry faces growing sustainability challenges due to fast fashion, rising textile waste, and limited waste-management capacity, which has resulted in large volumes of fabric waste being sent to landfills. Rosli [26] claims given much of this waste originates from household sources, the high disposal rate may reflect limited public awareness and understanding of textile waste management practices. Similar to Rosli, Chu [27] mentions Malaysians dumped an astounding 195,300 tonnes of fabric waste in a single year, highlighting how textile waste is a major contributor to landfill burdens in the country and underscoring the lack of effective waste diversion systems. The objectives of this study are (i) to examine the tie-and-dye for an upcycling method in transforming post-consumer textile waste reduction into usable fashion products and (ii) to explore the contribution of tie-and-dye-based upcycling to circular fashion practices, with particular relevance to sustainable production contexts. The significance of this study is based on the generation of practical evidence that tie-and-dye-based upcycling reduces textile waste while strengthening sustainable fashion practices, offering a viable zero-waste strategy for textile and fashion designers and small-scale producers in the country.

2. Methodology

Post-consumer textiles have been found by the researchers from household donations and fabric waste streams with a focus on textiles made from natural fibre such as cotton and rayon. The materials were washed to clean off any surface residue, air dried, and wherever needed unstitched or cut out into flat panels. According to Fletcher [28] existing stains, fading and colour inconsistencies were kept as purposeful and considered inputs used to design rather than defects used in the design process thus reflecting upcycling principles of extending materials and recovering their value. Fabric dyes are implemented within the tie-and-dye method to provide colour and to be revived into upcycled fashion production in order to visual discrimination and prolong material usage in upcycled fashion production. The study by Cardon [29] offers low-impact substances such as alum or vinegar were selectively used to increase the colour fixation and decrease the harm to the environment. Traditional tie-and-dye processes of binding, folding, pleating and stitching were used with simple, re-usable tools for this study. Fabrics were placed into dye-baths for 20 to 60 minutes depending on the colour intensity desired, and the fabric was turned from time to time in order to promote the development of uneven and organic pattern. After dyeing, fabrics were left to cool and untied, rinsed in cold water and spread under shaded conditions to stop the colour on these fabrics being ruined. The results were examined by visual rating of the colour depth, clarity of patterns and the degree to which flaws on the surface were changed to aesthetic features. Gwilt [22] found that the reflective, practice-based approach is in line with sustainable textile methodologies that understand making as a process of experimentation and knowledge building. This study applies Bell's formalism theory [30] to tie-and-dye by treating the textile as a visual structure whose aesthetic force comes from "significant form", the relationships among elements of art and principles of design. In tie-and-dye, significant form emerges through line, colour and balance created by dye diffusion, rather than symbolism or representational motifs. Reading tie-and-dye through formalism keeps the analysis anchored on what is materially visible, for example symmetry vs asymmetry, density of pattern, tonal gradation, and figure-ground tension, because these formal relationships are what generate aesthetic emotion in the viewer.

3. Results

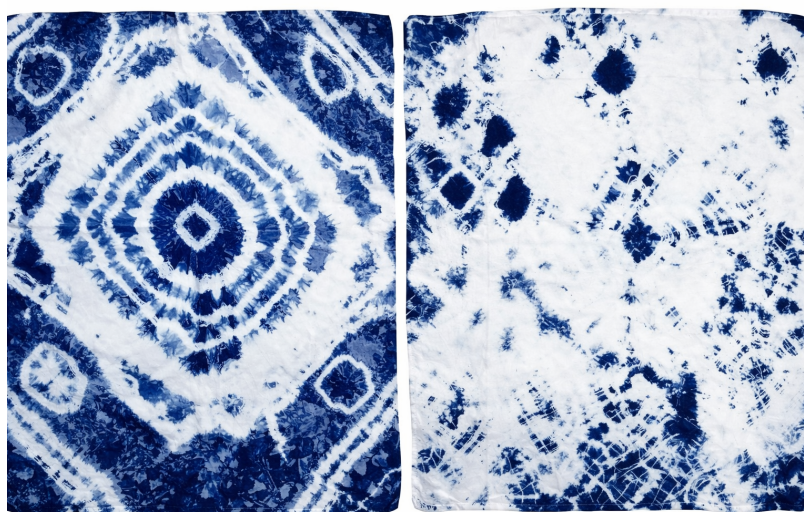


Fig. 1. Indigo tie-dye compositions reveal controlled resist, symmetry, and blue-white contrasts for upcycling statement

The scarf runs along an indigo - white axis, where white takes up the greater portion of the surface as can be seen from Figure 1. Indigo appears in layered depths, going from near-black in the centre to softer blue-grey at the edges spreading outwards. According to Cardon [29] such tonal gradation is consistent with the behaviour of vat dyes and resist dyes, in which factors of time of immersion, agitation and degree of compression influence dye penetration and edge definition. The researchers, Wada *et al.*, [30] along the white zones it leaves fainter bleeding and softened borders, which takes away contrast, preserving a hand-processed look longer than the arguably mechanically printed finish. The subdued palette facilitates a sense of atmosphere and meditation often found in indigo dyed textiles and their longstanding cultural-aesthetic resonance. As little as a flat square, the chromatic pull of the scarf works radially, with indigo working as a visual anchor stabilising the composition. The dominating structure is concentric repetition, the diamond forms expand outward from a central diamond in increasing scales that yields symmetry and very strong sense of order. The principles of visual organisation especially how balance, repetition, and visual weight control where attention extends in a field. The scarf design next to the first one, although the geometric framework is stable in each ring, the internal dye textures are different from one another. Some areas explode outward spread of diffuse water and some remain tighter and more contained, which reflects the productive tension between planned resist structures and dye movement in cloth that is unpredictable in each material. Distance the pattern reads: systematic, aided by the repetition of corners, but the smaller diamonds near the periphery reflect the motif, they balance it in the centre-heavy by used to redistribute the visual weight to the square Overall, tonal gradation creates depth, repetition provides radial structure. The surface has a deliberate and contemplative character, closer to symbolic patterning, and away from decoration which is appropriate to a scarf that is to be folded, rotated and reoriented in use.



Fig. 2. Upcycling tie-and-dye tote bag from a discarded fabric into a timeless, functional statement

This tote in Figure 2 shows a controlled tie-and-dye resist of most probably indigo-based, applied with clear planning rather than chance. Across the body of the bag, the white streaks are arranged

as a mirror image of the diagonal patterns which unite at the centre seam suggesting folding and tight binding (pleating or accordion folding) before dyeing. The resist is strong but some dye does seep in to produce soft-edged highlights rather than the hard outlines. On the bottom corners, there are semi-circular burst forms which appear to be consistent with small gathered and tied points giving a second resist contrasting the linear banding above. The handles then have a lighter and more irregular resist design that helps to visually cut apart the darker body. Colour is organised on a great indigo-white axis. Indigo is the predominant coloration, dark navy and blue-grey degrees of less saturation give the surface depth, and a feeling of movement results. White is the function of interruption, rather than ornament: it cuts through the blackness of the ground to make lightness and create rhythm. In terms of shape, the simple rectangular shape of the bag is activated by the geometry of the dye (of course): the diagonals suggest a slight chevron or V-shape to draw attention inwards, but the circular bursts in the base help stabilise the composition by radial counterpoints. The overall effect is calm, balanced and deliberate with colour and resist structure working in harmony to provide the identity of a minimalist silhouette.



Fig. 3. Upcycling indigo
breathes new life into a
flowing, long

The indigo in the long cardigan dominates the composition, with white as negative space as shown in Figure 3. This is a classic resist-dye relationship in which the colour appears to be drawn into the fabric, with indigo shifting from deep navy to softer blue, suggesting uneven dye penetration. White functions as an interruptive element that irregularly breaks the indigo field, introducing contrast while maintaining a visual balance. The overall temperature remains serene, peace and tranquil which strengthens a natural identity linked to artwork. The side panels display repeated organic shapes, loosely diamond-like or petal-like whereby their size, the clarity of their edges, and their distance from each other varies. This keeps the repetition in a rhythm which in the centre creates symmetrical balance. Colour of this artwork creates calmness with indigo being the dominant

colour, and repetition works with motif-based which makes the piece visually stable. Taken together, it demonstrates a definite trend from structured to diffuse repetition and from imagery as a visual emphasis to functional understatement. The same dye creates three different surface identities due to its design decisions responding to the ways that each piece of art is worn, seen, and used. This is a grasp of the fact that repetition and colour is not a tool of decoration but an adaptive system influenced by context, material behaviour and purpose.

4. Conclusion

This research shows that tie-and-dye can be used as an upcycling process for post-consumer textile wastes in order to obtain fashion products with a clear aesthetic value while preserving their use as functional products. Through a combination of controlled resist and dye processes, cast off materials were activated as a resource of intentional design surfaces instead of being treated as secondary or inferior resources. The results further indicate that upcycling in the form of tie-and-dye is of meaningful use value in terms of waste reduction, in prolonging the lifecycles of textiles and in the practice of circular fashion within the sustainable production context. By locating the craft-led dyeing strategy as a design prerogative as well as a waste management intervention, the study validates its practical applicability for small-scale producers and sustainable fashion systems in search for low impact, adaptable and culturally-grounded solutions. Beyond the transformation of materials, the study supports the understanding that tie-and-dye upcycling promotes a mind change towards design and shifting from a linear consumption to a greater value retention. The approach permits variability in the outcomes while having standardised production parameters, which makes it flexible for small enterprises and community-based makers. It is also shown that aesthetic irregularity, perceived as a limitation of materials derived from waste, can also be converted into a strength of the design. Importantly, the process does not require relatively low technological input to use, which reduces the barriers of adoption in resource conscious settings. Formalism theory is important in tie-and-dye because the technique itself produces meaning primarily through visual structure, not narrative content. Using formalism makes it possible to judge tie-and-dye outcomes with clear visual criteria, instead of reducing evaluation to cultural reference or subjective taste. Together, these insights put tie-and-dye upcycling in a position of scalability and context sensitivity in pursuit of circular fashion implementation.

4.1 Limitations of the Study

However, there are several limitations for upcycling with tie-and-dye namely scalability issues, economic limitations and adoption barriers within the local Malaysian fashion industry. Scaling up the practice of upcycling through the use of tie-and-dye is a practice that faces many structural limitations. First, the input to post-consumer garment supply is a highly variable stream in terms of fibre composition, size, wear condition and colour history, etc., limiting the standardisation of input and making it difficult to get consistent batches of output. Second, the production of tie-and-dye products is still labour intensive and process sensitive, and the need for a high degree of sorting, pre-treatment, binding, dyeing, rinsing, drying, and finishing mean that the number of rework and lead times are higher compared to conventional manufacturing processes and are affected by fabric blends and previously applied finishes. Third, economic constraints arising from the fact that unit costs are more dependent on skilled labour, water and energy usage, studio infrastructure and quality control than on raw material inputs, and due to limited access to capital of small and medium enterprises for equipment, safe handling of chemicals and wastewater. Finally, there are still barriers

at the market and institutional level with regards to consumer stigma attached to using second-hand materials, limited willingness to pay a premium for non-standardised aesthetics, preference of retailers for predictable Stock Keeping Units (SKUs) and retailer replenishment, and perceived performance risks related to colourfastness and durability that cause a limiting factor in commercial scalability and mainstream diffusion of upcycled tie- and-dye products within the Malaysian market.

4.2 Practical Implications

Despite advocating for transformation in the entire industry, the nearer-term implementation can be achieved through several ways. First, scalability may be facilitated by the standardisation of upcycling processes, rather than outcomes, by defining the parameters around the selection of garments, fibre composition, dye concentration, fixation methods and colourfastness testing, with performance monitored by the defect rate, as well as processing time per unit. Second, the policy support must prioritise the provision of shared sustainable production infrastructure as communal dye studios and wastewater treatment facilities to allow for small enterprises to keep down the costs per unit of output while achieving set environmental and safety standards with effectiveness gauged through compliance rates and cost efficiencies. Third, the adoption may be strengthened with limited pilot procurement programmes and transparent upcycling labels to permit retailers and consumers to test adoption in controlled volumes, which may be assessed in terms of sell-through rates, price tolerance and repeat purchase behaviour. Collectively, these steps offer tangible evidence to shape a gradual scaling-up while maintaining the craft-based and sustainability values of upcycled tie-and -dye.

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