

Eco-friendly Product: Evaluating Steamed Ecoprint Training's Usefulness, Impact, and Contribution to the Green Economy

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Abstract. Steaming ecoprint, a natural fabric printing method utilizing plant-derived dyes, provides ecological benefits and income-generating opportunities for rural areas. This study seeks to evaluate the usefulness, perceived influence, and contribution to the green economy of steaming ecoprint training offered to women in Jaranan, Panggungharjo, Sewon, Bantul. The program aimed to enhance participants' production skills, promote community empowerment, and assist Ayik Ecoprint SME in fulfilling huge market demand. Twenty-three women participated in an interactive training program that imparted technical production skills, sustainable material sourcing, and business management techniques. This study employed a 5-point Likert scale grounded on empowerment and sustainability frameworks to assess three key variables before and after training: usefulness, perceived impact, and contribution to the green economy. Paired-sample t-tests with a 95% confidence level were employed to evaluate the difference in scores. Significant improvements were observed in all metrics: perceived usefulness, impact, and contribution to the green economy. Qualitative feedback revealed that participants acquired practical skills, increased confidence in product marketing, and elevated environmental awareness. The findings indicate that steaming ecoprint training markedly enhances women's skill relevance, livelihood outcomes, and environmental accountability, hence aligning Sustainable Development Goals 5, 8, and 12. This work contributes to the field by introducing a measurement approach for evaluating the effectiveness of ecoprint training in the green economy, an area that has been absent in prior research. The initiative demonstrates the need of conducting training within a Quadruple Helix cooperation involving academia, industry, government, and civil society.

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1 Introduction

The world is moving toward sustainability, and green business practices are now seen as a way to protect the environment and promote social and economic growth [1]. Creative businesses, especially those that use eco-friendly production methods, are becoming increasingly popular to balance making money with being responsible for the environment. Ecoprint, a natural dyeing method that transfers plant pigments to fabric, has become a new, eco-friendly alternative to making synthetic textiles. Ecoprint uses plant-based dyes instead of chemical-based pigments, which create toxic waste. This makes the process much less detrimental to the environment and creates unique, high-quality textile designs [2].

The development of ecoprint-oriented small and medium companies (SMEs) in Indonesia is closely aligned with the Sustainable Development Goals (SDGs), namely SDG 5 (Gender Equality), SDG 8 (Decent Work and Economic Growth), and SDG 12 (Responsible Consumption and Production) [3]. Facilitating women's involvement in green business endeavors enhances household income while promoting environmental sustainability and community resilience [4]. The active participation of women in sustainable entrepreneurship enhances socio-economic advantages, as they tend to reinvest profits into family welfare, education, and community development [5].

Ecoprint techniques illustrate this dual capacity—facilitating money generating while promoting sustainable development. Research on female-led green and inclusive MSMEs in Indonesia indicates that eco-friendly product creation might substantially enhance local green economy growth [6]. Furthermore, integrating traditional eco-friendly crafts with entrepreneurship, digital marketing, and environmental legislation can broaden market access and improve competitiveness [4]. This integration is widely regarded as vital for powerful and inclusive economic growth.

The example given is Ayik Ecoprint in Jaranan, Panggungharjo, Sewon, Bantul. With the steaming method, Ayik Ecoprint can create high-quality ecoprint fabrics and ready-to-wear clothes that are water-resistant and have vibrant, rich colors. This is achieved by utilizing plant-based dyes instead of synthetic chemicals. Still, the business has a hard time fulfilling orders during peak demand using just internal resources. Supporting the expansion of small and medium-sized enterprises (SMEs) and empowering local communities, steaming ecoprint training can help local women overcome this production constraint and provide them with a secure livelihood.

Although ecoprint training is increasingly practiced, previous research has predominantly focused on cultural preservation [7], social inclusion, eco-innovation [8], or product promotion, neglecting to systematically evaluate the training's effectiveness on socio-economic and environmental outcomes or to integrate programs within a collaborative ecosystem connecting SMEs, policy actors, and communities. This presents two deficiencies: (i) the lack of a definitive, validated measuring methodology for green-economy-focused training; and (ii) insufficient evidence about the operationalization of Quadruple Helix (QH) collaboration to convert skills into production and market access suitable for SMEs [9].

This research enhances both theoretical understanding and practical application through two contributions. We present and empirically assess a concise measurement approach for evaluating green-economy training across three outcome domains—usefulness, perceived impact, and contribution to the green economy—rooted in training evaluation, empowerment, and green-economy literature. Secondly, we incorporate a Quadruple Helix collaboration—comprising academics, industry (Ayik Ecoprint), local government, and civil society—through a community-based participatory design that aligns training content with SME production limitations and market avenues. Collectively, these contributions advance

from mere descriptive community training to a theory-driven, evaluative framework that can be reproduced for enhancing local SME capacity in sustainable entrepreneurship.

The study operationalizes women's economic empowerment and green-economy models into quantifiable training outcomes and evaluates them using pre/post evidence, so advancing training assessment in community-based green entrepreneurship. The QH architecture illustrates how local training may be integrated into SME processes and marketplaces, promoting equitable livelihoods and enhancing ecologically sustainable production.

This study aligns with the UNEP's Education for Sustainable Development (ESD) framework by aiming to cultivate sustainable consumption and production practices, alongside advancing economic development and social inclusion. The research emphasizes the integration of environmental sustainability with local entrepreneurial capacity building, aligning with the broader UNEP aim of enabling communities to tackle environmental and socio-economic concerns. This study highlights the significance of training and collaboration among many sectors—government, academia, industry, and civil society—in fulfilling the global sustainability goal and promoting green entrepreneurship at the grassroots level. The QH collaboration model effectively implements UNEP/ESD's advocacy for multi-stakeholder involvement in sustainable development initiatives.

2 Material and methods

2.1 Research Design

This study utilized a community-based participatory research (CBPR) methodology to evaluate the results of steaming ecoprint training for women in Jaranan, Panggungharjo, Sewon, Bantul. The Quadruple Helix structure was used as the basis for the program. It involved cooperation between academia, business, government, and civil society to make sure that the program was both technically sound and relevant to the community.

2.2 Subjects

The training included 23 women who lived near Ayik Ecoprint. They were chosen because they were willing to take part, could attend the whole program, and could use the skills they learned to make money. The sample size of 23 women was established based on the participants' availability and willingness to engage in the complete training session. The sample was selected based on participant availability; nonetheless, it is crucial to acknowledge that it may not accurately represent the wider population of women in the region. Subsequent research should pursue larger and more randomized samples to enhance the generalizability of the results.

2.3 Training material

The training comprised three fundamental modules: (1) Technical Proficiencies - Steaming ecoprint methodologies, botanical selection, color fixation, and textile finishing. (2) Sustainable Practices — Utilization of natural dyes, minimization of waste, and ethical procurement of plants. (3) Entrepreneurship - Fundamental costing, pricing strategy, product marketing, and potential integration with Ayik Ecoprint's production processes.

2.4 Measurement indicators

The following three indicators were assessed using a structured questionnaire during the pre- and post-training surveys:

Usefulness (A1–A6): How relevant and useful the training material is.

Personal, social, and economic changes that result from training are referred to as the perceived impact (B1–B6).

C1–C6: Contribution to the green economy: sustainable production practices and environmental awareness.

Indicators were derived from the training evaluation model by Kirkpatrick and Kirkpatrick [10], empowerment measurement frameworks [11], and research on the green economy [12,13]. The Likert scale was used to rate each item on a scale of 1 to 5, with 1 representing a strong disagreement and 5 representing a strong agreement. Open-ended questions (D1–D3) were used to gather qualitative feedback. Table 1 exhibits details of the questionnaires.

The use of the Kirkpatrick model was justified based on its well-established utility in training evaluation across diverse contexts. However, future studies could explore alternative frameworks, such as the CIPP (Context, Input, Process, Product) model or the 5-Level Evaluation Model, which may provide additional insights into training outcomes and program efficiency.

2.5 Data analysis

To quantify the differences between the scores before and after training at a 95% confidence level ($\alpha = 0.05$), paired-sample t-tests were performed. However, due to the limited sample size, we perform the normality test first to decide whether to use non-parametric testing such as the Wilcoxon signed-rank test or the paired-sample t-test. Results of the normality test show that the data is normally distributed, and then we use the paired sample t-test. To enhance the quantitative findings, thematic analysis was also used to assess the qualitative input derived from field observations and additional open-ended questions. As usual, the validity and reliability of the questionnaires were also performed to ensure the questions are valid and reliable.

3 Results and discussion

3.1 Demographic of the training participants.

As stated earlier, twenty-three women took part in the steaming ecoprint training. Sixty percent (14 women) are in the age range of 40–45, and the rest, 40 percent (9 women), are age 50 or above. Eighty percent (18 women) are housewives, and the remaining 20 percent (5 women) work in the private sector, such as morning market sellers (3 persons) and kindergarten teachers (2 persons).

Table 1. The detailed questionnaire for the ecoprint training assessment

Code	Question	Indicator	Source of questionnaires development
A1	The training material was useful for my daily tasks and demand.	Usefulness (how relevant and useful the training is)	Kirkpatrick and Kirkpatrick [10]
A2	I can use the skills I learnt to make ecoprint fabrics.		
A3	The training enhanced my capacity to create high-quality items.		
A4	I am capable of employing the steamed ecoprint procedure independently.		
A5	It was easy to understand the training materials, such as examples and demos.		
A6	I may modify the steaming ecoprint technique to accommodate various plant materials accessible in my region.		
B1	The training has enhanced my prospects for generating additional revenue.	Perceived impact	Goulart [11]
B2	I am sure that I can sell things that were produced utilizing the steamed ecoprint method.		
B3	The abilities I gain in this program will help my family's finances.		
B4	I am more inclined to establish a small enterprise that specializes in textile items.		
B5	The training helped me feel more confident while responding to consumers.		
B6	In my opinion, the production of ecoprint fabrics has the potential to serve as a sustainable source of income.		
C1	I am aware that utilizing natural dyes instead than synthetic dyes is better for the environment.	Contribution to the green economy (Awareness of the environment and sustainable practices)	Loiseau et al. [12]; SDG 12
C2	I am dedicated to employing production methods that are good for the environment.		
C3	I know more about how to cut down on wastage when making fabric.		
C4	I assert that my ecoprint items help promote eco-friendly clothing.		
C5	I am committed to advocating for environmentally sustainable practices in my community.		
C6	I am committed to sourcing plant materials in a manner that is environmentally friendly.		
D1	Which aspect of the training proved to be the most beneficial for you?	Open ended questions	DeVellis and Thorpe [14]
D2	What obstacles do you anticipate encountering when employing the steaming ecoprint method?		
D3	What recommendations do you have for enhancing this training?		

3.2 Validity and reliability test.

Validity testing is used to determine whether statements in a questionnaire are valid. The validity of a questionnaire can be determined by the correlation between the scores of each statement item and the total score. If the significance level is below 0.05 or the p-value is <0.05, the questionnaire is considered valid. Table 2 presents the results of validity test using bivariate Pearson Correlation.

Table 2. Results of validity test

Code	Indicator	R value	P value	Meaning
A1	Usefulness	0.356**	0.000	Valid
A2	Usefulness	0.304**	0.000	Valid
A3	Usefulness	0.332**	0.000	Valid
A4	Usefulness	0.333**	0.000	Valid
A5	Usefulness	0.371**	0.000	Valid
A6	Usefulness	0.325**	0.000	Valid
B1	Perceived impact	0.293**	0.000	Valid
B2	Perceived impact	0.374**	0.000	Valid
B3	Perceived impact	0.314**	0.000	Valid
B4	Perceived impact	0.323**	0.000	Valid
B5	Perceived impact	0.256**	0.002	Valid
B6	Perceived impact	0.303**	0.000	Valid
C1	Contribution to the green economy	0.261**	0.001	Valid
C2	Contribution to the green economy	0.342**	0.000	Valid
C3	Contribution to the green economy	0.400**	0.000	Valid
C4	Contribution to the green economy	0.285**	0.000	Valid
C5	Contribution to the green economy	0.272**	0.001	Valid
C6	Contribution to the green economy	0.243**	0.003	Valid

** means significant at 1 percent.

Reliability tests check the reliability of a questionnaire. A questionnaire is reliable if the answers people give to statements stay the same over time. How reliable an indicator or questionnaire is taken by its Cronbach's alpha (α) value. If the value is greater than 0.60, it means that the indicator or questionnaire is reliable. If it is less than 0.60, it means that the indicator or questionnaire is not reliable. Table 3 displays the test results for reliability tests.

Table 3. Results of reliability test

Variable	Cronbach's Alpha	Number of statements	Meaning
Usefulness	0.720	6	Reliable
Perceived impact	0.785	6	Reliable
Contribution to the Green Economy	0.723	6	Reliable

Based on Table 2 and Table 3, the questionnaires distributed to the respondents or training participants are valid and reliable.

3.3 Results of the paired t-test.

Table 4 demonstrates results of the training participants' answer in the pre and post ecoprint training. As depicted in the table all indicators show significant improvement.

Table 4. Results of the paired t-test

Code	Pre-training mean	Post-training mean	t value	P value
A1	3.14	4.67	9.26	0.002**
A2	3.17	4.52	9.28	0.001**
A3	3.12	4.72	9.31	0.001**
A4	3.04	4.56	9.31	0.000**
A5	3.12	4.38	8.98	0.000**
A6	3.10	4.46	9.26	0.001**
B1	3.11	4.41	8.92	0.003**
B2	3.21	4.52	8.98	0.001**
B3	3.08	4.56	9.26	0.000**
B4	3.16	4.41	9.21	0.001**
B5	3.09	4.56	8.87	0.000**
B6	3.12	4.41	9.26	0.000**
C1	2.98	4.38	10.12	0.001**
C2	3.21	4.41	10.01	0.000**
C3	3.15	4.46	9.68	0.002**
C4	2.98	4.56	10.01	0.001**
C5	3.14	4.41	10.21	0.000**
C6	2.98	4.38	9.81	0.000**

** means significant at 1 percent.

A substantial improvement in Usefulness is evidence that the training was really useful in facilitating the transfer of skills [10,15]. Perceived impact has improved, which is consistent with empowerment frameworks [11] and indicates that there have been noticeable changes in self-assurance, financial possibilities, and initiative to start a business.

The significant improvements in Green Economy Contribution show that people are becoming more environmentally responsible, which is in line with Loiseau et al. [12]. Incorporating this program within a Quadruple Helix framework enhanced its effectiveness by aligning training with market demands, policy assistance, and community engagement.

This study enhances the literature by presenting a measurement approach designed to assess ecoprint training outcomes within the context of the green economy. Prior studies have addressed ecoprint training in general but have not established a systematic framework of metrics to evaluate training effectiveness across socio-economic and environmental aspects.

3.4 Qualitative feedback.

In terms of post-training participant feedback, 20 out of 23 women give comments and the summary of the comments revealed the following themes: (1) Skill enhancement, i.e. the ability to make high-quality ecoprint products on their own. (2) Economic preparedness means being sure of their ability to market and sell their products. (3) Environmental consciousness, i.e. dedication to natural dyes and waste minimization.

4 Conclusion

This study aims to assess the use, perceived impact, and contribution to the green economy of steaming ecoprint training provided to women in Jaranan, Panggungharjo, Sewon, Bantul. Meanwhile, the purpose of the program was to improve the production abilities of the participants, to encourage community empowerment, and to aid Ayik Ecoprint SME in meeting the enormous demand in the market. Participants' views on the usefulness of training, the impact it had on their lives and finances, and their sense of environmental responsibility all improved significantly after the steaming ecoprint instruction. The measurement framework that was created is a useful way to evaluate comparable programs in entities that are beneficial for the environment. The program illustrates the attainment of skill development, environmental stewardship, and SME support through collaborative, community-based activities by aligning with SDGs 5, 8, and 12. Consider the limitations of this study when interpreting the results. First, a small sample size (23 women) from a single venue limits the generalizability. Second, this study employs a short-term assessment, lacking any long-term follow-up on income or environmental behavior. Future research should undertake longitudinal studies to monitor enduring effects over a period of 6 to 12 months and replicate findings across various geographic contexts for enhanced generalizability. Subsequent research may also incorporate assessments of digital marketing and e-commerce preparedness.

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