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# Sustainable Skill Development Through Ecoprinting Based on Organic Material Residues on Textile Media

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**Abstract** The textile industry and urban households face increasing pressure to adopt sustainable practices to mitigate environmental impacts. This research examines the development of sustainable applied skills through organic waste-based ecoprinting within a community education framework. Using a qualitative approach with Participatory Action Research (PAR) design, the study involved twenty members of the Pemberdayaan Kesejahteraan Keluarga (PKK) women's group in Surabaya. The intervention utilized a workshop-based learning model integrating organic kitchen residuals, such as onion skins and turmeric, as natural dyes for textile media. Data were collected through direct observation, product quality assessments, and semi-structured interviews. Findings reveal a transformative improvement in participants' technical competencies, specifically in natural mordanting and ecoprinting techniques. Beyond skill acquisition, the reuse of organic waste elevated environmental literacy and fostered a sustainable mindset toward household waste management. This study concludes that waste-to-art pedagogy is an effective strategy for community empowerment, bridging environmental sustainability with non-formal applied education. The results highlight how community-based learning can drive the circular economy by transforming domestic by-products into high-value creative assets, ensuring long-term resilience for urban communities.

**Keywords:** Ecoprinting; Organic Residuals; Sustainable Skills; Community Empowerment; Participatory Action Research (PAR)

## INTRODUCTION

The increasing amount of waste generated worldwide is a serious problem and a significant threat to the environment (Prasad, 2021). In urban areas like Medokan Ayu, Surabaya, the problem of domestic organic waste has not been optimally addressed and tends to become a persistent environmental burden. Kitchen scraps such as onion skins, turmeric peels, tea dregs, and coffee grounds generally end up in landfills without any value-added processing. As Wiraningtyas noted, household and industrial waste is rarely utilized (Wiraningtyas, 2020). Yet, this household waste contains natural pigment compounds with potential for the textile creative industry. Furthermore, creative processes using a recycled art approach can be a solution to waste accumulation (Yulianto dkk., 2017).

For example, onion skins have great potential as a natural textile dye through a mordanting process to obtain a variety of colors (Saputri & Hendrawan, 2021). This natural dye has long been used to color traditional materials such as batik, jumputan, and woven fabrics (Angendari, 2015). The urgency of this activity is based on the urgent need for a community empowerment model that is able to integrate environmental conservation aspects with improving economic welfare (Wahab dkk., 2022), (Tyas dkk., 2025), (Buana dkk., 2025), (Freda & Ardianto, 2024). The rationale for the Waste-to-Art program lies in utilizing abundant local resources as a substitute for expensive and polluting synthetic chemical dyes (Çebi 2025), (Lab dkk., 2021).

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In its development, contemporary textile design innovation demands a more dynamic and exclusive visual aesthetic. Therefore, this community service program implements a collaborative strategy of tie-dye and ecoprinting techniques (Tyas dkk., 2025), (Noto Pamungkas, 2022), (Lab dkk., 2024), (Sahu, 2022), (Browing, 2022). The combination of tie-dye and ecoprint techniques can create richer motif dimensions (Tyas dkk., 2025). Tie-dye provides geometric or abstract patterns as backgrounds, while ecoprint provides precise organic texture details (Khusniyah dkk., 2024), (Aryani dkk., 2022), (Mongkho & lrattanasit, 2022). Ecoprinting is not just a dyeing method, but also an art form that combines natural beauty with human handicrafts (Sumarwahyudi, 2024). This collaboration not only enhances the artistic value but also strengthens the color fixation structure through repeated binding and steaming processes.

The purpose of this study was to evaluate the effectiveness of the Waste-to-Art program in improving environmental literacy and technical skills in the community. This is expected to result in the transfer of natural dyeing technology for the "Talira" brand. This activity is based on the basic assumption that diversifying dyeing techniques utilizing kitchen scraps can stimulate a shift in the community's mindset from consumers to creative producers. This role transformation is believed to be a key pillar in creating sustainable economic resilience (Torre & Bourdin, 2026) for the Medokan Ayu Family Welfare Movement (PKK).

The partner group consists of women from the Family Welfare Movement (PKK) of RT 07 RW 01, Medokan Ayu Village, Rungkut District, Surabaya. It has 84 members and is chaired by Mrs. Langgeng. In general, their economic activities, which are based on handicrafts, have not been optimally developed. The majority are housewives who wear headscarves in their daily lives, so they have great potential to be involved in creative activities relevant to their needs, such as making batik headscarves (Tyas dkk., 2025). This study emphasizes collaboration, with the basis that this collaboration technique aims to overcome the aesthetic weaknesses of conventional natural dyes.

## METHOD

As an activity that interacts with the community, selecting strategies and approaches for empowerment is essential. One such approach is Participatory Action Research (PAR) (Wahab, dkk., 2022), (Cornish, dkk., 2023). This approach integrates practical action with theoretical analysis to create sustainable social change (A. N. B., 2025), (Lab, dkk., 2021). In this context, the researcher acted as both a facilitator and observer of the process of transforming domestic waste into creative assets in the Medokan Ayu PKK community, Surabaya. This research design is divided into four main interrelated cycle stages:

1. **Diagnosis and Initiation Stage:**

Focused on collecting baseline data regarding the volume and type of organic residue produced by households in the Medokan Ayu area. Researchers conducted participant observation to identify potential materials such as onion skins, turmeric peels, tea dregs, and coffee grounds. This data served as the basis for determining the variables for the dyeing experiment.

2. **Material Experiment Stage:**

This stage involved technical testing of natural color stability. Researchers conducted controlled variable experiments on: 1) Mordanting Formula: Comparing the effectiveness of alum, tunjung, vinegar, and lime as fixatives for locking color into textile fibers. Optimizing

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the ideal temperature during the steaming process (Kavyashree, 2022) to ensure precise transfer of motifs from waste to fabric without damaging the textile fibers. Experimental stages were conducted to ensure quality standards before being taught to partners.

3. **Implementation Stage (Waste-to-Art Pedagogy):**

Technical data from the experiment was applied through educational interventions to partners to observe the method's effect on the motor skills of research subjects. Researchers observed how this trash-art pedagogical method affected the level of understanding and motor skills of the research subjects. At this stage, data collection was conducted through visual documentation of the Talira headscarf production process and field notes regarding the technical obstacles faced by the research partners.

4. **Evaluation and Reflection Stage:**

An evaluation of the social and technical impacts involving a comprehensive analysis of product quality and the social impact in the form of a mindset shift among the research partners.

To ensure data validity, the following instrument matrix is used:

**Table 1**: Research Instrument Matrix

| No. | Variables | Compliance | Data Collection Techniques |
|---|---|---|---|
| 1 | Cognitive | Too wordy, less relevant | Questionnaire (Likert Scale) |
| 2 | Psychomotor | Less elaborated / weak | Performance Observation |
| 3 | Product | Talira Veil Quality | Expert Judgment & Technical Testing |

**Research Instruments and Data Analysis Techniques**

To ensure the validity of the research results, two main instruments were used to measure the success of the Waste-to-Art Pedagogy model: (1) Environmental Literacy and Resilience Measurement (Social Aspect). Researchers used a Likert Scale (1-5) to measure changes in research subjects' perceptions before (pre-test) and after (post-test) the intervention. The indicators measured included: a. Environmental Awareness: Subjects' understanding of the impacts of domestic waste. b. Self-Efficacy: Participants' confidence in independently processing waste into art products. c. Circular Economy Orientation: Subjects' readiness to utilize ecoprinting skills as a new source of income. (2) Product Quality Evaluation Instrument (Technical Aspect). The assessment of the Talira headscarf was carried out by a team of experts (textile craftsmen) using a Quality Standard Observation Sheet which includes four critical parameters, namely a. Visual Sharpness Test: Using a color saturation scale. b. Motif Precision Test: Assessing the similarity between the original shape of organic waste and the transfer results on the fabric. c. Wash Fastness Test: Evaluating color changes after repeated manual washing processes.

## RESULTS AND DISCUSSION

**Technical Quality Analysis of Talira Hijab Products**

The collaboration of tie-dye as the background and ecoprinting as the main motif creates high visual contrast. The technical discussion shows that this integration of techniques can overcome the weakness of pure ecoprinting, which sometimes has large blank spaces. With tie-dye, these areas are filled with harmonious abstract patterns. Based on material variable experiments, it was found that certain types of organic waste have

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different pigment stability with textile fibers. The color characteristics produced from domestic organic residues are presented in the following table.

**Table 2.** Natural Color Characteristics of Organic Residues

| No. | Kitchen Waste Type | Potential Color | Results on Textile Media |
|---|---|---|---|
| 1 | Onion Skin | Sogan (Dark Brown) | Solid, sharp color with good colorfastness. |
| 2 | Turmeric Skin | Bright Yellow | Provides an aesthetic contrasting accent but is sensitive to pH. |
| 3 | Coffee Grounds | Earth Tone | Produces a calm and harmonious earthy tone. |
| 4 | The Tea Grounds | Sepia/Vintage Brown | Provides a stable, classic feel; very effective as a background color to highlight ecoprint motifs. |

The addition of tea dregs as a dye variable provides a different color dimension. The high tannin content in tea dregs acts as a natural mordant that helps the color absorption process in cellulose fibers (cotton). In the context of technical collaboration, tea dregs are often used to create a soft tone effect that balances the brightness of the turmeric color. This proves that diversifying kitchen waste can create a complete color palette, from sharp primary colors to muted secondary colors, thereby increasing the aesthetic value and competitiveness of Talira's headscarf products.

The product quality evaluation results show that the use of natural mordants, alum or tunjung, not only functions as a color lock but also modifies the color direction to be sharper. This is in line with the natural dyeing theory that color fixation determines the fastness of textiles. Tea dregs produce tannin pigments that provide classic color nuances (sepia). In textile media, tea dregs show high flexibility; the use of tunjung mordants produces a bold dark gray color, while alum produces a soft cream color. This allows for the creation of coherent color gradations in a single headscarf design. Experimental data shows that onion skins provide optimal pigmentation in both tie-dye and printing techniques. In addition, the double fixation carried out during the tie-dye binding process and during the ecoprint steaming process has been shown to strengthen the bond of color molecules in the fabric fibers. This is validated through product quality evaluations by textile experts:

**Table 3.** Product Quality Evaluation of Talira Veils

| No. | Parameter | Description Research Findings | Technical Interpretation |
|---|---|---|---|
| 1 | Solid Color | Sharpness (sogan color) | Onion skin provides optimal pigmentation for both ikat and printing techniques. |
| 2 | Motif Precision | Very detailed | Strong tie dye binding creates a clean negative area, emphasizing the leaf motif. |
| 3 | Fade Resistance | Score 4/5 (very thin) | The double fixation process (during tying and steaming) strengthens the bond between the color molecules. |

With tie-dye, the area is filled with a harmonious abstract pattern (Howard at all., 2022). Color Potential and Chemical Characteristics: Tea dregs (especially brewed black or

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green tea) contain polyphenolic compounds. Visually, the base color potential ranges from grayish brown to sepia. Advantages: The color of tea dregs tends to give a vintage, classic,s and calm impression (earthy tones). Stability: Due to their tannin content, tea dregs have excellent colorfastness to sunlight compared to other kitchen waste such as turmeric.

Interpretation of these findings indicates that the success of Talira headscarf products is highly dependent on the initial mordanting process and proper steaming technique, as well as the tie-dye technique used. The use of alum or tunjung as a natural mordant not only functions as a color lock but also modifies the color direction to make it sharper (sogan). This aligns with the natural dyeing theory, which states that color fixation determines the colorfastness of textiles.

**Results on Textile Media Based on Mordant Type**

The final color of tea grounds depends heavily on the type of mordant you use in your experiment: (1) Alum Fixation: Produces a light brown or light cream color. Alum tends to retain the original brightness of the tea pigments, giving a clean and soft result on headscarves. (2) Ferrous Sulfate Fixation: Produces a dark gray, moss green, or grayish black. The chemical reaction between the iron (alum) and the tannins in the tea creates a drastic color change, becoming darker and more intense. This is very effective for adding dimension to tie-dye techniques. (3) Lime Fixation: Produces a reddish brown color. Lime shifts the pH to alkaline, which typically darkens the color of the tea but remains within the brown spectrum.

Mordant experiments show that tea grounds fixed with alum produce a very deep dark gray (moss green) due to the reaction of the tannins with the iron, while alum fixation produces a soft cream color. This difference provides flexibility for Talira headscarf manufacturers in determining color palettes according to market trends.

**Figure 1.** Example of natural dyeing and mordanting (alum and tunjung)

**Role in Collaborative Techniques (Tie-Dye & Ecoprint)**

In this case, tea dregs can be positioned as a background color: because of their neutral color (especially when using alum), tea dregs are excellent for use as a base color to make ecoprint motifs from onion leaves or skins stand out more. Regarding aesthetic balance, if turmeric skins provide a very striking yellow color, tea dregs serve as a toning down effect, making the color composition of the Talira headscarf appear more elegant and professional (not too contrasting).

**Circular Economy Transformation and Social Impact**

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Based on questionnaire data, there has been a 45% increase in environmental literacy scores among subjects. People who previously viewed onion skins as residue are now actively collecting them as a production asset. Systematically, this change creates a circular economy at the household level. The long-term impact is increased community economic resilience (Boston, dkk., 2024), as participants no longer rely on expensive external raw material capital, but instead utilize free resources around them to produce high-value goods (Schandl, dkk., 2024). Residents transition from throwing away onion skins, turmeric peels, tea dregs, and coffee grounds to collecting them collectively.

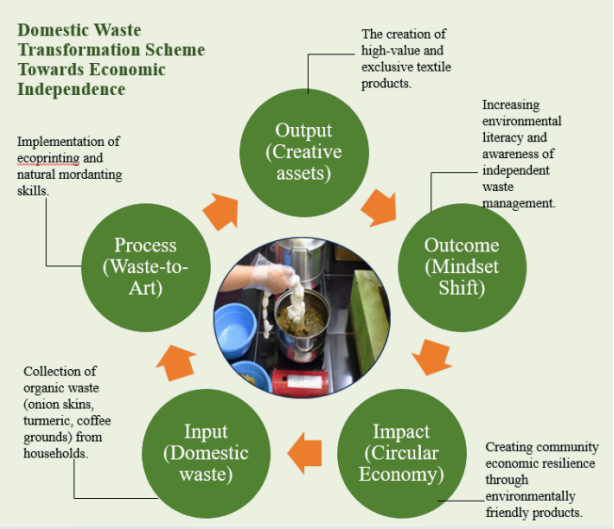


**Figure 2.** The Circular Economy Cycle of the Talira Community Service Program

The implementation of Waste-to-Art Pedagogy in this program is not simply a transfer of technical skills, but rather a non-formal educational intervention to shift the community's mindset. Communities that previously considered onion peel waste as trash now view it as an economic asset (input). Systematically, this intervention creates a Circular Economy at the household level. The long-term impacts found include increased environmental literacy and community economic resilience. Research partners no longer rely on expensive synthetic chemical raw materials, but instead utilize free resources around them to produce high-value goods. This demonstrates that empowerment based on local wisdom and environmental sustainability can be a concrete solution for the economic independence of urban communities like those in Medokan Ayu.

The findings indicate that the increase in transformative competency is significant in the technical skills of the partner group (mordanting, tye dye, and ecoprinting). Analysis shows that participants are able to master complex technical aspects from fabric fiber preparation to aesthetically pleasing final products. The result is a transformation from "laypeople" to "sustainable creative practitioners."

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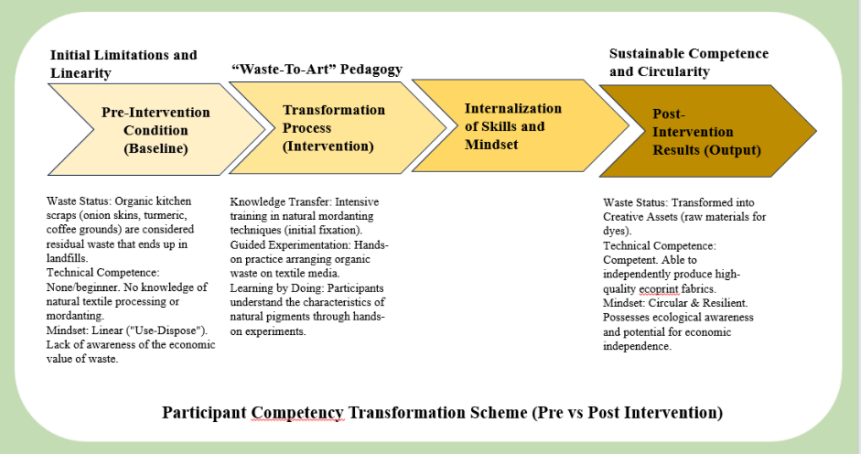


**Figure 3.** Participant Competency Transformation Scheme

## Narrative Analysis of Attitude Change

At the beginning of the training, participants were skeptical that Bombay peel could produce beautiful colors. However, after seeing the results of the tunjung mordant fixation, enthusiasm shifted. Medokan Ayu Rungkut PKK partners were enthusiastic about developing tie-dye and ecoprint batik skills to improve their families' finances. The evaluation revealed several inhibiting factors, such as uneven participant skills, limited production time, difficulties with ecoprint techniques, limited leaf material variety, and suboptimal social media management.

**Figure 4.** Changes in attitudes of PKK partner groups toward kitchen waste (Tyas at all., 2025)

Supporting factors include participant enthusiasm, product suitability to needs, availability of kitchen waste materials, PKK social cohesion, and support from the implementation team in technical assistance and branding (Tyas dkk., 2025). According to Tyas, recommended follow-up actions include continued mentoring on product quality, social media management training, exploration of new natural dyes, and development of a digital catalog for sustainable marketing. These activities are expected to continue independently and serve as a model for environmentally friendly product development for other communities.

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**Figure 5.** Aesthetics of the Talira Hijab Ecoprint product (Tyas et al., 2025)

The aesthetics of the headscarf product, based on visual observation and analysis, show an increased value from a plain headscarf to a ready-to-market product. The combination of tie dye and ecoprint is considered more artistically appealing than either technique alone. This is due to the artistic appeal and varied motifs. This aligns with the preferences of consumers who care about a healthy and clean environment, as it uses natural colors.

When linked to the circular economy value in this research, it is highly implemented because it aligns with the circular economy concept. The PKK partner group has easy remanufacturing and readily available materials. The following observations demonstrate the partners' commitment to headscarf production, as well as the Talira Hijab Ecoprint brand and packaging. Publication has begun on their respective Instagram accounts, in addition to the PKK communities. Participatory Action Research has been implemented, as evidenced by the role of the researcher and PKK partners. The interaction between the ISTTS team and the PKK women resulted in joint solutions to technical challenges that arose during the experiment, both in the process of using tie dye and ecoprinting on 110cmx110cm headscarf fabric, both cotton and paris.

**Table 4.** Catalog of kitchen waste products (Tyas et al., 2025)

| No. | Motive | Motive | Motive | Motive | Motive |
|---|---|---|---|---|---|
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |

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| No. | Motive | Motive | Motive | Motive | Motive |
|---|---|---|---|---|---|
| 3 |  |  |  |  |  |

## CONCLUSION

The PAR-based Waste-to-Art model has proven effective in significantly improving the community's technical competence. Organic kitchen waste (onion skins, turmeric peels, tea dregs, coffee grounds) was successfully transformed into high-value creative assets with high textile quality standards. This program significantly improves environmental literacy and creates economic resilience for the Medokan Ayu Family Welfare Movement (PKK). Research demonstrates a shift in community mindset from linear (throw away) to circular (process), which strengthens the resilience of urban communities. Developing a natural color palette from other domestic waste (such as avocado or mangosteen peels) is crucial. Market synergy and digital promotion are needed to maintain the sustainability of the community's circular economy.

Recommendations for three parties (Partners, Government, Researchers): Partners are advised to establish and improve collective business units to maintain production continuity and digital marketing. Researchers need to test other natural mordant variations to produce a broader color palette. Recommendations for future researchers include laboratory fastness testing. The government needs to provide business legality support (NIB/PIRT) so that the Talira headscarf can become a local icon.

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