

Original Article

Combination of Zero Waste Patterns to Maximize Multi Fabric and Wastra Nusantara Applications

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Abstract: The fashion industry has long been known as the ultimate source of waste in landfills. Many designers and fashion enthusiasts tried to introduce slower fashion to promote sustainability. Among many approaches, the zero-waste pattern (ZWP) has been known as the keyword that captures the attention of many. The baseline is to produce any fashion pieces with 15% waste or up to nearly 0% waste from a piece of cloth. Because of this definition, many designers are trapped into thinking that Zero Waste Fashion (ZWF) products should only use mono fabric. Indonesia has various local fabrics (wastra) that can be explored. The initial bottom line of wastra is to use the whole fabric with no cutting at all. Therefore, the same spirit of ZWF is found relatable to the use of wastra in the modern context. This study aims to find the right multi-fabric combination using zero waste patterns on wastra. This study uses a design thinking method with an experimental approach. The fabric used in this research is limited to plain modern fabric and wastra with the tie-dye technique. This study found that the sustainable cutting technique is highly efficient when applied to fabric with a width of 115 cm to produce five clothing items. The wastra used should have a pattern that can be rotated without considering the position of the motifs that must meet each other.

Keywords: Zero Waste Pattern; Zero Waste Fashion; Multi Fabric; Wastra



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1. Introduction

The more than 100 billion new garments are produced annually (Goyal & Parashar, 2023). However, 87% of the garment becomes waste in landfills. The total amount of textile waste generated worldwide is 92 million metric tons. Specifically in Indonesia, textile waste accounts for 2.6% of the total 19 million tons of waste produced yearly, meaning that as much as 494 thousand t of textile waste are produced yearly (Nahar et al., 2022). This textile waste is caused by fast fashion. Fast fashion is clothing that is mass-produced quickly and sold at low prices (Black, 2010). There are two types of waste generated from fast fashion: pre-consumer waste (waste generated during clothing production) and post-consumer waste (waste

generated after the clothes are in the hands of consumers) (Rissanen, 2015). The waste generated by fast fashion has a negative impact on environmental sustainability. Slow fashion is the opposite of fast fashion. Slow fashion prioritizes long-lasting production and strives to preserve the environment. In Indonesia, slow fashion is attracting an increasing number of enthusiasts. Judging from the emergence of many local brands that carry the concept of slow fashion, such as Sejauh Mata Memandang, Sare Studio, Imaji Studio, and many more (Tedjokoesoemo et al., 2023).

One of the slow fashion methods is the Zero Waste Pattern. The Zero Waste pattern aims to produce less than 15% to 0% pre-consumer waste in production (Rissanen, 2015). Many designers who design Zero Waste Fashion are limited to mono fabric, so the variety of Zero Waste Fashion products on the market is less diverse. Indonesia has many types of textiles that can be explored. Wastra is a traditional cloth that has a meaning in Indonesian traditions and culture. Indonesian textiles from various regions of Indonesia have different philosophical meanings, colors, sizes, and materials. Wastra is made traditionally, and pure manual tools result from craftsmen's handicrafts. Some examples of the types of traditional Indonesian fabrics are batik, lurik, songket, ulos, sasirangan, bugis sarongs, tapis, gringsing, jumputan, poleng, besurek, and so on (Kusrianto, 2023). Batik tie-dye (Jumputan) is one of the most popular wastra fabrics. Therefore, this research will be started by using Jumputan. The essence of wastra is to utilize the entire cloth without cutting it at all. Therefore, the same spirit of ZWF is found related to the use of wastra in modern contexts. This study uses a Zero Waste Pattern on wastra and popular fabrics to find the right multi-fabric combination.

2. Materials and Methods

This study is designed using an experimental approach. This method aims to try which Zero Waste Fashion design approach is most suitable for application to patterned fabrics, specifically batik. The Design Thinking method will be applied to this research. Design Thinking is a way of thinking to solve a problem creatively and innovatively. Following are the six steps of the Design Thinking method:

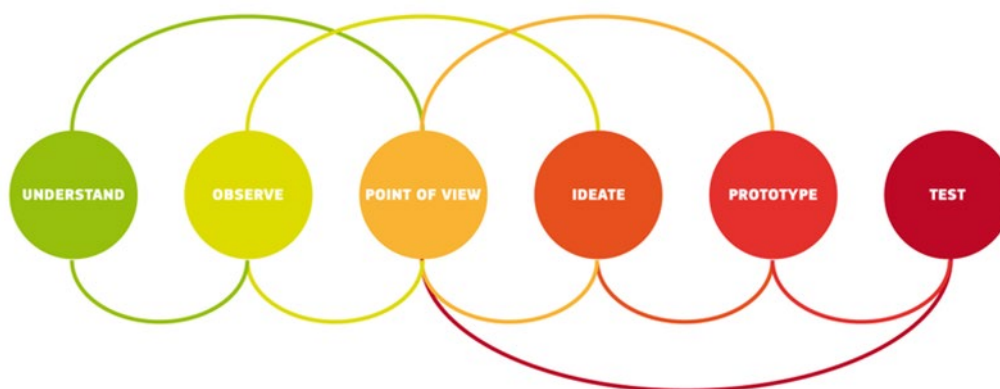


Figure 1. Six steps of the Design Thinking method

At this stage, literature data collection, typology, and gaps of knowledge were determined to act as a guide for this investigation.

2.1. Zero Waste Fashion

Zero Waste Fashion (ZWF) is a method to minimize textile waste (Fletcher, 2012). Textile waste is classified into two categories: pre-consumer textile waste and post-consumer textile waste. Pre-consumer textile waste is generated by manufacturers, ranging from manufacturing fibers, yarns, fabrics, and garments. Garment production produces the most textile waste during the production process. Meanwhile, post-consumer textile waste is generated by consumers, namely household waste such as used clothing (Rissanen, 2015). In 2015, the apparel industry worldwide produced an average of around 400 billion square meters of fabric, of which 15%, or about 60 billion square meters, was production waste.

2.2. Zero Waste Pattern

One of the Zero Waste Fashion approaches is using the Zero Waste Pattern (ZWP) method. According to [ElShishtawy et al. \(2022\)](#), the development of the Zero Waste Pattern is carried out using the following 4 methods:

1. Creative Pattern Making

- **Embedded Jigsaw** - The pattern is made to resemble a puzzle and will refer to the length of the cloth. This pattern was developed by [Rissanen \(2015\)](#) and [McQuillan & Karana \(2023\)](#).
- **Jigsaw** - Designers only develop designs for specific parts, for example, the arms. Furthermore, the design will be manipulated to interlock. The design was developed by [McQuillan & Karana \(2023\)](#) and [Liu \(2019\)](#).
- **Sustainable Cutting** - The patterns are in geometric shapes, and the fabric cuts regardless of the direction of the fabric fibers. Design developed by [Rissanen \(2015\)](#).
- **Creative Cut** - In this method, the designer will start by using a certain figure as inspiration and build his design using borrowing. This method was developed by [McQuillan & Karana \(2023\)](#).
- **Tessellation** - In this method, the pattern will be repeated using the fractal method. This method was developed by [McQuillan & Karana \(2023\)](#).

2. Draping

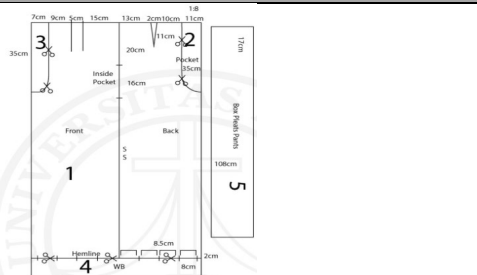

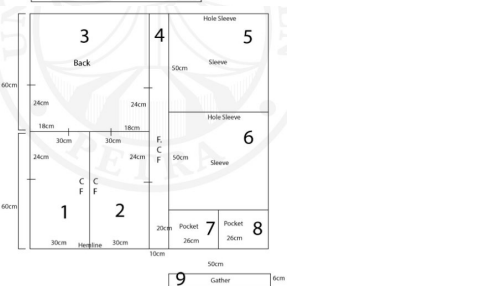

- **Subtraction Cut** - This method uses a negative and positive space approach. This method was developed by [McQuillan et al. \(2013\)](#).
- **Minimum Cut** - Designs with this approach use pure draping techniques that trim the fabric slightly. This method was developed by [McQuillan & Karana \(2023\)](#) and [Carrico & Kim \(2014\)](#).

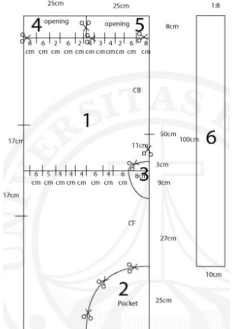

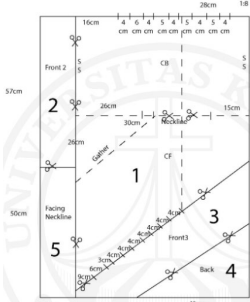

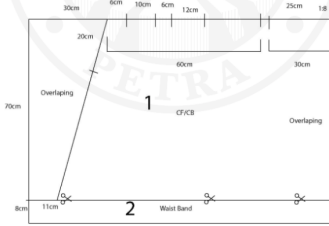

3. Folding

- **Transformation Reconstruction** - The design starts with making simple lines and shapes to be converted into flat patterns, which are then manipulated by folding and draping. The design was developed by [El-Dosuky \(2023\)](#).
- **Origami** - This pattern was created using a folding technique like origami. This technique was developed by [Choi \(2016\)](#).

Zero waste pattern fashion design in the new normal era was conducted by [Hervianti & Nursasari \(2018\)](#), a Petra Christian University Fashion and Textile Design student. The Zero Waste Pattern method used in the design uses a sustainable cutting method approach ([Rissanen, 2015](#)). The following are the results of research conducted by [Hervianti & Nursasari \(2018\)](#):

Table 1. Tiffany's Zero Waste pattern

Name	Pattern	Result
Pleated Batik Trouser		
Outer Gather Top		

Name	Pattern	Result
Pleated Pocket Top		
Asymmetric Gather and Pleated Top		
Batik Skirt		

2.3. Wastra

Wastra in Sanskrit means a piece of cloth. Wastra is a traditional cloth that has a meaning in Indonesian traditions and culture. Indonesian textiles from various regions of Indonesia have different philosophical meanings, colors, sizes, and materials. Some examples of the types of traditional Indonesian fabrics are batik, lurik, songket, ulos, sasirangan, Bugis sarongs, tapis, gringsing, jumputan, poleng, besurek, and so on. Wastra is made traditionally, and pure manual tools result from craftsmen's handicrafts. Wastra is different from textiles. Textiles are fabrics made with modern machines. Wastra is a traditional cloth, but not all are a wastra cloth. For example, batik motifs made by printing are traditional fabrics but not silk fabrics because of the different ways of processing (Kusrianto, 2023).

Based on the manufacturing process, Wastra fabrics are divided into two categories. The first is rafting, the process of making motifs simultaneously with making the cloth. The rafting process produces woven fabrics. Weaving has many types, from simple weaving to tenun ikat. The second category is background design, the process of making motifs on the surface of the cloth after it is finished. Batik, jumputan, and embroidery techniques are wastra fabrics that use a background design process (Semuel et al., 2022). The process of making wastra cloth is much more environmentally friendly compared to machine-made cloth. Wastra usually comes from natural fibers and is made by craftsmen.

2.3.1. Observe

At this step, researchers will also try to understand market tastes by observing retail, social media, and various ready-to-wear line alternatives to understand the designs that the market likes. At this stage, we will also look for fabrics that will be used for research. The following are the results of a wastra survey that was conducted at Sekar Sari, BTC, Surakarta, on December 3, 2022:



Table 2. Wastra Research at Market

Name	Figure	Size
Tenun Troso		width: 110 cm length: 240 cm
Batik Cap		width: 110 cm length: 200 cm
Lurik		width: 100 cm length: 200 cm
Jumputan		width: 110 cm length: 200 cm

2.3.2. Point of View

On the basis of the data that has been collected, the researcher can determine the initial design, the zero-waste pattern method, and the material to be used. This research will focus on the development of Tiffany's patterns from DFT 18 Petra Christian University students. The textile fabric to be used is Batik Ikat Celup (Jumputan), with a sun motif and a fabric width of 115 cm. The popular fabrics used in combination are kawung printed cotton with a width of 115 cm and Dameron cotton with a width of 115 cm.

Table 3. Material

Fabric	Figure	Size
Batik Jumputan		length: 200 cm width: 115 cm
Kawung Printed Cotton		width: 115 cm

Fabric	Figure	Size
Dameron Cotton		width: 115 cm

The textile chosen in this study is Batik Ikat Celup (Jumputan) with sun motifs. Jumputan was chosen because it has a pattern that repeats constantly. If the fabric is cut from various sides, the cut motifs will still look the same, making it easier for early studies on applying Zero Waste Patterns to fabrics. The selection of quite tenuous but constant motifs makes it easier to cut and sew fabrics to produce clothes with seamless motifs. Jumputan was specially ordered at Jumputan Sisca, Solo. The popular fabric used in this study is printed cotton with kawung motifs. This fabric is out of date stock from the company PT Bateeq Retailindo Utama. The selection of out-of-date fabrics aligns with the concept of slow fashion. In addition, even though the cloth is made using modern printing techniques, the motif is batik. White Dameron cotton is another popular fabric used in multi-fabric combinations.



Figure 2. Design Sketch

2.3.3. Ideate

At this step, the researchers conducted pattern development and testing to obtain the most efficient zero-waste combination pattern to be applied to multi-fabrics.



Figure 3. Documentation of the Ideating Process

2.3.4. Prototype

This step will be carried out by testing the pattern on the originality with calico fabric, and in the second step, it will be tried for application with wastra.



Figure 4. Documentation of the Prototyping Process

2.3.5. Test

At this step, the pattern is ready, and the model to be put on the market is ready to be documented and exhibited. Until this article was written, the testing step had not been done because of a time limitation.



3. Results

The results of this study concern the data about zero-waste fashion on the market, the development of zero-waste patterns, and selected fabrics.



3.1. Market Research

Many local Indonesian brands are moving towards Zero Waste Fashion (ZWF). The Zero Waste Fashion method used by each brand is different. Here are the results of Zero Waste Fashion research in Indonesia:

Table 4. Market Research

Brand	Figure	ZWF Method	Fabric
Sejauh Mata Memandang		recycling patchwork into new clothes	batik cap & batik tulis (wastra)
Sare studio		using natural fiber on their product	printed cotton rayon

Sare

Brand	Figure	ZWF Method	Fabric
Imaji Studio		using natural-dyes on coloring their product	cotton
Hlaili	<p>Imaji</p>  <p>Hlaili</p>	using zero waste pattern	organza, tulle

Most of the existing Zero Waste Fashion products only use mono fabric. This research wants to provide innovation in the form of zero-waste fashion design using a combination of wastra and popular fabrics using the zero-waste pattern method.

3.2. Zero Waste Pattern

This design development will use a cloth with a width of 115 cm to achieve a residue below 5%; ideally, it can reach 0%. Mapping is done by trying several alternative ZWF pattern models on the market and seeing how these patterns are realized in the half-scale module. Of the various patterns tried, the researcher decided to find the optimal combination of 5 designs (2 tops, 2 bottoms, and 1 dress). In idea stage 1, the researcher tries five patterns to form the basis for the next product development. The pattern made in this study is a development of the pattern belonging to Tiffany, a Design Fashion and Textile 2018 student at Petra Christian University. Tiffany's pattern does not consider the width of the fabric, so it still leaves the waste on the width side. In this research, the width of the fabric will be considered and optimized for reducing waste. These patterns are:

3.2.1. Top 1

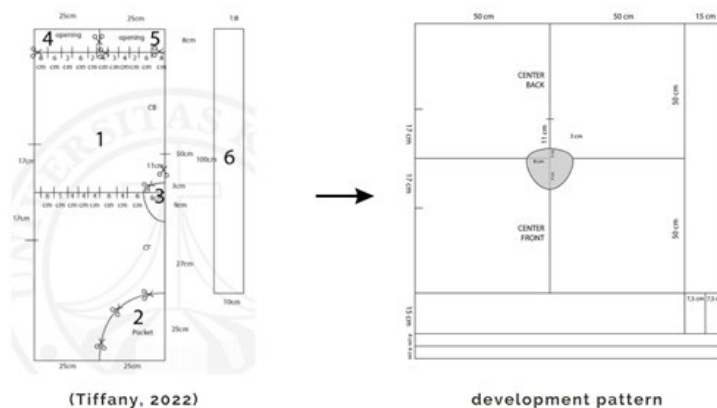


Figure 5. Top 1 Zero Waste Pattern

This pattern requires an area of fabric 123 cm x 115 cm, with the remaining fabric the gray area is, leaving 1,4% of waste.



Figure 6. Top 1 Prototype on Half Scale

3.2.2. Top 2

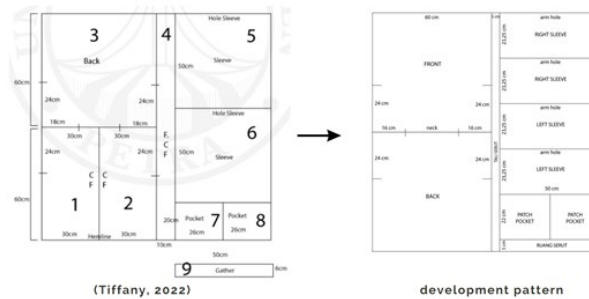


Figure 7. Top 2 Zero Waste Pattern

This pattern requires a fabric area of 120 cm x 115 cm and leaves 0% of waste.



Figure 8. Top 2 Prototype on Half Scale

3.2.3. Pants

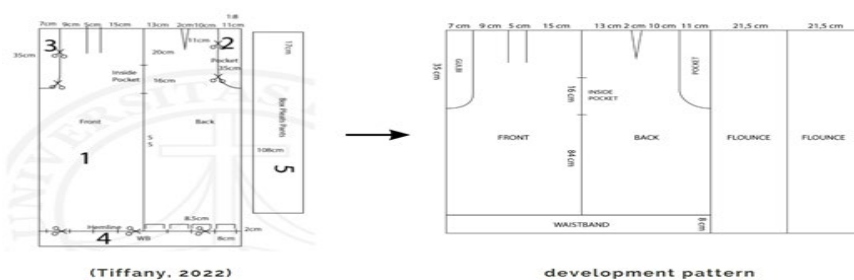


Figure 9. Zero Waste Pants

This pattern requires a fabric area of 92 cm x 115 cm and leaves 0% of waste.



Figure 10. Pants Prototype on Half Scale

3.2.4. Skirt

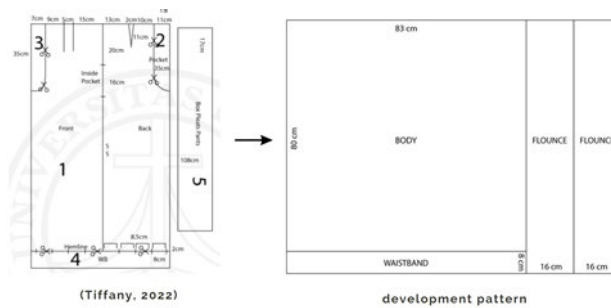


Figure 11. Zero Waste Skirt

This pattern requires a fabric area of 88 cm x 115 cm and leaves 0% of waste.



Figure 12. Skirt Prototype on Half Scale

3.2.5. Dress

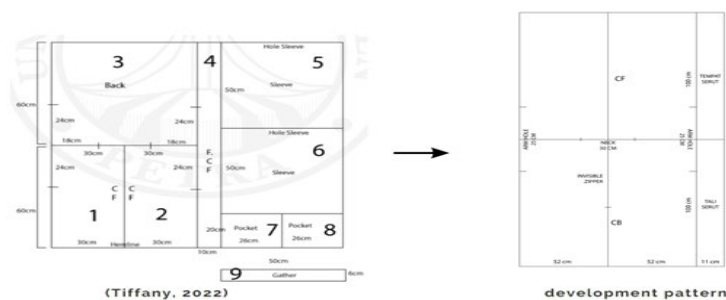


Figure 13. Dress Zero Waste Pattern

This pattern requires a fabric area of 200 cm x 115 cm and leaves 0% of waste.



Figure 14. Dress Prototype on Half Scale

4. Discussion

The Zero Waste Pattern applied to multi-fabrics will be optimal if all types of fabrics used have the same width. In this study, all types of cloth used had a width of 115 cm, making research easier. The combination is done using two pieces of cloth. For the two pieces of cloth to produce less than 15% waste or up to 0% waste, a logic puzzle is needed. In order to make it easier to understand the puzzle's logic, it can be seen in Figure 13. One zero waste pattern applied using the puzzle logic produces two clothes, so all types of fabric used produce close to 0% waste. Both designs produce opposing results.

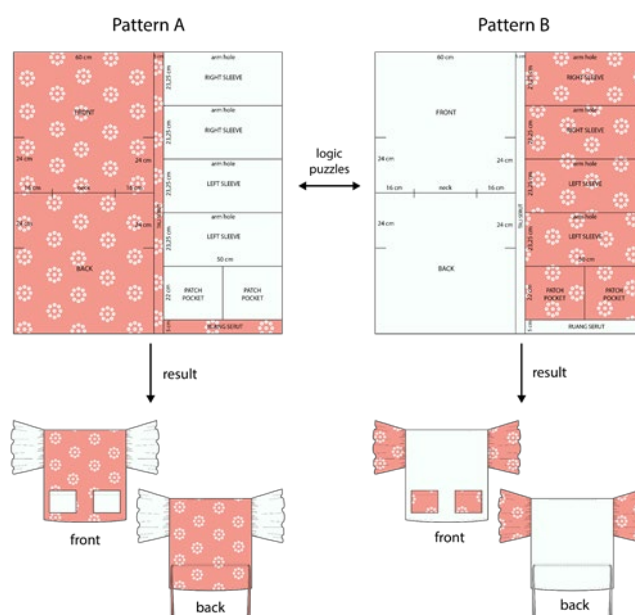


Figure 15. Logic Puzzle Illustration

Wastra is in the form of pieces of fabric that have various lengths. The Jumputan fabric has a length of 200 cm. In this study, the length of the wastra has not been considered, so it still results in the remaining waste on the length part of the fabric. Wastra is different from popular fabric in that the length of the fabric can be purchased on the market as needed so as to minimize waste on the length of the fabric. It can be a suggestion for future research to pay attention to the length of the fabric when making Zero Waste Patterns.

5. Conclusions

This study concludes that the sustainable cutting technique is highly efficient when applied to fabric with a width of 115 cm to produce five clothing items. A multi-fabric combination using the zero-waste pattern method will optimally zero fabric waste by making two clothing items A and B from the same pattern, resulting in an inverted look between items A and B. The choice of width for each different fabric

must be the same. The Wastra must have a pattern that can be rotated in various directions and still produce a seamless pattern. This research focuses on cloth with a width of 115 cm. The Zero Waste Pattern that has been made needs to be readjusted if applied to fabrics with different widths. In addition, this research only focuses on consuming the width of the fabric, so the Wastra in the form of pieces of fabric still leaves waste in the length part of the fabric. It could be a suggestion for future research to pay attention to the length of the cloth in making Zero Waste Patterns.

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