

Research Article

## Transformation of Production Techniques and Textile Materials Towards Sustainable Fashion

Rizka Sarah Heydarina Fathima Ahsan<sup>1, \*</sup>, Jibril Maulana<sup>2</sup>, Galih Janggan Titian<sup>3</sup>, Dina Aulia Mawardah<sup>4</sup>, Aurelia Vika Anggun R.<sup>5</sup>

<sup>1,3,5</sup>Fashion Design Study Program, Vocational Faculty, Universitas Negeri Malang, Indonesia

<sup>2</sup> Manufacturing Engineering Technology Study Program, Vocational Faculty, Universitas Negeri Malang, Indonesia

\* Corresponding Author: [rizka.ahsan.fv@um.ac.id](mailto:rizka.ahsan.fv@um.ac.id)

**Abstract:** This study aims to analyze the relationship between production techniques, selection of textile materials and the level of sustainable fashion implementation in MSMEs in the fashion sector in Indonesia. The method used in this study is a quantitative approach with an explanatory descriptive design. Data was collected through a questionnaire distributed to MSME respondents in the fashion sector and collected 100 respondents. The variables tested in this study are knowledge of sustainable fashion, production techniques used by MSMEs and textile materials applied in production. Data analysis used validity, readiness, t-test and multiple linear regression tests. The results of the study show that production techniques have a significant influence on the level of sustainable fashion implementation, with a p-value of 0.041. Meanwhile, textile knowledge and materials did not show a significant influence on the implementation of sustainable fashion with a p-value of >0.05. The value of the determination coefficient (R<sup>2</sup>) for production techniques is very high at 0.95, which shows that production techniques are the most influential factor in the implementation of sustainable fashion in MSMEs in the fashion sector to prioritize the development of sustainable production techniques as the main step towards increasing sustainability in the fashion sector.

**Keywords:** Fashion Industry; MSMEs; Production Techniques; Sustainable Fashion; Textile Materials.

### 1. Introduction

The fashion industry is one of the economic sectors that makes a major contribution to global economic growth, but it also has a significant environmental impact. The fashion production process often results in fabric waste, carbon emissions, and the use of chemicals that pollute the environment. In this context, several studies support this statement (Qiddist Sayyida & Wardaya, 2022). Research Gazzola et al. (2020) shows that the fashion industry is experiencing an increased awareness of the importance of sustainability and the circular economy, although it is still a niche market. This reflects the urgent need to develop environmentally friendly production techniques and sustainable materials. In addition, (Chan, T. and Wong, 2012) emphasizes that fashion companies do not only need to produce clothes but must improve production systems and designs to meet the needs of sustainable consumers. As well as the importance of innovation in production techniques, such as zero waste fashion and the use of recycled and organic materials (Mukendi et al., 2020).

The application of this technique is still limited to MSMEs in the fashion sector facing additional challenges related to access to environmentally friendly technology and materials. In Indonesia, it is noted that sustainability in the fashion industry is very important to achieve the Sustainable Development goals of the SDGs set by the United Nations, especially in terms of quality Education and responsible consumption (SHAFIE et al., 2021). So, it can be concluded that education and awareness of sustainability need to be improved to support MSMEs in adopting more environmentally friendly production practices. Therefore, the

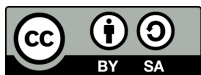
Received: July 22, 2025

Revised: September 11, 2025

Accepted: November 25, 2025

Published: January 31, 2026

Curr. Ver.: January 31, 2026



Copyright: © 2025 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>)



The basic principles of sustainable fashion or sustainability in fashion, which cover the entire life cycle from design, production to consumption and disposal (Fletcher et al., 2012). The circular fashion approach also emphasizes the importance of resource efficiency, waste reduction and sustainable reuse of materials (Niinimäki, 2018). By applying circularity in fashion, including the use of sustainable materials, innovative production techniques, and consumer involvement in sustainable practices. Apart from that, sustainable fashion also has great challenges, with rapid production cycles and low-cost garments will continue to dominate industry and lead to excessive waste and cause environmental damage (Piippo & Niinimäki, 2021). But there are also opportunities for innovation and collaboration in this sector, by leveraging technology, fostering partnerships and promoting the fashion industry using production techniques as well as in sustainable business models. So, sustainability in fashion design and production will be very important to create a more responsible fashion ecosystem.

### **Production techniques**

The fashion industry has long been one of the largest contributors of waste and is an environmental and social problem in the world. After the emergence of the concept of sustainable fashion, it became an important response to this challenge. Production techniques that support sustainable fashion focus on ethical practices, the use of eco-friendly materials and design innovations that reduce negative impacts on the environment (Rissanen, Timo ; McQuillan, n.d.). One of these production techniques is by implementing ethical production practices. This includes the use of environmentally friendly materials and minimal waste and pollution processes (Havenga & Walt, 2023). The integration of traditional motifs and techniques into modern design can also improve sustainability by preserving cultural heritage while promoting innovative practices (Alajaji, 2022). This technique emphasizes the importance of reformulating traditional designs in contemporary contexts to protect against extinction, thus encouraging a sustainable fashion approach (Kusuma et al., 2025). In addition, production techniques can also be seen in the method of working on pattern and sewing techniques. In this context, the use of residual patchwork materials, zero waste patterns, subtraction cutting and eco printing is included in production techniques that support sustainable fashion.

### **Sustainable materials**

One of the focus areas in sustainable textiles is the development of eco-friendly fibers and materials. Natural fibers such as organic cotton offer great environmental benefits compared to conventional cotton production (Tang, 2023). Organic cotton significantly reduces the negative impact on the environment using traditional farming methods including the use of pesticides (He, 2023). Innovative blends such as cotton fabrics with cork blends have emerged as promising sustainable options, displaying good results for the fashion industry (Arya & Sarkar, 2024). One of the sustainable textiles that stands out is textiles made from recycled materials. Like post-consumer cotton recycling, it is gaining traction as a method to recover value from textile waste. This recycling or upcycling process, although effective, often leads to downcycling, resulting in low-quality products such as rags or others, which necessitate mixing with new fibers to produce high-quality fabrics (Cao et al., 2022). These recycled textiles play an important role in sustainable fashion, textile waste management practices such as reduction, reuse and recycle are increasingly adopted by the fashion industry aimed at creating circular fashion. The fashion industry in Indonesia is dominated by MSMEs, MSMEs in the fashion sector in Indonesia have great potential to contribute to the national economy. However, this sector also has difficulties in facing challenges related to sustainable fashion. Some of the main challenges faced, 1) difficulties in waste treatment; 2) limited knowledge and skills; 3) access to technology; and 4) high production costs (Niati, 2020). By understanding these challenges, MSME industry players in the fashion sector in Indonesia can take the necessary steps to overcome the barriers and leverage them in their design and production innovations. The reality in Indonesia Sarasi et al. (2024) is that sustainable practices carried out by MSMEs in the fashion sector in Indonesia are still in the early stages with a focus on local design and limited skills, raw materials that are difficult to choose for their motives, low production capacity and limited capital because the price of sustainable products is still considered expensive compared to fast fashion (Ahsan et al., 2025).

### 3. Research Method

This study uses a quantitative approach with an explanatory descriptive design. This descriptive approach is used to see the actual conditions in the application of production techniques and the use of textile materials in MSMEs in the fashion sector, while the explanatory approach is used to analyze the relationship between production techniques and textile materials to the level of sustainable fashion application. This research is also applied, because the results of the analysis will be used as the basis for determining production techniques and materials at the stage of developing sustainable fashion prototypes. The subjects of this study are MSME actors in the fashion sector in Indonesia who have been operating for at least 3 years, have experience in fashion production, and are directly involved in the production process. Data collection is carried out indefinitely; the main data is collected through quantitative surveys and observations.

This study examined three independent variables and one dependent variable, namely knowledge about sustainable fashion (X1) measuring the level of knowledge of MSME actors about the concept of knowledge of MSME actors, production techniques (X2) measuring the extent to which production techniques used by MSMEs have considered sustainability principles, textile materials (X3) measuring the selection of environmentally friendly textile materials, such as organic cotton, linen, or recycled materials, and the level of sustainable fashion (Y) adoption measures the extent to which sustainable fashion practices are implemented by MSMEs in their production. Data analysis was carried out using several statistical methods:

#### Validity and Reliability Tests

The validity test was conducted using the Pearson correlation between the items in the questionnaire while the reliability test used Cronbach's Alpha. A Cronbach's Alpha value greater than 0.5 indicates that the instrument is reliable.

#### Frequency Distribution

At this stage, it is used to describe the distribution of respondents based on the categories of variables studied, such as the level of knowledge about sustainable fashion, the type of production techniques used, and the type of materials used.

#### T-test

The t-test used the mean difference between the two groups to determine whether the independent variable significantly affects the dependent variable.

$$t = \frac{X_1 - X_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Description:

X1, X2 = Average sample 1 and sample 2

S1, S2 = the variance of each sample

n1, n2 = number of respondents in each group

#### Multiple Linear Regression Test

$$Y = a + b_0X_1 + b_2X_2 + \dots + b_NX_N$$

Description:

Y = Independent Variables

X1, X2....Xn = Independent Variables

b1, b2... bn = The regression coefficient of each independent variable

#### R<sup>2</sup> Test (Coefficient of Determination)

$$R^2 = \frac{(ryx_1)^2 + (ryx_2)^2 - 2.(ryx_1).(ryx_2).(ryx_1x_2)}{1 - (ryx_1)^2}$$

Description:

R<sup>2</sup> = Coefficient of Determination

ryx1 = Simple correlation (product moment pearson) between X1 and Y

ryx2 = Simple correlation between X2 and Y

ryx1x2 = Simple correlation between X1 and X2

The R2 test is used to measure how well the regression model reflects variations in the data. So, if a high R2 value indicates that the model can explain most of the variation in the application of sustainable fashion, according to the following correlation category table.

**Table 1.** Category Correlation.

Category Correlation	
0.00-0.19	Very Low
0.20-0.39	Low
0.40-0.59	Medium
0.60-0.79	Strong
0.80-1	Very Powerful

Meanwhile, to calculate the coefficient of determination (KD) to see how much variable X contributes to variable Y using the following formula:

$$KD = r^2 \times 100\%$$

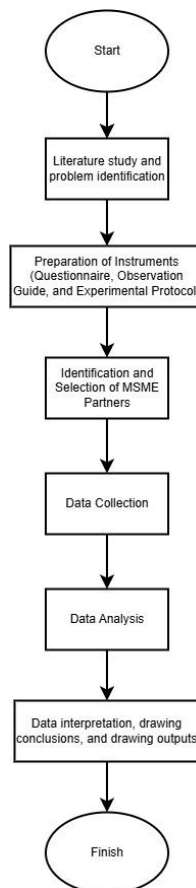
Description:

KD = Coefficient of Determination

$r^2$  = Correlation Coefficients

**Boundary conditions and research flows**

This study uses a descriptive quantitative approach that aims to analyze the application of production and material techniques which aims to analyze the application of sustainable fashion production techniques and materials in MSMEs in the fashion sector in Indonesia. Data will be collected through surveys, observations and experiments. The population in this study is MSMEs in the fashion sector in Indonesia. Data will be collected through surveys, observations and experiments. The population in this study is MSMEs in the fashion sector in Indonesia that have or want to adopt the principles of sustainable fashion. Meanwhile, samples will be selected using purposive sampling techniques with the criteria of MSMEs that have been operating for at least 3 years, have experience in fashion production and are interested in using production techniques for sustainable fashion. This research has a research stage that will explain the activities of each stage as well as its outputs and indicators on the flow chart.



**Figure 2.** Flow Chart Research.

#### 4. Results and Discussion

This study aims to analyze the relationship between production techniques, textile material selection, and the level of application of fashion sustainable in MSMEs in the fashion sector in Indonesia. Data obtained from 100 respondents showed that production techniques and textile materials play an important role in sustainable fashion practices in MSMEs.

##### Knowledge of Sustainable Fashion

Most MSMEs have a sufficient or good level of knowledge about sustainable fashion, although there are a small number of respondents who do not know about the concept.

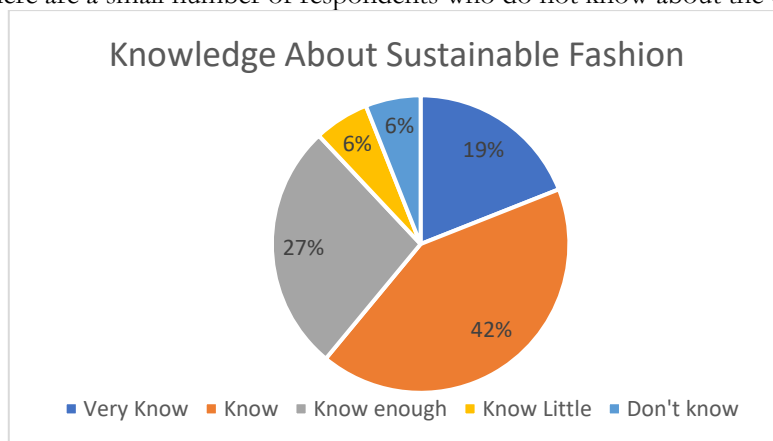


Figure 3. Knowledge of Sustainable Fashion

Based on the diagram above, 42% of respondents stated that they know about sustainable fashion, while 27% feel they know enough and only 6% do not know at all. This shows that there is a growing awareness among MSMEs about the importance of sustainability in the fashion industry.

##### Use of Sustainable Materials

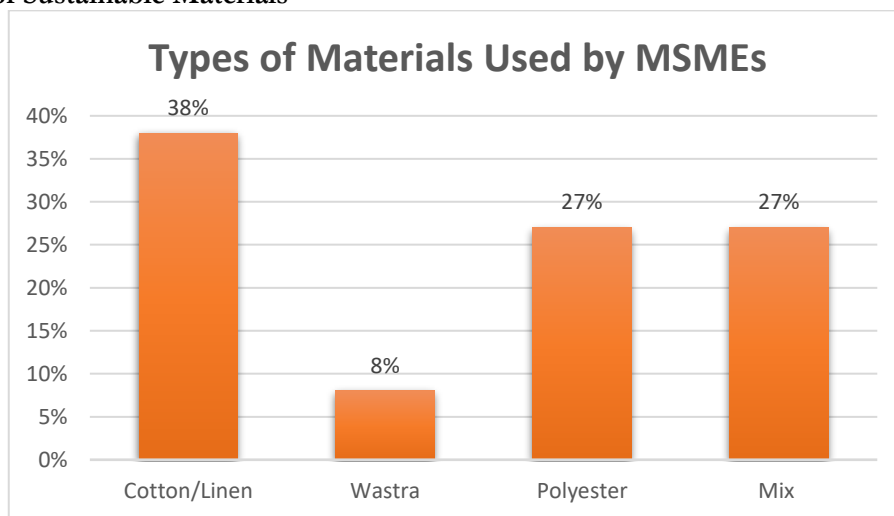


Figure 4. Types of Materials Used by MSMEs.

Based on the image above, 46% of MSMEs have used sustainable materials in their fashion products, namely cotton/linen and wastra, but there are still some MSMEs that have not fully switched to more environmentally friendly materials. 27% still use blends and the other 27% use polyester materials.

##### Production Techniques

Most MSMEs in the Indonesian fashion sector still use medium or low production techniques. Only 5% of respondents consider their production techniques to be at a high level. This shows that many MSMEs have not fully adopted sustainable production techniques, although a small percentage have implemented some more environmentally friendly practices, reducing the negative impact on the environment through incremental production techniques does not seem to be a top priority for most MSMEs.

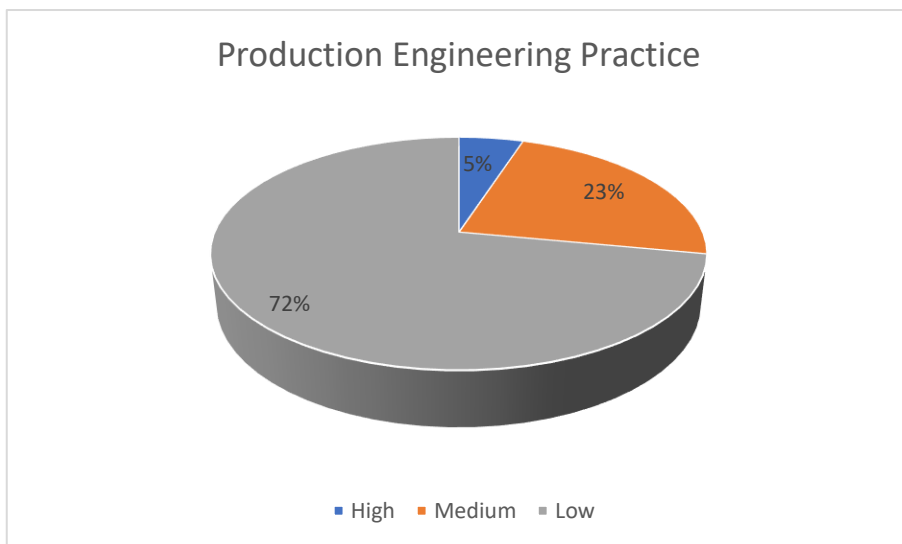


Figure 5. Production Engineering Practice.

**Difficulties in Implementing Sustainable Fashion**

Some MSMEs face difficulties in implementing sustainable fashion practices, especially related to the availability of sustainable raw materials and higher production costs.

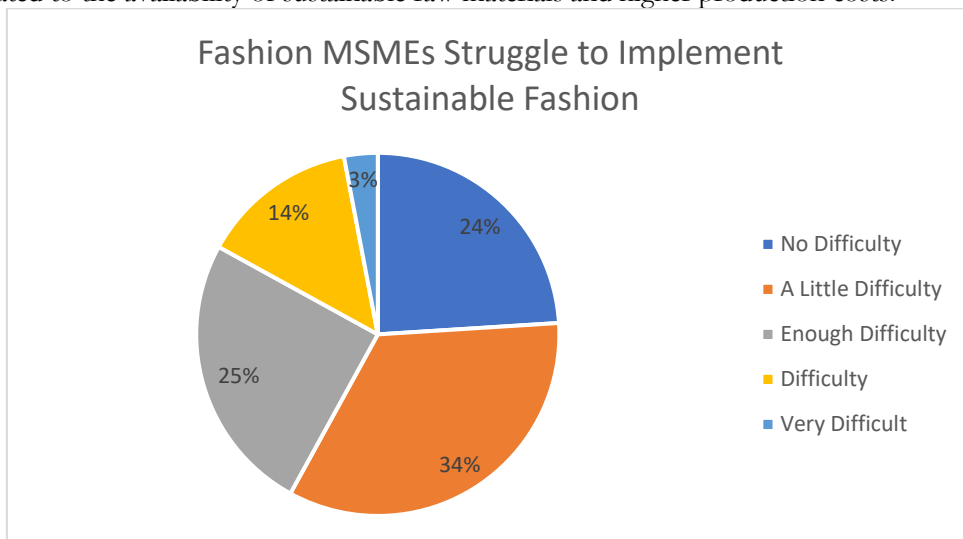


Figure 6. Fashion MSME's Struggle to Implement Sustainable Fashion.

Based on this data, 24% of respondents admitted that no one faced difficulties, but more than 50% revealed that there were challenges in the implementation process.

**Results of the t-test and its interpretation**

**The Influence of Knowledge on Sustainable Fashion (X1) on the Application of Sustainable Fashion (Y)**

Based on the results of the T test, X1 did not have a significant influence on Y in MSMEs in the fashion sector with a total p-value = 0.649. This shows that although many MSMEs have knowledge of the concept of sustainable fashion, this understanding is not enough to drive significant changes in their production practices. This is due to a lack of practical skills or cost barriers in applying sustainable principles in production.

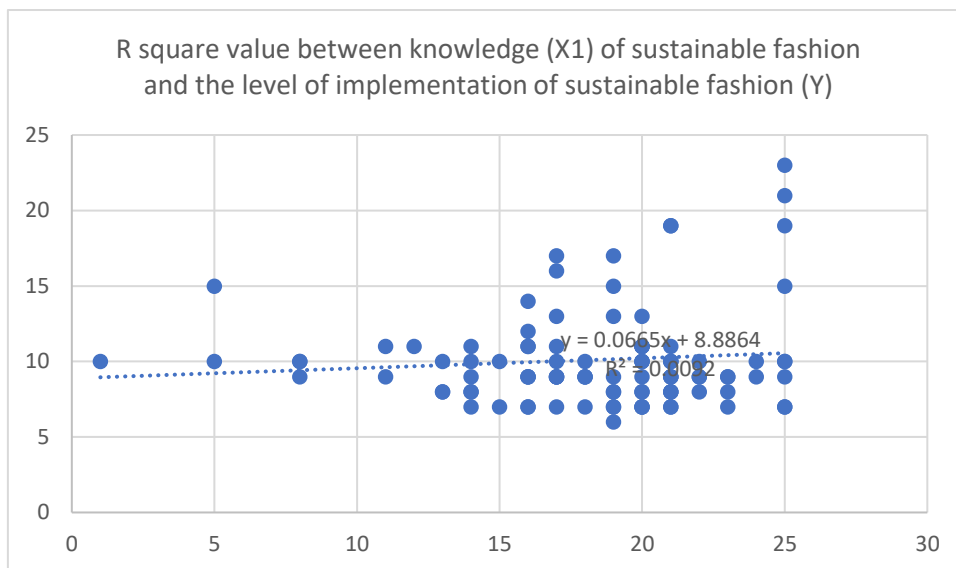


Figure 7. R square value between knowledge (X1) of sustainable fashion and the level of implementation of sustainable fashion (Y).

The multiple linear regression test that has been carried out on X1 has a result of  $R^2 = 0.0092$  so that the effect on the level of sustainable fashion implementation is very small, so knowledge alone is not enough to change the production practices of MSMEs towards better sustainability.

**The Influence of Production Techniques (X2) on the Implementation of Sustainable Fashion (Y)**

The t-test showed that X2 had a significant influence on Y with a p-value = 0.041. This means that MSMEs that adopt more environmentally friendly or sustainable production techniques tend to have a higher rate of sustainable fashion implementation. These results show that sustainable production techniques can reduce environmental impact and improve production efficiency.

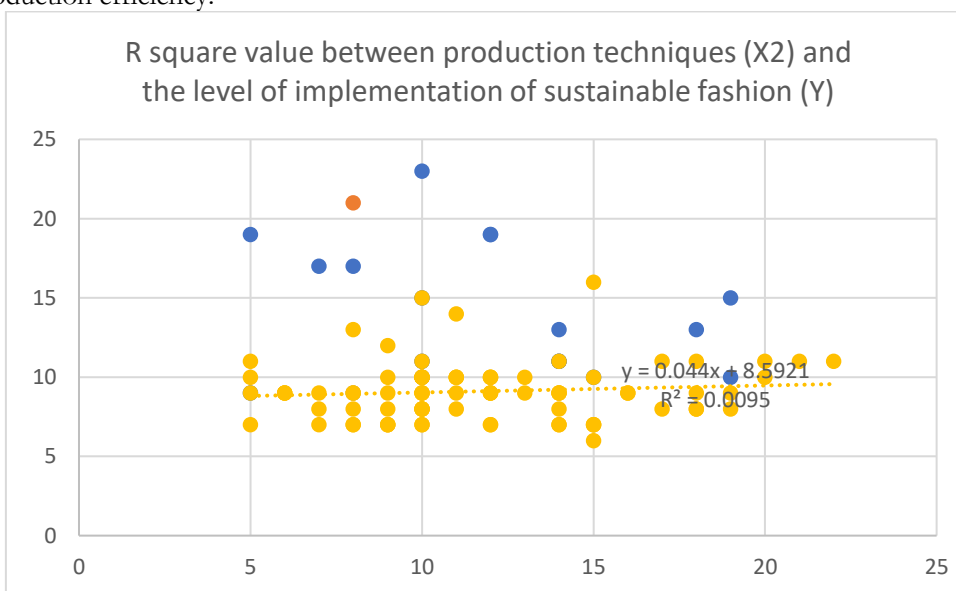
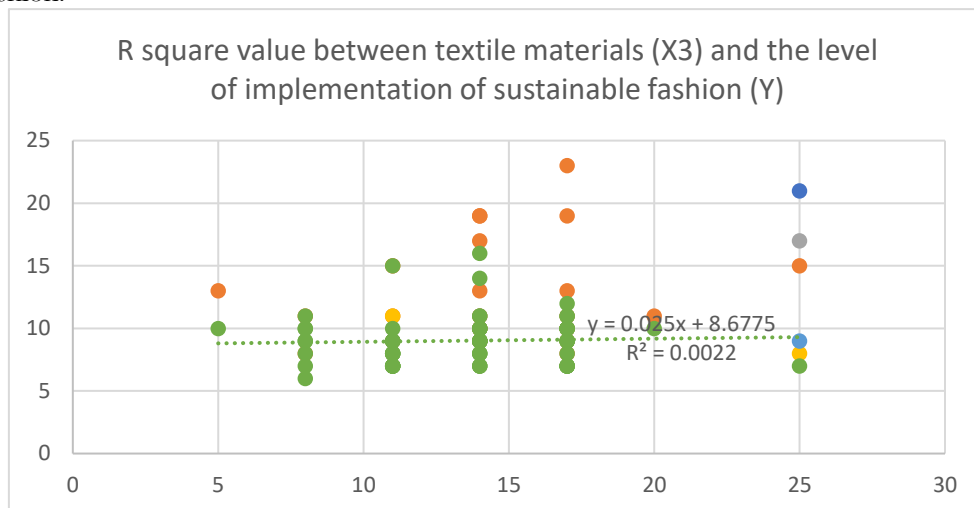


Figure 8. R square value between production techniques (X2) and the level of implementation of sustainable fashion (Y).

The multiple linear regression test that has been carried out has data  $R^2 = 0.95$  so it shows that X2 has a strong influence which means that almost any change in the level of sustainable fashion implementation can be explained by this factor. This emphasizes the importance of adopting sustainable production techniques as the main step in increasing sustainability in MSMEs.

### The Influence of Textile Materials (X3) on the Implementation of Sustainable Fashion (Y)

The results of the t-test showed that X3 had no significant effect on Y with a p-value = 0.264. Although many MSMEs use sustainable materials, the use of these materials is not always accompanied by significant improvements in other sustainable practices, such as waste treatment or energy efficiency in the production process. This shows that material selection alone is not enough to encourage substantial changes in the implementation of sustainable fashion.



**Figure 9.** R square value between textile materials (X3) and the level of implementation of sustainable fashion (Y).

The multiple linear regression test that has been carried out has data  $R^2 = 0.0022$  so that it shows that the effect on Y is very small, the figure shows that even though MSMEs use sustainable materials, the material is not influential enough to encourage significant changes in overall production practices.

Based on the analysis above, it can be concluded that production techniques are the most significant factor in the implementation of sustainable fashion in MSMEs in the fashion sector in Indonesia. Although knowledge and use of materials have increased, constraints such as cost and availability of raw materials remain barriers to adopting sustainable practices widely. The adoption of sustainable technology in production does require a change in mindset and investment in equipment and training. This is in accordance with research findings that show that sustainable production techniques are the main determining factor in the implementation of sustainable fashion. Meanwhile, the use of sustainable materials is not enough to drive greater changes in production practices in MSMEs.

### 5. Conclusion

This research shows that production techniques are a key factor in encouraging the application of sustainable fashion in MSMEs in the fashion sector. Although the awareness about sustainable fashion is increasing, the cost factor and the availability of clothing materials are still a big challenge. Therefore, it is important for MSMEs to increase the application of sustainable production techniques so that they can more effectively mitigate environmental impacts and increase production efficiency.

The results of the study show that production techniques have a significant influence on the application of sustainable fashion in MSMEs, with a very high p-value and determination coefficient ( $R^2$ ). Meanwhile, knowledge about sustainable fashion and textile materials does not show a significant influence on the implementation of sustainable fashion. These findings show that production techniques are the main factor in the implementation of sustainable fashion in MSMEs in the fashion sector. These findings support the argument that the development of more environmentally friendly production techniques needs to be a priority for MSMEs in adopting sustainable principles.

An important contribution in this study is to understand the factors that affect the implementation of sustainable fashion in the fashion MSME sector in Indonesia. Further research is expected to explore and develop what production techniques are appropriate to support sustainable fashion.

## References

- Ahsan, R. S. H. F., Rahayu, S. E. P., & Kibtiyah, A. (2025). *Eksplorasi transformasi simbolik gajah oling dalam penciptaan busana ready-to-wear berbasis budaya Banyuwangi*. *Journal of Fashion & Textile Design Unesa*, 6, 334–345. <https://ejournal.unesa.ac.id/index.php/baju/article/view/73641/53059>
- Alajaji, T. N. (2022). Developing sustainable traditional costume designs inspired by Saudi traditional fashion. *World Journal of Education and Multidisciplinary Studies*, 18(4), 533–553. <https://doi.org/10.47556/J.WJEMSD.18.4.2022.7>
- Arya, P., & Sarkar, A. K. (2024). *Cotton–cork blended fabric: An innovative and sustainable apparel textile for the fashion industry*.
- Cao, H., Cobb, K., Yatvitskiy, M., Wolfe, M., & Shen, H. (2022). *Textile and product development from end-of-use cotton apparel: A study to reclaim value from waste*.
- Chan, T., & Wong, C. W. Y. (2012). The consumption side of sustainable fashion supply chain: Understanding fashion consumer eco-fashion consumption decision. *Journal of Fashion Marketing and Management*, 16(2), 193–215. <https://doi.org/10.1108/13612021211222824>
- Fletcher, K., & Grose, L. (2012). *Fashion and sustainability: Design for change*. Laurence King Publishing. [https://books.google.co.id/books/about/Fashion\\_and\\_Sustainability.html?id=kFZAXwAACAAJ](https://books.google.co.id/books/about/Fashion_and_Sustainability.html?id=kFZAXwAACAAJ)
- Gazzola, P., Pavione, E., Pezzetti, R., & Grechi, D. (2020). *Trends in the fashion industry: The perception of sustainability and circular economy: A gender/generation quantitative approach*.
- Havenga, S., & Van der Walt, P. (2023). Design optimisation of TPU modular footwear for sustainable fashion: A South African Fashion Week case study. *E3S Web of Conferences*, 05005.
- He, J. (2023). Comparative sustainability assessment of organic versus conventional cotton production. *International Journal of Education and Humanities*, 10(2), 8–10. <https://doi.org/10.54097/ijeh.v10i2.11317>
- Kusuma, A. A., Ahsan, R. S. H. F., Hidayati, N., Sunan, A., Rahayu, S. E. P., & Pradani, R. Y. (2025). Transformasi desain fesyen virtual 3D dengan teknologi artificial intelligence Luma. *JIPi: Jurnal Ilmiah Penelitian dan Pembelajaran Informatika*, 10(3), 2700–2713.
- Mukendi, A., Davies, I., Glozer, S., & McDonagh, P. (2020). Sustainable fashion: Current and future research directions. *European Journal of Marketing*, 54(11), 2873–2909. <https://doi.org/10.1108/EJMJ-02-2019-0132>
- Niati, B. (2020). PKM tata busana di Desa Suka Damai Kecamatan Ujungbatu Rokan Hulu. *Dinamisia: Jurnal Pengabdian Kepada Masyarakat*, 4(1), 161–168. <https://doi.org/10.31849/dinamisia.v4i1.3753>
- Niinimäki, K. (2018). *Sustainable fashion in a circular economy*.
- Piippo, R., & Niinimäki, K. (2021). Garment quality and product lifetimes. In *Proceedings of the 4th PLATE Conference 2021*.
- Qiddist Sayyida, S., & Wardaya, M. (2022). Sustainable fashion: Investasi pada produk fashion yang berkualitas untuk mengurangi limbah fashion yang menumpuk. *Nirmana*, 21(2), 92–96. <https://doi.org/10.9744/nirmana.21.2.92-96>
- Rissanen, T., & McQuillan, H. (n.d.). *Zero waste fashion design* (2nd ed.). Bloomsbury Visual Arts. <https://doi.org/10.5040/9781350241862>
- Sarasi, V., Primiana, I., Harsanto, B., Satyakti, Y., Krismawintari, D. P. N., Kusnady, D., Sunarni, P., Pithaloka, H., Gunarian, N., Natalia, S. F., Endrayana, J. P. M., Retnasari, D., & Tanzil, M. Y. (2024). The sustainable practices of Indonesian fashion brands. *Prosiding Pendidikan Teknik Boga Busana*, 4(4), 26–37. <https://doi.org/10.1108/RJTA-08-2022-0091>
- Shafie, S. B., Kamis, A., & Ramli, M. F. (2021). Sustainability of fashion apparel toward environmental well-being and sustainable development. *Journal of Vocational Education Studies*, 4(1), 60. <https://doi.org/10.12928/joves.v4i1.3638>
- Shen, B., Zheng, J. H., Chow, P. S., & Chow, K. Y. (2014). Perception of fashion sustainability in online community. *Journal of the Textile Institute*, 105(9), 971–979. <https://doi.org/10.1080/00405000.2013.866334>
- Tang, K. H. D. (2023). State of the art in textile waste management: A review. *Textiles*, 3(4), 454–467. <https://doi.org/10.3390/textiles3040027>