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Empowering the Kayambang Youth Cooperative through Plastic-Waste Shredding Training to Support the Citarum Harum Program in Bojong Picung, Cianjur

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Abstract
Plastic waste remains a major driver of pollution in the Citarum River watershed, and informal-sector actors along its tributaries in Cianjur Regency have limited access to technology that could convert this waste into an income-generating resource. This community service program aimed to strengthen the capacity of the Kayambang Youth Cooperative in Desa Bojong Picung, Kabupaten Cianjur, to manage plastic bottle waste using an appropriate-technology shredder (crusher) machine, as part of the Citarum Harum river-restoration program. The two-day program (29-30 July 2026), attended by 18 cooperative members, combined lecture-based environmental education, green-entrepreneurship coaching, and hands-on technical training, evaluated with a single-group pre-post-training assessment and a post-activity satisfaction survey. Participants' understanding of plastic pollution and the 3R (Reduce, Reuse, Recycle) principle increased by 35 percent, while technical competence in operating the shredder increased by 45 percent; during the practicum, participants processed 25 kg of plastic bottles into flakes within approximately 45 minutes. A value-chain simulation indicated that shredding could raise the price of the waste roughly threefold, from about IDR 2,500-3,000 per kilogram for whole bottles to IDR 7,500-9,000 per kilogram for flakes, and 86 percent of participants reported greater confidence in plastic waste as a business opportunity. These outcomes suggest that appropriate-technology training combined with entrepreneurship coaching can plausibly support both Citarum Harum's environmental objectives and cooperatives' economic empowerment. However, these are short-term, end-of-program results from a single cohort: the economic figures are simulation-based projections, and no long-term monitoring data yet confirm sustained income or environmental impact.

Keywords: appropriate technology; circular economy; Citarum River; community empowerment; plastic waste management

INTRODUCTION

The Citarum River, which runs through West Java and supplies water to millions of residents, has for decades been identified as one of the most polluted rivers in Indonesia, with plastic packaging waste as one of its most visible contaminants (Djuangsih, 1993; Nahib et al., 2024). Since 2018 the Indonesian government has pursued the Citarum Harum ("Fragrant Citarum") program, a cross-sectoral effort to accelerate pollution control and ecological restoration of the Citarum watershed (Zaenudin & Komariah, 2022). Evaluations conducted several years into the program report measurable reductions in downstream pollution load, but also note that sustaining these gains depends on continued community participation rather than infrastructure and law enforcement alone (Permatasari et al., 2022).

Polyethylene terephthalate (PET) bottles are a disproportionately large share of the plastic waste entering rivers such as the Citarum because, unlike many other polymers, they are technically well suited to mechanical recycling once collected and sorted (Istirokhatun et al., 2025; McNeeley et al., 2025; Zhang et al., 2025). Mechanical recycling (shredding, washing, and reprocessing bottles into

flakes or pellets) is widely regarded as the most mature and least energy-intensive recycling pathway for PET, and its main practical bottleneck is not the technology itself but reliable collection and sorting at the point closest to the waste stream (Du et al., 2022; Kroell et al., 2024; Yu et al., 2022). At village and small-cooperative scale in Indonesia, that bottleneck is compounded by limited access to even basic processing equipment and by the continued marginalization of the informal actors who already collect much of the recyclable waste (Djeutchouang, 2025; Velis, 2017).

Desa Bojong Picung in Kabupaten Cianjur lies within the upper Citarum watershed and is home to the Kayambang Youth Cooperative, a village-level youth organization whose members had previously collected and sold plastic bottle waste in its unprocessed form, at a price that provided little economic incentive for sustained collection. Before this program, the cooperative had no shredding or other processing equipment and no member had received formal training in plastic-waste handling; its role was limited to manual, low-value collection, consistent with the wider pattern in which informal collector groups in Indonesia continue to be marginalized from the more valuable, processed end of the plastic supply chain (Djeutchouang, 2025; Velis, 2017). This gap in processing capacity, rather than a shortage of collectible material, was the specific condition that this program was designed to address. Nationally, plastic packaging waste is reported to be a large and only partially managed component of Indonesia's solid-waste stream (Triwibowo, 2026), and Extended Producer Responsibility and deposit-return policy instruments intended to address this problem are still at an early and uneven stage of implementation (Lin et al., 2025; Wulandari & Wisnaeni, 2026). In this policy environment, a community-owned, low-cost processing unit that upgrades collected bottles into a more valuable intermediate product offers a complementary, bottom-up route to the same goal: keeping plastic out of the river while creating local income (Indrayani & Sapiun, 2026; Purnamasari et al., 2026; Winarko et al., 2022).

Community service programs elsewhere in Indonesia have shown that pairing appropriate technology with structured training can measurably improve both technical skill and business orientation among target groups, typically assessed through pre- and post-training instruments (Agustiani et al., 2026; Siswanto et al., 2024). Similar waste-bank and plastic-upcycling programs report gains in participants' environmental knowledge and, in some cases, modest income diversification (A'zdom & Asilah, 2025; Drupadi, 2025; Irdiana et al., 2020; Nurwidiana & Fatmawati, 2022). What these prior programs share, and what this program sought to extend, is a combination of environmental-literacy content, entrepreneurship coaching, and hands-on technical practice within a single, short intervention, rather than any one of these components alone.

Because deposit-return and extended-producer-responsibility reforms typically take years to mature and are contested during implementation elsewhere (Meyersohn, 2024; Tena Cortés, 2025), community-level interventions that train existing collector groups to add value to what they already gather can plausibly deliver nearer-term, if smaller-scale, reductions in plastic leakage while those national instruments are still being built out.

This article reports on a two-day plastic-waste shredding training program delivered to the Kayambang Youth Cooperative in July 2026, funded through Universitas Pendidikan Indonesia's community service scheme and framed explicitly as a contribution to the Citarum Harum program. The objectives of the activity were threefold: (1) to improve participants' understanding of plastic pollution and the 3R principle; (2) to build participants' technical competence in operating a plastic-bottle shredder machine safely and productively; and (3) to introduce a simple value-chain perspective

that reframes plastic waste as a tradable input rather than a nuisance to be discarded. Its contribution lies less in technological novelty; the shredder itself uses well-established mechanical recycling principles (Buckshumiyan et al., 2023; Suwignyo et al., 2022). Instead, the contribution lies in documenting, with pre/post and satisfaction data, how a single short intervention combining education, entrepreneurship coaching, and hands-on operation performed with an actual river-adjacent youth cooperative. The article is also explicit about what that evidence can and cannot support.

METHODS

This activity followed a participatory, appropriate-technology transfer approach: the team introduced and transferred operating knowledge of a mechanical shredder to the partner cooperative through direct, hands-on instruction rather than through a one-way lecture format alone. It was designed and reported as a community service (Pengabdian kepada Masyarakat) program rather than an experimental study, and its outcomes were evaluated using a single-group pre-test-post-test design combined with a post-activity satisfaction survey. This evaluation design allowed the team to document change in participants' knowledge and skill but does not support causal inference in the way a controlled design would; this limitation is addressed directly in the Discussion. The program was carried out under a university community-service grant (contract No. 127/UN40.F7/AM.02.01/2026) and implemented in partnership with the Kayambang Youth Cooperative, with support from the Bojong Picung village government and the Cianjur Regency Environmental Agency (Dinas Lingkungan Hidup Kabupaten Cianjur).

The target community was the Kayambang Youth Cooperative in Desa Bojong Picung, Kabupaten Cianjur, West Java, an area within the upper Citarum watershed. Eighteen cooperative members participated in the full two-day program, held on 29-30 July 2026 at the cooperative's premises. The implementing team consisted of four lecturers from Universitas Pendidikan Indonesia, each responsible for a distinct session: environmental education, entrepreneurship coaching, and technical training, respectively, with the team leader coordinating overall implementation and community liaison.

The program was implemented in three sequential sessions across two days. Day 1 (29 July 2026) comprised two sessions: an environmental-education session that introduced the ecological consequences of plastic pollution in the Citarum watershed and the 3R (Reduce, Reuse, Recycle) principle, using discussion and illustrated materials, followed on the same day by a green-entrepreneurship session that reframed plastic waste as a tradable commodity, covering basic business management and the differential market value of common plastic types (PET, HDPE, and PP). Day 2 (30 July 2026) comprised the technical session, which introduced the operating principles of the shredder (crusher) machine, a mechanical-recycling unit with a rated capacity of approximately 100 kg per hour, followed by supervised, hands-on practice in which participants fed, monitored, and collected output from the machine under instructor guidance.

Program effectiveness was assessed with three complementary instruments. The first was a structured pre-test and post-test on plastic-pollution and 3R concepts, administered immediately before and after the first-day educational session. The second was an observed technical-competence assessment before and after the hands-on shredding practicum, scored by the instructing team against a simple operational checklist (correct feeding technique, safe machine handling, and consistent flake output). The third was a post-activity participant satisfaction questionnaire administered at the close of

the program, which also asked participants to rate their confidence in treating plastic waste as a business opportunity. All three instruments were brief, team-developed tools rather than previously validated psychometric scales, consistent with common practice in short community service programs. Percentage gains reported in the Results section were calculated descriptively, as the difference between mean pre- and post-scores relative to the pre-score; given the single-group design and small cohort (n = 18), no inferential statistical test was applied, and the percentages should be read as descriptive indicators of change rather than statistically tested effects.

In addition, the team recorded machine throughput (kilograms processed per unit time) during the live demonstration and compiled prevailing local market prices for whole bottles and for shredded flakes, reported by the cooperative and cross-checked against the team's own market inquiry, to construct an indicative value-chain comparison. Participation was voluntary, and no personally identifying data beyond aggregate counts are reported here.

Beyond the two delivery days, the team and the cooperative's management jointly agreed on a sustainability plan comprising periodic remote mentoring, institutional strengthening of the cooperative's waste-management unit, and future diversification of processed flakes into higher-value products such as paving blocks and ecobricks (Gund et al., 2023; Kakerissa & Latuheru, 2023; Syahira et al., 2026). At the time of writing, this sustainability phase had only just begun, and the outcomes reported below should accordingly be read as short-term, end-of-program results rather than evidence of durable behavioral or economic change.

RESULTS AND DISCUSSION

This section first reports the program's measured knowledge, skill, and satisfaction outcomes, summarized in Table 1, before turning to their interpretation as community-empowerment outcomes and their relationship to the program's longer-term, as yet unmeasured, environmental and economic objectives.

Table 1 summarizes the program's principal knowledge, skill, and economic indicators. Participants' understanding of plastic pollution and the 3R principle, assessed through the pre-/post-test administered around the first-day educational session (Figure 1), increased by 35%. This gain is broadly consistent with comparable appropriate-technology and environmental-training programs in Indonesian community service literature, which typically report knowledge gains in the order of 30-60% following a single short intervention (Agustiani et al., 2026; Siswanto et al., 2024).

Table 1. Training outcomes: knowledge, skill, and indicative economic indicators

Indicator	Baseline / comparison	Post-training / result
Understanding of plastic pollution and 3R principle (pre-/post-test)	Pre-test score	+35% relative to pre-test
Technical competence in shredder operation (observed checklist)	Pre-practicum score	+45% relative to pre-practicum
Machine throughput (live practicum, first-time operators)	Rated capacity ≈ 100 kg/hour	25 kg processed in ≈ 45 minutes (≈ 33 kg/hour observed)
Market price of collected material	Whole bottles: IDR 2,500-3,000/kg	Flakes: IDR 7,500-9,000/kg (+150-200%)
Participant confidence / satisfaction (post-activity survey)	-	86% reported greater confidence in plastic-waste business potential

Figure 1. Environmental-education and technical-orientation session introducing the plastic-shredding process flow to participants

Technical competence in operating the shredder machine, assessed through the instructing team's observed checklist before and after the hands-on practicum, increased by 45%. During the live practicum (Figure 2), the 18 participants collectively fed and processed 25 kg of plastic bottles into flakes in approximately 45 minutes, corresponding to an observed throughput of roughly 33 kg per hour under supervised, first-time operating conditions, below the machine's rated capacity of about 100 kg per hour. This gap is expected given that participants were operating the equipment for the first time; this single demonstration cannot establish a stable production rate; it is reported here as a feasibility indicator rather than as evidence of sustained operational capacity.

Figure 2. Hands-on practicum: supervised operation of the shredder (crusher) machine by cooperative members

The indicative value-chain comparison found that a kilogram of whole plastic bottles fetched approximately IDR 2,500-3,000 in the local market, whereas the same material, once shredded into flakes, fetched approximately IDR 7,500-9,000 per kilogram, an increase of roughly 150-200%. Extrapolating this margin to the machine's rated throughput (about 100 kg per hour, or a hypothetical 800 kg across an 8-hour working day) would imply a gross revenue in the range of IDR 6-7.2 million per day and a projected net monthly margin in the tens of millions of rupiah. This extrapolation, however, assumes continuous, fully utilized operation that the cooperative has not yet sustained. It

should therefore be read as an upper-bound planning estimate rather than an achieved or verified income figure, and its accuracy depends on collection volume, machine uptime, and market prices that the program did not track over time.

On the post-activity satisfaction survey, 86% of participants reported greater confidence in managing plastic waste and in recognizing it as a business opportunity, a proportion comparable to satisfaction levels reported in other short, hands-on community-training interventions (Agustiani et al., 2026). Qualitatively, several participants and cooperative leaders indicated during the closing session (Figure 3) that the two most valued aspects of the program were the direct machine practicum and the reframing of plastic waste as a commodity with a calculable market value, rather than the lecture content alone.

Figure 3. Closing session of the training program with representatives of the Kayambang Youth Cooperative, Bojong Picung village government, and the implementing team

Turning from these measured training outcomes to their broader significance as a community-empowerment effort, the program is intended to contribute to the environmental objectives of Citarum Harum by diverting collected bottles from open burning or riverside dumping toward a processing pathway, and by building local capacity that does not depend on continuous external funding once established. This aligns the activity, at least in intent, with Sustainable Development Goal (SDG) 12 (responsible consumption and production) through waste valorization, SDG 8 (decent work and economic growth) through informal-sector income diversification, and SDG 13 (climate action) insofar as diverting PET from open burning or landfilling avoids the associated emissions (Ayeleru et al., 2020; Kroell et al., 2024). These linkages are programmatic aspirations rather than measured environmental outcomes, since the present evaluation did not include river-water or emissions monitoring.

The program's technical approach, mechanical shredding as a first-stage processing step, is consistent with the broader literature's assessment of mechanical recycling as the most mature and least energy-intensive pathway for PET (Istirokhatun et al., 2025; McNeeley et al., 2025). It deliberately avoided proposing chemical recycling or complex optical sorting technology (Kroell et al., 2024; Yu et al., 2022), which would be neither affordable nor operable at cooperative scale. The cooperative's post-program interest in diversifying flakes into paving blocks or ecobricks (Gund et al., 2023; Kakerissa & Latuheru, 2023) is consistent with similar small-scale plastic-waste valorization efforts documented elsewhere in Indonesia (Ekowati & Ismail, 2026; Nurwidiana & Fatmawati, 2022),

though realizing that diversification will require further technical assistance beyond the scope of the present program.

The relative weight participants and cooperative leaders placed on the hands-on practicum and the reframing of waste as a commodity, rather than on the lecture content alone, echoes a broader finding in the Indonesian community-based waste-management literature. An Analytic Hierarchy Process evaluation of an established West Java waste bank found that social and human factors, more than technical infrastructure, were the strongest predictors of program performance (Purnamasari et al., 2026). Read together with that finding, the present results suggest that the Kayambang Youth Cooperative's continued engagement, not the machine alone, will be the binding constraint on whether the program's gains are sustained.

Several limitations qualify these results. First, the pre-/post-test and satisfaction figures come from a single group without a comparison condition, so the observed gains cannot be attributed to the training with certainty; some improvement could reflect test familiarity or social-desirability responding rather than durable learning. Second, the reported economic figures are simulation-based projections built from a one-off price check and the machine's rated capacity, not from tracked production or sales; actual throughput, collection volume, and market prices are likely to vary and may be lower in practice. Third, the evaluation window covers only the two-day program itself; whether the knowledge, skills, and confidence gains persist, and whether the cooperative sustains regular machine operation, can only be established through the planned follow-up mentoring and monitoring.

CONCLUSION

This community service program's principal achievement was to improve the knowledge, technical skills, and self-reported readiness of 18 Kayambang Youth Cooperative members (Desa Bojong Picung, Kabupaten Cianjur) to develop community-based plastic-waste management as a practical, cooperative-owned response to pollution in the Citarum watershed. Over two days, participants' understanding of plastic pollution and 3R principles increased by 35% and their technical competence in operating a plastic-bottle shredder machine increased by 45%; they successfully processed 25 kg of bottles into flakes during a supervised practicum, and 86% reported greater confidence in treating plastic waste as an economic opportunity. An indicative value-chain comparison further suggests, cautiously, that shredding could raise the market value of collected bottles, offering the cooperative a plausible but as yet unverified income pathway that these knowledge and skill gains alone do not guarantee.

These results indicate that a short, structured intervention combining environmental education, entrepreneurship coaching, and hands-on technical training can measurably shift a village youth cooperative's knowledge, skills, and stated confidence within two days, in a manner consistent with, and contributing concretely to, the aims of the Citarum Harum program. At the same time, because the training outcomes reported here rest on a single-group pre-/post-test design and on simulation-based economic projections rather than tracked production data, they should be read as an encouraging short-term result rather than as confirmed, durable impact.

For the Kayambang Youth Cooperative and similar groups, sustaining and verifying these gains will depend on the periodic remote mentoring already agreed with the cooperative, institutional strengthening of its waste-management unit, and the planned diversification into higher-value products such as paving blocks and ecobricks. For future community service programs of this kind, the team

recommends incorporating a short follow-up monitoring visit, for example at three and six months. Such a visit would verify actual machine throughput, collection volume, and realized sales price, so that the economic case for appropriate-technology waste processing at cooperative scale can be assessed against real, rather than projected, figures.

Declaration of Generative AI and AI-Assisted Technologies

During the preparation of this manuscript, the author(s) used Claude (Anthropic) to assist with organizing and drafting the manuscript text, retrieving and verifying candidate literature, and copy-editing the prose for clarity and academic style. All activity data, figures, and results reported here originate from the authors' own program records; the tool was not used to generate or fabricate data, results, or citations. All AI-assisted output was reviewed, verified, and edited by the author(s), who take full responsibility for the accuracy, integrity, and originality of the final content.

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Author Contributions

Aam Hamdani: Writing, original draft.
Bambang Darmawan: Translation.
Sudjani: Data curation and verification.
Asep Hadian Sasmita (corresponding author): Writing, review and editing, manuscript formatting, and submission and revision handling.
All authors have read and approved the final manuscript.

Conflict of Interest

The authors declare no conflict of interest.

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