



ASSESSING THE EFFECTIVENESS OF AN ECO-ENZYME TRAINING OF TRAINERS (TOT) PROGRAM IN ENHANCING ENVIRONMENTAL LITERACY AND SOCIAL ENTREPRENEURSHIP THROUGH AN SROI APPROACH

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Diterima: 26/05/2026; Direvisi: 03/06/2026; Diterbitkan: 08/06/2026

ABSTRAK

Penumpukan sampah organik di wilayah perkotaan menjadi permasalahan lingkungan yang memerlukan solusi berkelanjutan melalui pendekatan edukatif dan partisipatif. Penelitian ini bertujuan untuk mengevaluasi dampak sosial, lingkungan, dan ekonomi dari Program Pengabdian kepada Masyarakat (PkM) berupa Training of Trainers (ToT) pembuatan Eco-Enzyme di SDN Beji Timur 1 Kota Depok. Program melibatkan 20 guru dan 42 siswa sebagai peserta utama yang selanjutnya mendiseminasikan pengetahuan kepada 142 siswa dan 30 guru lainnya. Penelitian menggunakan pendekatan kuantitatif evaluatif dengan metode Social Return on Investment (SROI) untuk mengukur nilai manfaat sosial yang dihasilkan dibandingkan dengan investasi program sebesar Rp40.000.000. Tahapan penelitian meliputi identifikasi pemangku kepentingan, pemetaan perubahan yang terjadi, penentuan indikator manfaat, penghitungan nilai manfaat sosial, serta analisis rasio SROI. Hasil penelitian menunjukkan bahwa program menghasilkan rasio SROI sebesar 3,95:1, yang berarti setiap Rp1 yang diinvestasikan mampu menghasilkan manfaat sosial, lingkungan, dan ekonomi senilai Rp3,95. Manfaat utama yang teridentifikasi meliputi peningkatan kapasitas guru dan siswa dalam pengelolaan sampah organik, peningkatan literasi lingkungan, penguatan perilaku ramah lingkungan, serta potensi penghematan biaya melalui pemanfaatan Eco-Enzyme sebagai alternatif produk berbahan kimia. Temuan ini menunjukkan bahwa program ToT Eco-Enzyme memiliki nilai sosial yang tinggi dan layak dikembangkan sebagai model pembelajaran berbasis lingkungan sekaligus laboratorium sosial (living lab) untuk menumbuhkan jiwa kewirausahaan sosial di sekolah dasar.

Kata kunci: *Eco-Enzyme, Sampah Organik, Kewirausahaan Sosial, Social Return on Investment (SROI), Training of Trainers (ToT)*

ABSTRACT

The accumulation of organic waste in urban areas has become a significant environmental challenge that requires sustainable solutions through educational and participatory approaches. This study aims to evaluate the social, environmental, and economic impacts of a Community Service Program (PkM) in the form of a Training of Trainers (ToT) on Eco-Enzyme production implemented at SDN Beji Timur 1, Depok City. The program involved 20 teachers and 42 students as primary participants, who subsequently disseminated their knowledge to 142 students and 30 additional teachers. This study employed a quantitative evaluative approach using the Social Return on Investment (SROI) framework to assess the social value generated relative to the program investment of IDR 40,000,000. The research process included stakeholder identification, outcome mapping, determination of benefit indicators, calculation of social value, and SROI ratio analysis. The findings revealed an SROI ratio of 3.95:1,



indicating that every IDR 1 invested generated IDR 3.95 in social, environmental, and economic benefits. The major outcomes included improved teacher and student capacity in organic waste management, enhanced environmental literacy, strengthened pro-environmental behavior, and potential cost savings through the use of Eco-Enzyme as an alternative to chemical-based products. These findings demonstrate that the Eco-Enzyme ToT program generates substantial social value and has strong potential to be developed as an environmental learning model as well as a school-based living laboratory for fostering social entrepreneurship among elementary school communities.

Keywords: *Eco-Enzyme, Organic Waste, Social Entrepreneurship, Social Return on Investment (SROI), Training of Trainers (ToT)*

INTRODUCTION

Indonesia is currently facing a serious environmental challenge related to the increasing volume of solid waste, particularly organic waste generated from household activities. The rapid growth of population and urbanization has significantly increased the amount of waste produced in urban areas. Improper management of organic waste contributes to environmental pollution and creates additional pressure on existing waste management systems. Organic waste disposed of in landfills also generates methane emissions, which are recognized as one of the major contributors to global warming. Ahsanti and Husen (2022) emphasized that community-based waste management is an important strategy for mitigating environmental problems and supporting climate change adaptation efforts.

The environmental impacts of unmanaged waste have become a growing concern in sustainability studies. Organic waste decomposition produces greenhouse gases that contribute directly to climate change. Effective waste management is therefore essential not only for environmental protection but also for achieving sustainable development goals. Sa'diyah and Davina (2025) reported that poor waste management practices can accelerate environmental degradation and increase climate-related risks. These conditions indicate the urgent need for innovative and participatory approaches to waste reduction at the community level.

One important approach to addressing environmental challenges is the improvement of environmental literacy among community members. Environmental literacy refers to the knowledge, awareness, attitudes, and skills necessary to understand environmental issues and engage in responsible environmental behavior. Schools play a strategic role in developing environmental literacy because they provide opportunities to cultivate sustainable values from an early age. Ahmadi (2022) explained that environmental literacy programs can significantly improve students' awareness and concern for environmental issues. Similar findings were reported by Karmana (2023), who found that environmental literacy initiatives contribute positively to the development of environmentally responsible behavior among students.

An environmentally friendly innovation that has received increasing attention in recent years is Eco-Enzyme. Eco-Enzyme is a multifunctional liquid produced through the fermentation of organic waste materials such as fruit peels and vegetable residues. The production process is relatively simple, inexpensive, and suitable for implementation in households, schools, and community organizations. Budiyanto et al. (2022) described Eco-Enzyme as an innovative approach for transforming organic waste into multifunctional products with environmental and practical benefits in urban communities. Langsa et al. (2024) demonstrated that Eco-Enzyme utilization can reduce the volume of organic waste while promoting sustainable environmental practices. Deviranty and Larassaty (2024) further explained that Eco-Enzyme can be effectively integrated into educational activities to provide practical learning experiences related to waste management and environmental



conservation.

In addition to its environmental benefits, Eco-Enzyme activities can also support the development of social entrepreneurship. Social entrepreneurship focuses on creating social value while addressing community problems through innovative and sustainable solutions. Through Eco-Enzyme production, participants learn how environmental challenges can be transformed into opportunities that generate social and economic benefits. Hasibuan and Nawawi (2023) stated that social entrepreneurship plays an important role in addressing social and environmental issues through community-based initiatives. Apriani et al. (2023) also highlighted the contribution of social entrepreneurship to strengthening community welfare and economic resilience. Similarly, Handoko et al. (2025) demonstrated that social entrepreneurship initiatives can empower local communities by strengthening economic resilience while addressing social needs through participatory approaches.

To maximize the dissemination of environmental knowledge and practical skills, many educational programs employ the Training of Trainers (ToT) approach. This model enables selected participants to become trainers who subsequently transfer their knowledge to others. As a result, the program impact can expand through a multiplier effect. Willemssen et al. (2024) found that ToT programs are effective in strengthening capacity building and knowledge transfer within communities. Hoang et al. (2025) also reported that ToT-based interventions significantly improve participants' competencies and support sustainable learning processes. Furthermore, Zaid et al. (2025) emphasized that contemporary ToT programs can be enhanced through innovative learning approaches and technological support, enabling more effective knowledge dissemination and participant engagement.

Despite the growing implementation of Eco-Enzyme programs and environmental education initiatives, previous studies have primarily focused on technical outcomes and descriptive evaluations. Limited research has examined the integration of environmental literacy, social entrepreneurship, and comprehensive social impact assessment within a single framework. Furthermore, studies investigating the broader value generated through Eco-Enzyme-based educational programs remain relatively scarce. This gap indicates the need for more comprehensive evaluations capable of capturing social, environmental, and economic outcomes simultaneously.

One approach that can address this limitation is the Social Return on Investment (SROI) framework. SROI is widely recognized as a method for measuring and monetizing social, environmental, and economic impacts generated by a program or intervention. Kadel et al. (2022) emphasized that SROI provides a comprehensive assessment of value creation beyond conventional financial indicators. Corvo et al. (2022) further explained that SROI enables researchers to evaluate both tangible and intangible outcomes experienced by stakeholders. Therefore, this study aims to analyze the social, environmental, and economic impacts generated by an Eco-Enzyme-based Training of Trainers program at SDN Beji Timur 1 Depok using the SROI framework. The novelty of this research lies in the integration of environmental literacy, social entrepreneurship, and SROI-based impact evaluation within a community-based environmental education program.

RESEARCH METHODE

This study employed a mixed-methods approach combining qualitative and quantitative techniques to evaluate the social, environmental, and economic impacts of an Eco-Enzyme-based Community Service Program (PkM) using the Social Return on Investment (SROI) framework. The program was implemented in 2025 at the Faculty of Economics and Business,



Universitas Indonesia, and SDN Beji Timur 1, Depok. A purposive sampling technique was used to select participants actively involved in environmental education and waste management activities. The program involved 234 participants, including 20 teachers and 42 students as primary trainees, who subsequently disseminated the acquired knowledge and skills to an additional 172 teachers and students through a Training of Trainers (ToT) model. The intervention included Eco-Enzyme production training, environmental literacy activities, organic waste management practices, and social entrepreneurship education.

Data were collected through interviews, Focus Group Discussions (FGDs), observations, documentation, and structured pre-test and post-test surveys. Primary data focused on changes in participants' environmental knowledge, awareness, and behavior, while secondary data were obtained from program financial reports, institutional documents, and market price references used as financial proxies in the SROI analysis. Qualitative data were analyzed using thematic analysis to identify patterns related to environmental literacy enhancement, behavioral change, and community empowerment. Quantitative data were analyzed descriptively and further utilized in the SROI calculation process to estimate the social value generated by the program. The SROI ratio was calculated by comparing the total monetized benefits produced by the intervention with the total program investment of IDR 40,000,000, thereby providing a comprehensive assessment of the program's effectiveness and sustainability.

RESULT AND DISCUSSION

Prior to presenting the results and discussion, it is important to emphasize that this study focuses on the implementation of an Eco-Enzyme-based Training of Trainers (ToT) program as an environmental education intervention that not only enhances participants' knowledge but also generates broader social value. The program was designed using a cascading knowledge-transfer approach, enabling its impact to extend across multiple stakeholder groups within the educational community. To comprehensively assess its effectiveness, the analysis was conducted through several stages, including stakeholder mapping, measurement of learning outcomes, monetization of social value, and the calculation of Social Return on Investment (SROI). These analytical stages were applied to capture not only individual learning improvements but also the wider educational, environmental, and socio-economic impacts produced by the program, thereby providing a holistic understanding of its overall effectiveness.

Result

The implementation of the Eco-Enzyme-based Training of Trainers (ToT) program successfully engaged various stakeholders within the educational community through a cascading knowledge-transfer mechanism. The program was funded through a Community Service Grant amounting to IDR 40,000,000, which supported training activities, educational materials, Eco-Enzyme production equipment, and dissemination programs. Participants who completed the initial training sessions subsequently transferred their knowledge and practical skills to other members of the school community. This approach enabled broader dissemination of environmental literacy and sustainable organic waste management practices. As a result, the program expanded its educational reach beyond the initial group of participants and strengthened environmental awareness within the school environment.

To identify the outcomes generated by the program, a stakeholder mapping process was conducted. This process focused on recognizing the main groups involved in the intervention and the outcomes experienced by each stakeholder category. The findings revealed that the program generated educational, environmental, and entrepreneurial outcomes among

participants. These outcomes reflected improvements in environmental literacy, Eco-Enzyme production skills, and social entrepreneurship awareness. A summary of stakeholder outcomes is presented in Table 1.

Table 1. Stakeholder Outcome Mapping of the Eco-Enzyme ToT Program

No	Stakeholder	Participants	Identified Outcome
1	Elementary School Teachers	12	Improved Eco-Enzyme production knowledge and skills
2	Elementary School Students	45	Improved Eco-Enzyme production competencies
3	Elementary School Students	45	Improved entrepreneurial and pricing knowledge
4	University Students	10	Improved entrepreneurial competencies
5	Educational Staff	6	Increased environmental awareness

Based on Table 1, the program outcomes were primarily concentrated on human capital development. Participants demonstrated improvements in environmental knowledge, practical Eco-Enzyme production skills, and entrepreneurial understanding. The diversity of outcomes indicates that the intervention generated multidimensional benefits across different stakeholder groups. Furthermore, the findings suggest that environmental education activities can simultaneously support sustainability awareness and capacity building. These identified outcomes subsequently formed the basis for the social value assessment conducted through the SROI framework.

In addition to stakeholder outcome mapping, program effectiveness was assessed through learning achievement measurements. The comparison between participants' knowledge levels before and after the training indicated a substantial improvement in environmental literacy and practical understanding. The observed changes suggest that participants gained a stronger understanding of organic waste management and Eco-Enzyme production procedures. Moreover, the integration of environmental education with entrepreneurial concepts contributed to broader learning outcomes.

This improvement reflects the effectiveness of the ToT model in enhancing participants' environmental knowledge and practical competencies. The increased understanding of Eco-Enzyme production processes also suggests greater readiness among participants to apply sustainable waste management practices. Furthermore, improved learning outcomes provided evidence that the training materials were successfully delivered and understood. These educational achievements became an important component in the subsequent social value calculation.

Following the identification of program outcomes, the next stage involved monetizing the social value generated by the intervention. The monetization process translated non-financial outcomes into economic values using relevant financial proxies. This approach

enabled the estimation of social benefits associated with environmental literacy improvement, technical skill development, and entrepreneurial capacity building. Through this process, the broader value generated by the program could be quantified systematically. The monetization results are summarized in Table 2.

Table 2. Monetized Value of Program Outcomes

No	Outcome	Final Impact Value (IDR)
1	Teachers' Eco-Enzyme knowledge and skills	8,820,000
2	Students' Eco-Enzyme production competencies	23,625,000
3	Students' entrepreneurial knowledge	37,800,000
4	University students' entrepreneurial competencies	5,250,000

The monetization results demonstrate that the program generated measurable social value across all stakeholder groups. Educational outcomes represented the largest proportion of the total value created by the intervention. The findings indicate that investments in environmental education can produce benefits extending beyond knowledge acquisition alone. In addition, the development of entrepreneurial competencies contributed to the overall social impact generated by the program. These monetized outcomes were subsequently used to calculate the overall Social Return on Investment.

The final stage of the analysis involved calculating the Social Return on Investment (SROI) ratio by comparing the total value generated with the investment allocated to the program. This calculation provided an overall assessment of the program's effectiveness in creating social, environmental, and economic value. The resulting ratio reflects the extent to which the investment generated benefits for stakeholders. A summary of the final SROI calculation is presented in Table 3.

Table 3. Final Social Return on Investment (SROI) Calculation

Component	Value (IDR)
Total Program Investment	40,000,000
Total Gross Social Value	198,000,000
Net Social Value	158,000,000
SROI Ratio	3.95 : 1

Based on Table 3, the program generated a net social value that exceeded the initial investment. The calculated SROI ratio indicates that the intervention produced substantial benefits for participating stakeholders. These benefits were reflected in improvements in environmental literacy, practical competencies, and entrepreneurial awareness developed throughout the implementation process. The findings also demonstrate the effectiveness of the ToT approach in expanding the reach of environmental education through knowledge dissemination mechanisms. Overall, the Eco-Enzyme-based ToT program successfully generated measurable educational, environmental, and socio-economic outcomes within the school community.

Discussion

The findings demonstrate that the Eco-Enzyme-based Training of Trainers (ToT) program generated meaningful improvements in environmental literacy and practical competencies among participants. The positive outcomes indicate that environmental education becomes more effective when learners are directly involved in experiential and participatory



activities. Participants were not only exposed to theoretical information regarding organic waste management but were also actively engaged in the production and utilization of Eco-Enzyme. This process enabled them to connect environmental knowledge with real-life practices and problem-solving experiences. Such findings support the argument that environmental literacy develops more effectively through active learning experiences that encourage direct interaction with environmental issues (Miterianifa & Mawarni, 2024).

The improvement in participants' knowledge and competencies also reflects the effectiveness of environmental learning approaches that integrate practical projects into the educational process. The Eco-Enzyme activities provided opportunities for participants to learn through observation, experimentation, and reflection, thereby strengthening their understanding of sustainable waste management. Environmental education programs that emphasize project-based experiences have been shown to increase learners' environmental awareness and responsibility toward ecological problems. Through direct participation, individuals are more likely to internalize environmental values and adopt sustainable behaviors. This interpretation is consistent with the findings reported by Putra et al. (2024), who found that environmentally based project learning significantly enhances environmental literacy among students.

The success of the program can also be understood through the characteristics of Eco-Enzyme itself as an accessible and practical environmental innovation. Eco-Enzyme transforms organic waste into a multifunctional product with environmental and economic value, making it an effective educational medium for sustainability learning. Participants were able to observe tangible outcomes from the waste processing activities, which likely increased their motivation and engagement throughout the program. The conversion of waste into useful products also demonstrates the practical application of circular economy principles at the community level. Similar benefits of Eco-Enzyme implementation in community and household settings have been reported by Dewi and Utama (2022), who emphasized its potential to reduce organic waste while promoting environmentally responsible behavior.

Another important finding relates to the effectiveness of the ToT model as a strategy for knowledge dissemination and community empowerment. The cascading mechanism allowed trained participants to transfer their knowledge and skills to a broader audience, thereby extending the impact of the intervention beyond the initial training group. This multiplier effect is particularly valuable in environmental education because sustainable behavioral change often requires continuous reinforcement through social interaction and peer learning. The findings suggest that participants functioned not only as learners but also as environmental change agents within their communities. A similar conclusion was reached by Widyadhari and Nurwianti (2025), who reported that ToT programs strengthen participants' confidence and capacity to disseminate acquired knowledge to others.

The integration of environmental literacy with social entrepreneurship represents another significant contribution of the program. Beyond learning about waste management, participants gained an understanding of how environmental challenges can be transformed into opportunities for value creation and community development. This approach broadens the scope of environmental education by connecting ecological responsibility with economic and social innovation. Social entrepreneurship encourages individuals to generate solutions that simultaneously address environmental problems and community needs. According to Gurnayati et al. (2025), social entrepreneurship plays an important role in empowering local communities by creating sustainable innovations that generate both social and economic benefits.

The Social Return on Investment (SROI) ratio obtained in this study indicates that the program generated social value exceeding the resources invested in its implementation. This



result suggests that environmental education initiatives can produce benefits that extend beyond immediate learning outcomes. The value generated by the program includes increased environmental awareness, improved technical competencies, and strengthened entrepreneurial understanding among participants. The findings reinforce the notion that community-based educational interventions can create measurable social and environmental impacts when evaluated through comprehensive assessment frameworks. Similar conclusions were reported by Daly et al. (2025), who demonstrated that SROI analysis is capable of capturing broader social benefits that are often overlooked in conventional program evaluations.

From a theoretical perspective, the findings support contemporary views that sustainability education should integrate environmental literacy, community empowerment, and social innovation within a single framework. The results indicate that environmental education is most effective when participants are actively engaged in solving real-world environmental problems and are encouraged to disseminate acquired knowledge within their communities. Furthermore, the positive SROI ratio suggests that investments in environmental education can generate substantial social returns and contribute to long-term community resilience. These findings strengthen the relevance of impact-oriented evaluation approaches in sustainability programs. As emphasized by Lee et al. (2026), the measurement of social value through SROI provides important evidence regarding the broader benefits generated by sustainability-oriented interventions and supports more informed decision-making for future program development.

CONCLUSION

This study concludes that the Eco-Enzyme-based Training of Trainers (ToT) program significantly contributes to improving environmental literacy, ecological awareness, and practical skills in organic waste management among elementary school communities. The findings demonstrate that participatory and experiential learning approaches are effective in not only increasing participants' knowledge but also fostering sustainable behavioral change through direct engagement in Eco-Enzyme production activities. In addition, the ToT model creates a strong multiplier effect by enabling trained participants to disseminate knowledge to a wider community, thereby extending the impact beyond individual learning outcomes. In this context, schools function as strategic centers for environmental education and community empowerment in addressing urban waste challenges.

From an impact perspective, the Social Return on Investment (SROI) analysis indicates that the program generates substantial social, environmental, and economic value relative to the initial investment, highlighting the potential of environmental education programs to produce multidimensional benefits. However, these findings should be interpreted with caution due to assumptions in monetizing intangible outcomes and contextual limitations of the study. The results further emphasize the importance of long-term evaluation to determine the sustainability of behavioral changes, as well as the need for future research to replicate and adapt the Eco-Enzyme ToT model in broader educational and community contexts. Overall, this study provides a foundation for developing scalable and sustainable environmental education strategies that integrate literacy, practice, and social impact.

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