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Strengthening the Capacity of Nasyiatul Aisyiyah Cadres through Eco-Enzyme-Based Soap and Shampoo Product Innovation

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ABSTRACT

Background: The suboptimal management of household organic waste remains an environmental issue as well as an economic opportunity at the community level. Nasyiatul Aisyiyah cadres, as young women, have strategic potential in developing environmentally based entrepreneurship, but they still need enhanced knowledge and practical skills. This activity contributed to increasing public awareness of household organic waste management, strengthening women's economic empowerment, and reinforcing the role of Nasyiatul Aisyiyah cadres as agents of change in building a sustainable community economy.
Method: This community service program was implemented through the Muhammadiyah National Research Community Service Grant Batch IX 2025 using a participatory training and mentoring approach. The activities included the introduction of eco-enzyme concepts, hands-on practice in producing eco-enzymes from household organic waste, soap and shampoo formulation, and basic entrepreneurship strengthening.
Results: The results showed a 40% improvement in participants' understanding of household organic waste management, based on pre-test and post-test evaluations. Additionally, 85% of participants successfully formulated and packaged eco-enzyme-based soap and shampoo products.
Conclusion: This activity successfully achieved its objective of strengthening the capacity of Nasyiatul Aisyiyah cadres. Eco-enzyme-based product innovation has the potential to become an integrative community service model by linking environmental preservation with community entrepreneurship empowerment.

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1. Introduction

The Environmental and economic challenges at the community level remain significant in the post-pandemic period, particularly with regard to the suboptimal management of household organic waste. Globally, waste generation is increasing faster than the capacity of local systems to manage it; the World Bank reports that the world generated 2.56 billion tonnes of waste in 2022, and this figure may rise to 3.86 billion tonnes by 2050 under a business-as-usual scenario. In developing countries, this problem is even more critical because collection, separation, and treatment capacities remain limited, causing a large share of organic waste to end up in landfills or to be disposed of without adequate processing. In Indonesia, similar issues are reflected in low public awareness and limited source-based waste management practices, even though such practices are essential for reducing landfill pressure, preventing pollution, and creating circular-economy opportunities [1]–[6]. Therefore, the core problem is not merely technical waste handling, but also insufficient environmental literacy, community participation, and institutional capacity at the grassroots level [7], [8].

Previous studies have demonstrated that effective solutions should move beyond waste collection and disposal and instead emphasize waste valorization, circular economy practices, and community empowerment. One increasingly discussed approach is the conversion of organic waste into eco-enzyme or garbage enzyme, a fermented liquid made from fruit and vegetable residues, sugar/molasses, and water. A systematic review [9], [10] Identified garbage enzyme as a promising pathway for converting organic waste into value-added products, while highlighted that eco-enzyme offers a creative way to reduce, reuse, and recycle fruit waste. [11] Other studies have also shown that fermented biowaste contains microbial communities that may support cleaning and environmental applications ,whereas organic-waste biorefinery approaches are increasingly recognized as sustainable routes for producing useful bio-based products [11], [12]. In consumer-product development, the sustainable cosmetics literature further indicates that greener formulations, environmentally friendly ingredients, and life-cycle-oriented product design are becoming increasingly important in soap and shampoo innovation [13], [14].

From a social empowerment perspective, engaging young women in green entrepreneurship is strategically important because it connects individual capacity building, environmental awareness, and economic resilience [14]. Argued that green entrepreneurship can serve as a platform for women's empowerment, particularly when supported by education and entrepreneurial development. More recent research also indicates that the success of community-based green initiatives depends not only on technical feasibility but also on socially embedded empowerment models [15]. in this regard, Nasyiatul Aisyiyah cadres hold strong potential as community change agents because they are actively involved in social, religious, and empowerment activities.

However, previous studies and community programs have mostly addressed the technical production of eco-enzyme, community-based waste management, or women's economic empowerment separately [16]–[21]. The gap in the current research lies in the lack

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of integration between organic-waste fermentation, eco-friendly soap and shampoo formulation, and green entrepreneurship mentoring within a single intervention specifically targeted at young women's faith-based organizations. This study seeks to address this gap by offering an integrated model that combines all three dimensions.

Based on this context, the solution proposed in this program is intensive mentoring for Nasyiatul Aisyiyah cadres in converting household organic waste into eco-enzyme and utilizing it as a raw material for environmentally friendly soap and shampoo products, accompanied by basic entrepreneurial strengthening. This solution is relevant because it is practical, affordable, based on local resources, and aligned with source-level waste reduction principles. Moreover, Universitas Muhammadiyah Parepare has relevant academic and community-service experience in eco-enzyme development, herbal products, natural soap production, ecoprint, inorganic-waste processing, and local-resource-based food innovation [1], [14]. Such experience provides an important foundation for a distinctive laboratory recreation approach, in which the laboratory serves as a creative space for developing useful and economically valuable products from waste and local resources. In this program, the mentoring activities focus on processing organic waste into eco-enzyme [15], [22], [23] and developing its derivative products for Nasyiatul Aisyiyah cadres in Parepare City.

The state of the art of this study lies in integrating three dimensions that are often treated separately in previous works, namely eco-enzyme-based organic waste management, eco-friendly hygiene product innovation, and community-based green entrepreneurship for young women. The novelty of this program lies in positioning eco-enzyme not merely as a fermentation product from organic waste, but as an entry point for building soap and shampoo production skills while simultaneously fostering greenpreneurship among Nasyiatul Aisyiyah cadres. The contribution of this study/community service is the development of an integrative empowerment model that links environmental education, sustainable household product innovation, and the economic strengthening of young women. Practically, this model has the potential to be replicated in similar communities to support the circular economy, reduce organic waste at the source, and stimulate environmentally oriented micro-enterprises.

2. Method

This study applied a participatory action research approach designed to evaluate Nasyiatul Aisyiyah cadres' baseline understanding, measure knowledge improvement, and enhance practical skills in sustainable waste management and eco-enzyme-based product development through a community engagement program in Parepare City. A total of 20 Nasyiatul Aisyiyah cadres participated in the program, which integrated surveys, pre-test and post-test evaluations, and direct field practice in processing household organic waste into eco-enzyme, as well as formulating eco-enzyme-based soap and shampoo products.

A structured questionnaire was distributed to assess the participants' prior knowledge, exposure, and understanding of household organic waste management and eco-enzyme-based product development. The indicators included awareness of household organic waste,

knowledge of eco-enzyme, experience in processing organic waste, and understanding of the environmental and economic benefits of eco-enzyme-based products.

This research instrument was a knowledge assessment questionnaire comprising four closed-ended dichotomous questions. Each question was designed to measure a different aspect of the participants' basic knowledge.

First, question 1 (Q1): General knowledge of household organic waste. Second, question 2 (Q2): Understanding of eco-enzyme as a method for processing household organic waste. Third, question 3 (Q3): Direct experience in processing organic waste or producing eco-enzyme. Fourth, question 4 (Q4): Understanding of the benefits and impacts of eco-enzyme-based products for environmental sustainability and green entrepreneurship.

This questionnaire was self-developed by the researchers based on a literature review and the objectives of the community engagement program. To ensure content validity, the questionnaire was validated by two experts through expert judgment in the fields of environmental health, waste management, and community empowerment. The validation process aimed to evaluate the relevance of each question to the measured indicators, the clarity of the language used, and the appropriateness of the response choices. Clarity referred to whether the language was easily understood by the respondents, while appropriateness referred to whether the dichotomous response options, namely Yes/No, were suitable for the questions.

The revised questionnaire was then trialed on a small number of respondents with characteristics similar to the main participants but not included in the main program. This trial aimed to examine the clarity of instructions, ease of completion, item validity, and instrument reliability. The results of the trial are presented in Table 1. Table 1 shows that all items used in the pre-test were valid and that the overall reliability of the questionnaire was good.

Table 1. Validation and Reliability test based on trial respondents

Item	**r (Item–total)**	**r_table (df=13, α=0.05≈)**	**Interpretation**
Q1	0.707	0.514	Valid
Q2	0.807	0.514	Valid
Q3	0.560	0.514	Valid
Q4	0.807	0.514	Valid
Total Questions	KR-20 / Cronbach's Alpha	Interpretation	
4	0.898	Good (≥0.70)	

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2.1. Data Analysis and Statistics

Data were collected and visualized using bar charts and stacked graphs. A Chi-square test (χ^2) was applied to determine the significance of differences between participants who understood organic waste management and eco-enzyme production and those who did not yet understand (prior to training). Response data from 10 participants for the four questions were processed.

For the Chi-square analysis, this data was organized into a contingency table. The hypotheses were formulated as follows: the null hypothesis (H_0) stated that there was no significant difference in the proportion of knowledge among the response categories for each question, while the alternative hypothesis (H_1) proposed that a significant difference did exist. The Chi-square test was then applied to determine if the observed distribution of responses deviated significantly from the expected distribution. The Chi-square test was applied to evaluate differences in knowledge levels for each question as shown in Eq. (1):

$$\chi^2 = \sum \frac{(O - E)^2}{E} \quad \text{Eq. (1)}$$

After the Chi-square test for each question was conducted, the calculation continued as shown in Eq. (2):

$$\chi^2 = \chi^2_{Q1} + \chi^2_{Q2} + \chi^2_{Q3} + \chi^2_{Q4} \quad \text{Eq. (2)}$$

This image (Figure 1) illustrates the research phases designed to reduce household organic waste in Parepare, involving Nasyiatul Aisyiyah (NA) cadres as change agents in the community. The study begins with a situation analysis and urgency assessment of the organic waste issue, followed by a case study in Parepare and training on eco-enzyme production. The subsequent phases include the development of eco-enzyme and eco-enzyme-based mosquito repellent gel products, and empowering women as "greenpreneurs". The program also involves building and monitoring a marketing system, followed by evaluating the impact of the eco-enzyme products produced.

2.2. Training and Community Engagement

Nasyiatul Aisyiyah cadres participated in training sessions covering the production of eco-enzyme from household organic waste, the formulation of eco-enzyme-based products such as soap and shampoo, and green entrepreneurship practices. This stage emphasized hands-on learning and direct practice as a form of vocational training. After the training and the development of eco-enzyme products, a follow-up test was conducted to measure improvements in the participants' knowledge and skills, as well as to assess their understanding of organic waste management and the production of eco-enzyme-based products.

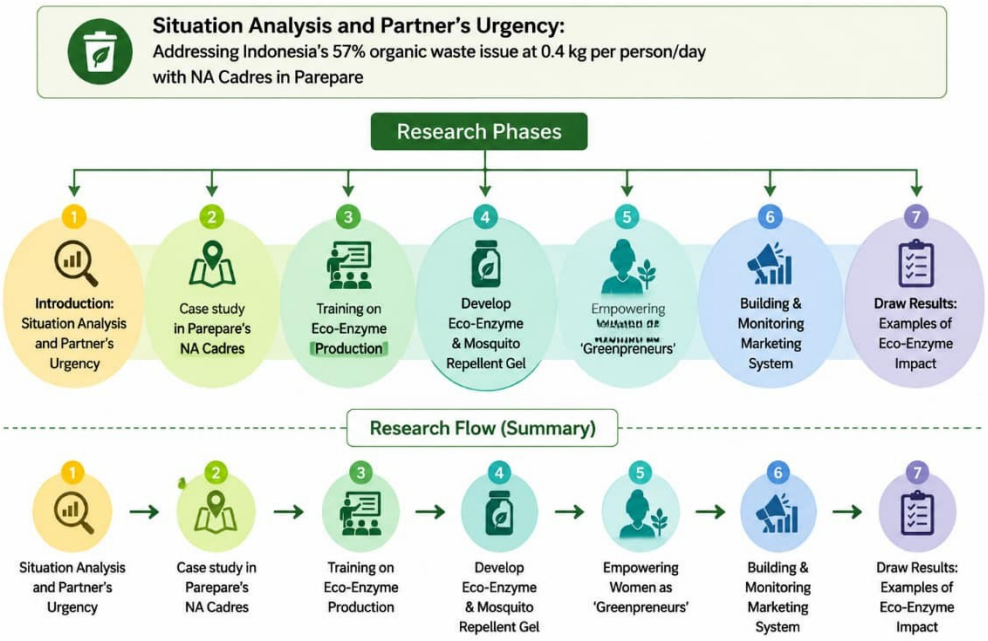

Figure 1. Research Phases for Reducing Household Organic Waste with Parepare's NA Cadres

Figure 1. Research stage

3. Results and Discussion

3.1. Baseline Survey

The training and mentoring activities for Nasyiatul Aisyiyah cadres focused on developing eco-enzyme-based green entrepreneurship through soap and shampoo production. A total of 20 participants from the Aisyiyah community in Parepare City participated in the program. The activities were conducted offline over two meetings and were well-received by the participants.

The baseline survey involving 20 Nasyiatul Aisyiyah cadres revealed a generally low awareness and exposure to household organic waste management and eco-enzyme production. Only 25% of the participants reported understanding the concept of eco-enzyme, and 35% understood its environmental benefits. None had ever produced eco-enzyme or used it in practical applications, while 60% showed an interest in learning more about its production and usage, as shown in Table 2.

The Chi-square analysis revealed a statistically significant difference in participants' responses across the four baseline survey indicators ($\chi^2 = 35.78$, $df = 4$, $p < 0.001$). The findings are consistent with previous studies, indicating that while participants showed a higher awareness of the environmental benefits of eco-enzyme, they lacked practical knowledge and experience in producing and using it. Research by [24], [25] also highlighted similar findings, where community members demonstrated knowledge of environmental sustainability but lacked direct involvement in eco-enzyme production due to limited exposure or training. This emphasizes the need for more hands-on experiences and practical projects to strengthen both theoretical knowledge and practical skills.

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Table 2. Baseline survey results on Eco-enzyme knowledge and awareness

Question	Not yet	Yet	Already know	Total
Have you heard about eco-enzyme? (Q1)	10	5	5	20
Do you know how to produce eco-enzyme? (Q2)	12	3	5	20
Have you ever produced eco-enzyme from organic waste? (Q3)	15	3	2	20
Do you understand the environmental benefits of eco-enzyme? (Q4)	10	5	5	20

Table 2 shows the results of the baseline survey on eco-enzyme knowledge among Nasyiatul Aisyiyah cadres. The survey reveals that 50% of participants had never heard of eco-enzyme, 60% were unaware of its production process, and 75% had no practical experience in producing eco-enzyme from organic waste. While 50% recognized its environmental benefits, deeper knowledge is required. These findings indicate a need for more comprehensive training in eco-enzyme production and its environmental advantages. Similar studies, like those by Gomes (2023) and L. Hemaloshinee Vasudevan (2024), [26] highlight that increasing practical knowledge through training is essential for sustainable practices adoption. The lack of practical experience found here aligns with the research by Lawrence (2021), [27] which emphasizes hands-on training to foster both awareness and engagement in sustainable activities.

3.2. Pre-Test Quiz

The pre-test quiz revealed varying levels of Nasyiatul Aisyiyah cadres' knowledge about eco-enzyme production and its environmental benefits. While the majority of participants correctly identified the concept of eco-enzyme (80%) and understood its basic environmental benefits (70%), their knowledge of the production process was relatively low (45%). Similarly, only 60% of respondents were able to identify the different types of products that can be made from eco-enzyme, such as soap and shampoo, as shown in Figure 2. These findings highlight that while the participants possess some basic conceptual knowledge about eco-enzyme, they still lack a deeper and more practical understanding of the production process and its potential applications in community-based entrepreneurship.

Figure 2 shows that there is a gap between understanding the basic concepts of eco-enzyme and its production process versus understanding the specific applications and benefits of eco-enzyme-based products. While 80% of participants could correctly define eco-enzyme and its environmental benefits, 60% understood the process of producing eco-enzyme from household organic waste. This demonstrates good mastery of theoretical knowledge. However, only 45% of respondents understood the potential applications of eco-enzyme in sustainable waste management and green entrepreneurship. This reveals a weakness in applied knowledge. Understanding that eco-enzyme can be used not only for waste management but also in green entrepreneurship models is a key concept that some participants are still lacking. This suggests that while participants can grasp the technical definitions of eco-enzyme production, they often struggle to fully understand its practical and entrepreneurial applications. Similar studies in community-based programs in Indonesia have shown that

while participants can recall basic definitions, the deeper understanding of eco-enzyme's application in environmental sustainability and entrepreneurship remains underdeveloped [24], [28].

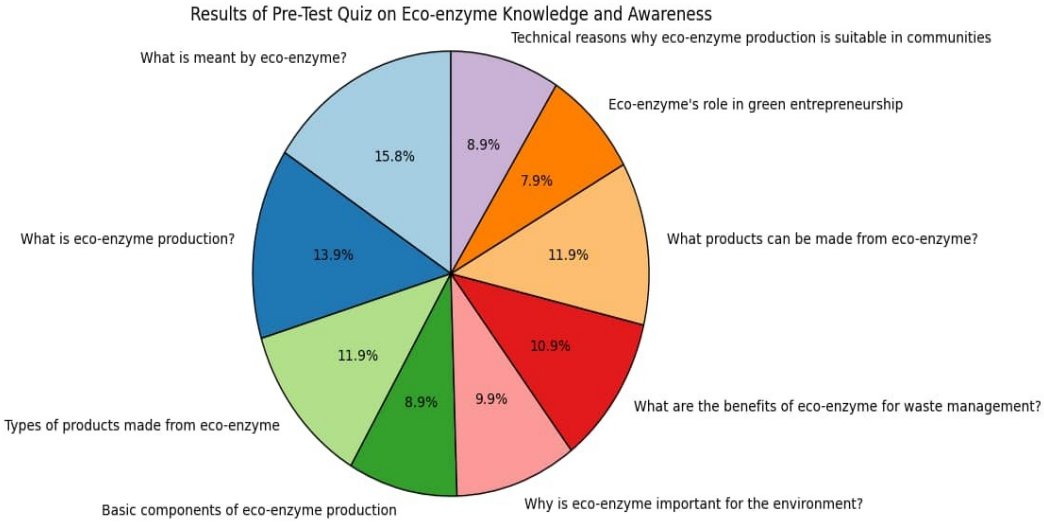

Figure 2. Results of pre-test quiz on Eco-enzyme knowledge and awareness among Nasyiatul Aisyiyah Cadres

3.3. Training and Community Engagement

The community engagement program titled "Strengthening Women's Empowerment through Eco-Enzyme-Based Product Innovation" was implemented with Nasyiatul Aisyiyah cadres in Parepare, as shown in Figure 3. This initial stage helped raise awareness and build enthusiasm among the participants for eco-enzyme production and its potential benefits for waste management and environmental sustainability. The program's focus on hands-on training and the development of eco-enzyme-based products such as soap and shampoo engaged the cadres in active learning, enhancing both their knowledge and practical skills in sustainable practices.

The mentoring focused on processing organic waste, including household waste and waste from fruit, vegetable, lotis, rujak, and juice vendors, such as fruit peels, overripe fruits or vegetables no longer suitable for consumption, and inedible leaves, into eco-enzyme through a fermentation process. Eco-enzyme has many benefits, including its use as fertilizer, insecticide, and external medicine, and it can also be further processed into various derivative products, such as F2 (second fermentation), soap, shampoo, face and body masks, and others.

Preparations for the mentoring activities were carried out well in advance by preparing the necessary materials and equipment, as well as experimenting with the production of eco-enzyme from organic waste so that the resulting product could be used as an example during the mentoring sessions. In addition to eco-enzyme, a derivative product known as F2 (second fermentation) was also prepared by adding natural aromatic ingredients to the eco-enzyme product, resulting in an aromatherapeutic F2 product that is useful for preventing mosquito bites, promoting hair growth, providing fragrance in rooms, and other purposes.

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Figure 3. Socialization session on Eco-enzyme production and green entrepreneurship for Nasyiatul Aisyiyah Cadres in followed by participants, trainers, and community leaders.

These images illustrate the process of creating eco-friendly products based on eco-enzyme. Figure 4 shows various organic waste materials, such as orange peels, pineapple skins, and papaya rinds, that can be transformed into eco-enzyme through the fermentation process. Figure 5 displays a starter kit for making eco-enzyme-based soap and shampoo, providing the essential ingredients to begin producing eco-friendly cleaning products. Figure 6 features the finished eco-enzyme, which can be used as the main ingredient in creating cleaning products. Meanwhile, Figure 7 showcases the liquid soap made from eco-enzyme, resulting in a natural and effective cleaning solution for everyday use.

Figure 4. Examples of organic waste materials

Figure 5. Shampoo and soap starter kit

Figure 6. Ecoenzym product

Figure 7. Eco-enzyme-based liquid soap product

3.4.. Post-Test and Evaluation Survey

The perception mapping of eco-enzyme production and its applications, shown in Figure 8, based on 20 Nasyiatul Aisyiyah cadres, revealed that eco-enzyme production was perceived as the highest impact (45%) despite relatively high effort. In contrast, traditional waste management systems received the lowest ratings, with only 25% of participants recognizing its relevance. Meanwhile, eco-enzyme-based products such as soap and shampoo were positioned in the middle range, with 30% of participants acknowledging their potential. Figure 8, shows that the perception of eco-enzyme production required consistent training and active management to ensure its correct positioning as an effective and sustainable practice. As this constitutes the final stage of the study, a limitation exists in the form of external factors, such as limited resources and community engagement. Consequently, further research is recommended to develop and implement communication and training programs focused on eco-enzyme production and its environmental benefits. These programs must consistently highlight the favorable effort-to-impact ratio of eco-enzyme production. The use of visual aids, success stories, and hands-on workshops will be essential to demonstrate its accessibility and multifaceted benefits.

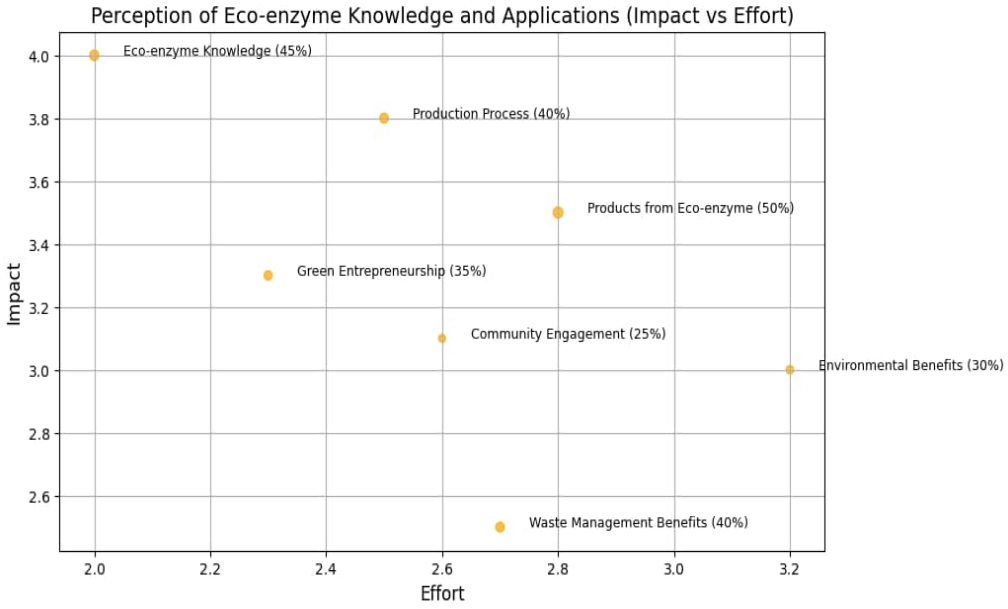

Figure 8. Perception of Eco-enzyme production and its environmental impact. A survey of Nasyiatul Aisyiyah Cadres in Parepare

As shown in Table 3, the evaluation results indicate a highly positive response from participants. Most participants stated that the activity was very beneficial (96%), while the remaining 4% considered it beneficial. In terms of material delivery, 72% of participants perceived it as very good and 28% as good. Regarding the methods applied in the mentoring process, 56% rated them as highly appropriate, while 44% considered them appropriate. In addition, 96% of participants reported that the activity was very helpful in broadening their knowledge, and 4% considered it helpful. These findings suggest that the mentoring program

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was well received and effectively contributed to participants' understanding and engagement in eco-enzyme-based organic waste processing.

The results from the post-test evaluations showed a significant improvement in participants' understanding of eco-enzyme production. While the pre-test revealed that most participants were unfamiliar with eco-enzyme, by the end of the training, 100% of participants could correctly identify the eco-enzyme process and its applications. This improvement can be attributed to the hands-on, practical nature of the program, which reinforced theoretical knowledge through the creation of actual products (liquid soap, mosquito-repellent gel). high success rate of the program is also linked to the participatory training approach, which encouraged active engagement from participants. The use of local materials and real-world applications for eco-enzyme production likely contributed to the positive responses during the evaluation, with 96% of participants reporting the activity was beneficial (Table 3).

Table 3. Overall evaluation of the mentoring activity

Evaluation Aspect	Very Good / Very Beneficial / Highly Appropriate / Very Helpful (%)	Good / Beneficial / Appropriate / Helpful (%)
Usefulness of the activity	96	4
Delivery of the materials	72	28
Appropriateness of the methods used	56	44
Contribution to broadening participants' knowledge	96	4

After participating in this activity, the participants believed that many follow-up actions could be carried out, including: sharing knowledge about the production of eco-enzyme and its benefits; producing eco-enzyme individually or in groups; trying the practice at home or making eco-enzyme at home; socializing and educating students about eco-enzyme; conducting joint practice with students or producing eco-enzyme in the school environment; conducting outreach and practice activities with neighborhood women's groups (dasa wisma); sorting kitchen waste and separating organic waste; disseminating knowledge about eco-enzyme; utilizing household organic waste to produce eco-enzyme; applying the practice and sharing the knowledge with friends and within the community, workplace, home, school, neighborhood association, family, and Adiwiyata team; practicing independently at home for plant fertilizer; disseminating knowledge on processing organic waste into eco-enzyme to fellow science teachers at school; applying the practice in different places and with different general audiences; producing eco-enzyme for application in the surrounding environment; conducting outreach in the community; applying the outcomes in practice; adjusting the material composition according to specific needs; introducing eco-enzyme products and their benefits; organizing similar training activities; conducting post-training monitoring; applying the training at home; carrying out research in the school environment; storing organic waste as raw material for eco-enzyme; and utilizing eco-enzyme in daily life.

One of the constraints in implementing the eco-enzyme production mentoring program was that it had not yet been able to reach a wider community, as expected by most participants, particularly in providing mentoring for the Aisyiyah women's cadre community (Nasyiatul Aisyiyah), due to limitations in time and funding. As a solution and future plan, further mentoring related to eco-enzyme and the processing of organic waste will be carried out for a broader community, especially through mentoring programs in schools in Magelang and other areas, in order to introduce eco-enzyme as a processed product of organic waste that has numerous benefits for health, plants, and the environment. Through this activity, it is expected that a meaningful contribution can be made to preserving a healthy environment and maintaining the sustainability of the surrounding natural ecosystem. eco-enzyme, making the mentoring sessions enjoyable, flexible, and engaging.

The mentoring program succeeded in improving the participants' knowledge and skills, particularly in processing organic waste into eco-enzyme, introducing F2 products as eco-enzyme derivatives, and providing participants and partners with the opportunity to develop greater environmental awareness, especially in separating organic waste from households or the surrounding environment, processing it into eco-enzyme, and applying it in daily life.

Eco-enzyme is produced through the fermentation of organic waste, resulting in a liquid that contains bioactive compounds, which have potential applications in environmentally friendly household and personal care products. In this community service program, eco-enzyme was utilized as the primary ingredient in the formulation of mosquito repellent gel lotion and body soap. These products were developed as eco-innovation outputs, providing not only functional benefits but also economic value for the partner community. The product formulations considered essential factors such as safety, effectiveness, ease of use, and the potential for further development as greenpreneur-based products.

Referring to the article by Adetunji [12], [29], which emphasizes the importance of active participation in strengthening the social capacity of communities, this eco-enzyme-based empowerment program aligns with those principles. By incorporating eco-enzyme into product development, the program enhances the empowerment model by linking practical skills in waste management with increased economic independence. This approach has the potential to accelerate behavioral change in household waste management and can stimulate the formation of green entrepreneurs at the community level, aligning with the principles of the circular economy and community-based management [12].

Table 4 shows that eco enzyme can be formulated into two applicable derivative products, namely mosquito repellent gel lotion and body soap. The mosquito repellent gel lotion was developed with natural ingredients such as citronella to enhance its repellent function, while the body soap was designed to provide a cleansing effect that is safe and comfortable for daily use. Both products demonstrate promising potential for further development as environmentally friendly products within a community empowerment framework.

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Table 4. Developed Eco-Enzyme-Based products

Product	Eco-Enzyme (ml/1000 ml)	MainAdditional Ingredients	pH	Main Function	Product Characteristics	Potential Use
Mosquito Repellent Gel Lotion	300	Citronella, carbopol, glycerin	3.8–4.5	Mosquito repellent	Gel/lotion texture, fresh aroma, easy to apply	Protection against mosquito bites
Body Soap	300	Mild surfactant, glycerin, natural fragrance	3.7–4.5	Body cleansing	Liquid form, skin-friendly, moderate foam	Eco-friendly soap for daily use

Previous community programs have also demonstrated the feasibility of developing eco enzyme into mosquito repellent gel in rural settings, where participants successfully produced and applied eco enzyme based mosquito repellent gel from household organic waste [25]. Similarly, eco enzyme has been shown to serve as a base for various household products, including cleaners and soaps [30]. Laboratory studies further indicate that eco enzyme derived soaps exhibit antibacterial properties when formulated properly, underscoring their functional value beyond just sustainability [30], [31].

Research on eco-friendly cosmetics shows a growing global trend toward using natural ingredients to reduce reliance on synthetic chemicals that may pose risks to both skin health and the environment. A review by Priyadharshana [32] emphasizes that herbal cosmetics are not only safe and effective for skincare but also deliver high ecological benefits by using biodegradable natural components [32]. Moreover, explain that replacing synthetic ingredients with natural alternatives can lower the environmental impact of personal care products while maintaining desired product functionality, supporting broader sustainability goals in the cosmetics industry [33], [34]. This approach aligns with findings that natural materials tend to be more environmentally friendly and help promote renewable resource use in cosmetic production [35].

4. Conclusion

The community service program focusing on the processing of organic waste into eco-enzyme and the development of derivative products, namely mosquito repellent gel lotion and body soap, has been successfully implemented and demonstrated positive outcomes. The program effectively enhanced the knowledge, skills, and environmental awareness of the participants, particularly the Nasyiatul Aisyiyah cadres, in managing household waste in a more productive and sustainable manner. The evaluation results indicate that the majority of participants responded very positively to the program, especially in terms of its usefulness, implementation methods, and material delivery.

Furthermore, participants showed improved understanding of circular economy concepts and the potential for developing environmentally based green entrepreneurship. The development of eco-enzyme-based products such as mosquito repellent gel lotion and body soap shows promising potential as environmentally friendly products with both functional and economic value. With continued mentoring and strengthening of production and marketing aspects, this program has strong potential to be expanded as a sustainable community empowerment model. Overall, the program contributes not only to the reduction of organic waste but also to the enhancement of community economic capacity and environmental awareness, while supporting the implementation of circular economy principles and sustainable development.

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