

BERBAKTI: Jurnal Pengabdian Kepada Masyarakat

Vol. 4 No. 2, Sep 2026, pp. 301–309

e-ISSN 2987-033X, <https://doi.org/10.30822/5834>

Open Access: <https://journal.unwira.ac.id/index.php/BERBAKTI>

Empowerment of WKRI Members at Paroki Katedral Kupang Through the Use of Eco-Enzymes as a Green Solution for Reducing Household Waste

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ARTICLE INFO	ABSTRACT
Article history: Received: August 13, 2026 Revised: Sep 07, 2026 Accepted: Sep 10, 2026 Keywords: eco-enzyme; household waste; women empowerment; WKRI; green solution.  Copyright of the article is reserved by the authors. This article is an open-access article under the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.	Household waste is the largest contributor to national waste generation, yet its management remains suboptimal due to limited public awareness and skills in processing organic waste at its source. This community service program aims to empower members of the Wanita Katolik Republik Indonesia (WKRI) DPC of the Paroki Katedral Kristus Raja in Kupang through the use of eco-enzymes as a green solution for reducing household waste. The activity was conducted in two stages involving 30 participants: an introductory session and hands-on eco-enzyme production on March 7, 2026, followed by the delivery of materials and practice in producing derivative products (3-in-1 soap, carboxol, and liquid organic fertilizer) on June 30, 2026, using lecture, demonstration, and hands-on training methods. The results show that all participants successfully completed the full cycle from eco-enzyme fermentation to processing it into value-added derivative products while also improving their knowledge, skills, and environmental awareness. The program aligns with circular economy principles and provides dual benefits for both the environment and household finances, while strengthening WKRI's role as a community-based agent of change on environmental issues. Ensuring the program's sustainability will require further mentoring and more measurable evaluation.

INTRODUCTION

The issue of household waste is one of the most pressing environmental issues in Indonesia. According to data from the Ministry of Environment and Forestry's National Waste Management Information System, Indonesia generated approximately 33.79 million metric tons of waste in 2024, with household waste accounting for the largest share at 50.8 percent of the total national waste (KLHK, 2024). The data also shows that food waste dominates the waste composition, accounting for 39.36 percent, followed by plastic waste at 19.64 percent (KLHK, 2024). This fact underscores that household activities particularly the management of organic waste and kitchen scraps significantly contribute to the national waste burden.

Unfortunately, waste management levels are still far from optimal. Of the total national waste generated, only about 64.3 percent or 20.5 million metric tons is managed properly, while

the remaining 35.7 percent or 11.4 million metric tons is not managed appropriately (Yulistiar, et al., 2023; BPS, 2025). This situation is exacerbated by low public awareness and engagement particularly at the household level in sorting and processing waste at the source (Yulistiar et al., 2023). Yet, active public participation is key to achieving efficient and sustainable waste management. The city of Kupang, as one of the growth centers in the East Nusa Tenggara region, faces similar challenges. The increase in population and household consumption goes hand in hand with a rise in the volume of organic waste generated daily, while waste management facilities and capacity at both the city and sub-district levels remain limited. Household organic waste such as vegetable scraps, fruit peels, and other kitchen waste if simply discarded without being processed, will cause environmental problems such as unpleasant odors, pollution, and an increase in the volume of waste sent to landfills, even though household waste management starting at the source has been mandated by Government Regulation No. 81 of 2012 and Presidential Regulation No. 97 of 2017 (KLHK, 2017).

One innovative, simple, and environmentally friendly solution that can be directly implemented by the public at the household level is the use of eco-enzymes. Eco-enzymes are a liquid produced by the fermentation of organic waste such as fruit peels and vegetable scraps mixed with sugar (molasses or brown sugar) and water, through an anaerobic fermentation process lasting approximately three months (Junaidi et al., 2021; Puspasari, 2024). This fermented product has proven to be multifunctional, serving as a natural household cleaner, liquid organic fertilizer, pest repellent, and even an air and water purifier (Rochyani et al., 2020; Izzati et al., 2024; Langsa et al., 2024; Parmawati et al., 2025). In addition to being environmentally friendly, eco-enzymes also have economic value because their raw materials come from kitchen waste that has traditionally been discarded, aligning with the principles of the circular economy and a zero-waste lifestyle.

In this context, community-based religious organizations play a strategic role as agents of change at the grassroots level. The Indonesian Catholic Women's Association (WKRI) Branch Executive Council (DPC) of the Christ the King Cathedral Parish in Kupang, as an active women's organization with an extensive network reaching into local communities, has great potential to serve as a driving force in the household-based waste management movement (Gatta et al., 2022; Maqbool, S., et al., 2023; Sekarningrum et al., 2024). Given that women generally play a central role in managing household consumption and kitchen waste, empowering WKRI members through training in the production and use of eco-enzymes is a strategic step toward raising environmental awareness while simultaneously enhancing the members' capacity and practical skills (Rochayati et al., 2018; Taridala et al., 2026).

However, to date, the knowledge and skills of WKRI members at the DPC of the Christ the King Cathedral Parish in Kupang regarding the processing of organic waste into eco-enzymes remain limited. There have not been many empowerment activities that specifically address this issue as part of the church's environmental movement (eco-theology or integral ecology), as also advocated in the encyclical *Laudato Si'*. Therefore, a systematic empowerment program is needed, encompassing education, practical training in eco-enzyme production, and guidance on its use in daily life. Based on this description, this article aims to describe the process and outcomes of the empowerment of the Indonesian Catholic Women's Association (WKRI) at the Kristus Raja Cathedral Parish in Kupang through the use of eco-enzymes as a green solution to reduce household waste, while also examining its impact on enhancing the knowledge, skills, and environmental awareness of WKRI members.

METHOD

The community service activity was carried out in two phases within the Christ the King Cathedral Parish in Kupang, namely: Phase I on March 7, 2026: raising awareness about household waste issues, introducing the concept of eco-enzymes, and practicing eco-enzyme production; Phase II on June 30, 2026: presentation of materials on eco-enzyme-derived products and practical sessions on making 3-in-1 soap, carboxol, and liquid organic fertilizer (POC). The approximately three-month interval between the two phases is aligned with the time required for

the eco-enzyme to complete the anaerobic fermentation process until it is ready to be used as a raw material for derivative products. The target audience for this community service activity consists of 30 members of the Indonesian Catholic Women's Association (WKRI) Branch Executive Council (DPC) of the Christ the King Cathedral Parish in Kupang. The selection of WKRI as a partner was based on the consideration that this organization has an extensive network extending to the parish community level, is socially active, and whose members play a central role in managing daily household consumption and kitchen waste, making it strategically positioned to serve as an agent of change in the community-based household waste management movement.

The community service program was implemented through a systematic participatory approach consisting of planning, implementation, and evaluation stages. The program was carried out by two lecturers and three sixth-semester students from the Food Technology Study Program, Faculty of Science and Technology, Universitas Katolik Widya Mandira, using a combination of lectures or socialization, demonstrations, and direct practice (hands-on training). The planning stage involved coordination with the management of WKRI DPC Kristus Raja Cathedral Parish of Kupang, determination of the activity schedule, and preparation of the materials and equipment required for the training. The materials included organic household waste such as fruit peels and vegetable residues, sugar or molasses, water, fermentation containers, and additional materials required for producing eco-enzyme derivative products. Therefore, the planning stage served as an essential foundation for ensuring that the subsequent training activities could be implemented in a structured manner and supported by adequate materials and facilities.

The implementation stage constituted the core of the program and was organized into two sequential activities according to the eco-enzyme fermentation period. The first activity, conducted on March 7, 2026, focused on introducing participants to household waste problems, their environmental impacts, and the concept and benefits of eco-enzymes through face-to-face presentations. Participants subsequently engaged in direct practice by mixing organic waste, sugar or molasses, and water in predetermined proportions and placing the mixture in fermentation containers. The prepared eco-enzyme mixtures were then taken home by participants and independently fermented for approximately three months. Following completion of the fermentation process, the second activity was conducted on June 30, 2026, and focused on further utilization of the resulting eco-enzymes. Participants received additional instruction on the production of eco-enzyme derivatives, including carboxyl, 3-in-1 soap, and liquid organic fertilizer (pupuk organik cair or POC), followed by hands-on practice using their own fermented eco-enzyme under the guidance of the community service team. This two-stage implementation enabled participants to experience the complete process, from converting household organic waste into eco-enzyme to transforming the fermented product into useful derivative products.

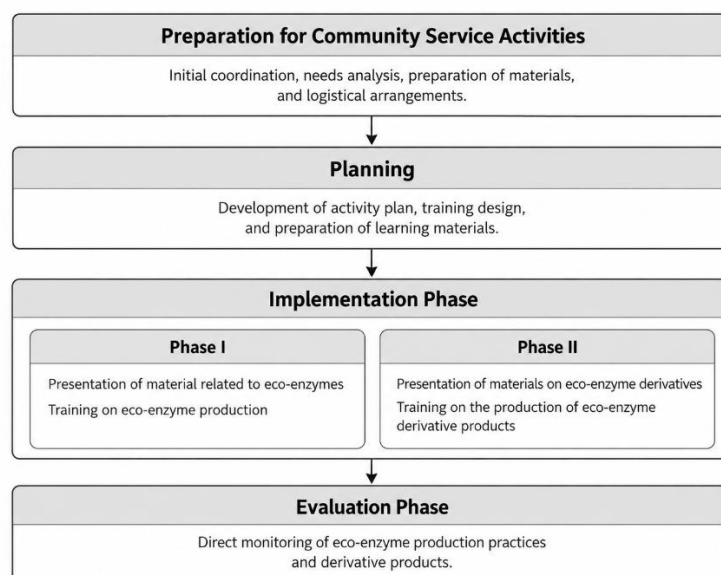


Figure 1. Stages of the Community Service Program Implementation.

The evaluation stage was designed to assess both participants' practical skills and the sustainability of eco-enzyme application in household waste management. Skill evaluation was conducted through direct observation during the practical sessions of eco-enzyme production and the preparation of its derivative products, allowing the implementation team to assess participants' ability to apply the procedures introduced during the training. In addition, sustainability evaluation was undertaken through monitoring the participants' eco-enzyme fermentation results and their subsequent application of derivative products in managing household waste. This monitoring approach extended the evaluation beyond the immediate training session by examining whether the knowledge and practical skills acquired during the program continued to be applied in participants' households. Accordingly, the evaluation stage functioned not only as a mechanism for assessing the immediate achievement of the program but also as a means of monitoring the continuity of environmentally responsible household waste management practices among WKRI members. For a clearer overview of the methodological sequence, the overall stages of the community service program, from preparation and planning to the two implementation phases and evaluation, are summarized in Figure 1.

RESULTS AND DISCUSSION

The empowerment activity for the Indonesian Catholic Women's Association (WKRI) of the Christ the King Cathedral Parish in Kupang was carried out in two major phases: the awareness-raising and eco-enzyme production phase on March 7, 2026, and the presentation of materials and practical training on the production of eco-enzyme derivative products on June 30, 2026. The approximately three-month interval between these two phases aligns with the time required for the eco-enzyme fermentation process until it is ready to be used as a base ingredient for derivative products. This activity was attended by 30 members of the WKRI DPC of the Christ the King Cathedral Parish in Kupang.

The event began with an awareness session on household waste issues and the basic concepts of eco-enzymes, attended by 30 members of the WKRI DPC of the Christ the King Cathedral Parish in Kupang (Figure 2). The material presented covered the types of household organic waste, the environmental impacts of improper management, and an introduction to eco-enzymes as a solution for processing organic waste into useful products. The participants' enthusiasm was evident, as reflected in their active engagement throughout the presentation session. The full participation of all 30 attendees in this session demonstrates that the issue of household waste management is a relevant topic considered important by WKRI members, thereby serving as a solid foundation for the program's sustainability.

This high level of participation can also be interpreted as an indicator of the target group's readiness to embrace new innovations. In the context of innovation diffusion, the successful adoption of a new technology or practice in this case, processing waste into eco-enzymes depends heavily on the initial introduction stage, during which potential users must first understand the relative benefits of the innovation compared to the old habit of simply discarding organic waste (Rogers, 2003; Parmawati R., et al., 2025; Syafei, et al., 2025). Presentations highlighting the real impact of household waste on the surrounding environment helped foster a sense of urgency among participants, so that they did not merely passively receive information but began to reflect on their own household waste management practices (Wahyuningsih, et al., 2023; Parmawati R., et al., 2025; Syafei, et al., 2025).

In addition, the choice of a face-to-face outreach approach with visual aids (as shown in Figure 2) was deemed effective for the target group of house as it allowed for two-way interaction, question-and-answer sessions, and immediate clarification of technical details such as which ingredients are and are not permitted in the production of eco-enzymes. This approach aligns with the principles of adult education (andragogy), which emphasizes the importance of the material's relevance to participants' daily experiences so that the knowledge gained can be more easily internalized and applied (Knowles, 1980; Alimen, et al., 2020; Maqbool, S., et al., 2023; Yulistia, et al., 2023). Thus, this orientation phase serves not only as a means of knowledge transfer but also as a step toward building collective awareness and the group's initial commitment to the program's

sustainability a crucial prerequisite before participants proceed to the hands-on practice of making eco-enzymes.



Figure 2. Presentation on Household Waste and Eco-Enzymes

On the same day, all participants engaged in hands-on practice making eco-enzymes (Figure 3). Each participant or small group was involved in the process of mixing the raw materials namely, organic waste (fruit peels and vegetable scraps), sugar/molasses, and water into fermentation containers, which they then took home to ferment independently for approximately three months. Participants were also given instructions on storage methods, signs of successful fermentation, and the gas release schedule throughout the process. By directly involving 30 participants in this hands-on activity, the program not only conveys concepts but also ensures that each participant returns home with an eco-enzyme product that is currently in the fermentation process, thereby fostering a sense of ownership over the success of the process (Parmawati R. et al., 2025; Syafei, et al., 2025).



Figure 3. Eco-Enzyme Production Practice

This hands-on practice serves as a crucial point in transforming knowledge into skills, in line with the principles of experiential learning, where participants learn most effectively through concrete experiences they undertake themselves, rather than merely listening to explanations (Kolb, 1984; Maqbool, S., et al., 2023). Participants' direct involvement in measuring, mixing, and packing raw materials into fermentation containers provides contextual understanding that cannot be gained through theory alone such as the correct ingredient ratios, the ideal texture of the ingredients, and sensitivity to the early signs of the fermentation process. The decision to have participants take home their own fermentation containers, rather than providing a single collective container, is a key strategy in promoting the program's sustainability.

With each participant having their own eco-enzyme product currently in the fermentation process, a personal responsibility is created to monitor the product's progress over the next three months, including the routine obligation to release fermentation gases to prevent the container from exploding. This kind of ongoing responsibility indirectly maintains participants' engagement with the program even after in-person activities have ended, while also serving as a form of self-directed learning that takes place outside of formal training sessions (Knowles, 1975; Parmawati R. et al., 2025; Syafei, et al., 2025). From the perspective of program sustainability, this approach also serves as a natural bridge to the second phase of activities on June 30, 2026. Participants who have invested time and effort throughout the fermentation process tend to be more motivated to

return and see the fruits of their labor transformed into useful byproducts, compared to if they had merely been passive observers in the eco-enzyme production process.

After the eco-enzyme fermentation process was complete (approximately three months after March 7, 2026), the program continued on June 30, 2026, with a presentation on the various derivative products that can be produced from eco-enzymes (Figure 4). The same participants were introduced to the use of eco-enzyme as a base for carboxol (floor cleaner), multifunctional soap (3-in-1), and liquid organic fertilizer (POC). This stage is crucial for broadening the participants' understanding that the eco-enzyme they had fermented for three months could be further processed into products that are both useful and economically valuable in daily life (Putra et al., 2023; Parmawati et al., 2025; Syafei et al., 2025).

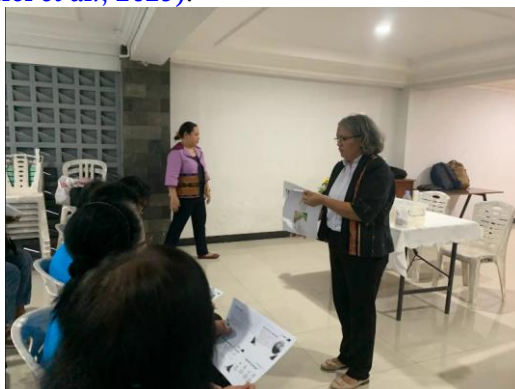


Figure 4. Presentation of Eco-Enzyme Derivative Products

This stage marks a significant transition from the mindset of processing waste to prevent environmental pollution to the mindset of processing waste into economically valuable opportunities, which psychologically reinforces participants' motivation to continue this practice independently. By learning that a single base product (eco-enzyme) can be transformed into a variety of functional products ranging from floor cleaners and soap to liquid fertilizer participants gain a concrete understanding of the flexibility and added value of eco-enzymes, so that the fermentation activities they have been carrying out for three months are no longer viewed as a process that ends with a single final product, but rather as a raw material for a range of sustainable household products.

The selection of three types of derivative products Carboxol, 3-in-1 soap, and POC also reflects careful consideration of the participants' actual household needs, as all three are items routinely purchased in commercial form (cleaning products and chemical fertilizers). Thus, the material presented was not only informative but also raised awareness of the potential for household cost savings, while simultaneously providing an initial insight into small-scale business opportunities (home industry) based on eco-enzymes if production is carried out consistently and in larger quantities (Parmawati et al., 2025; Syafei, et al., 2025). In addition, the three-month interval between the initial outreach session and the presentation on derivative products served as an indirect evaluation of the success of the fermentation process that participants carried out independently in their own homes. The return of the same participants at this stage indicated that the eco-enzyme fermentation process they conducted on their own was proceeding well, ensuring they had raw materials ready for further processing during the next practical session.

As the culmination of the activity, all 30 participants directly practiced making 3-in-1 soap, carboxol, and liquid organic fertilizer using the eco-enzymes they had fermented themselves (Figure 5). Working in groups, the participants mixed the eco-enzymes with additional ingredients according to each product's formulation, guided by the community service implementation team. This activity produced finished products that participants could immediately use for household needs, such as washing dishes, cleaning floors, and fertilizing plants. The success of all 30 participants in completing the full cycle from eco-enzyme fermentation to processing it into derivative products serves as a strong indicator of this empowerment program's success. The participants proved capable of applying their knowledge to create tangible products from household waste materials that previously had no value.



Figure 5. Demonstration of Making 3-in-1 Soap, Carboxol, and POC

This stage represents both the culmination and the final outcome of the entire program series, where all the knowledge and skills built up from the awareness-raising phase through fermentation culminate in one tangible achievement: a finished, ready-to-use product. Unlike the previous stage, which was still preparatory and involved waiting (a three-month fermentation period), this stage provides participants with instant gratification because they can immediately see, hold, and take home the results of their own work in the form of soap, carboxol, and POC all in a single session. Psychologically, this experience strengthens participants' self-efficacy that is, their belief that they are capable of repeating this process independently without guidance in the future (Bandura, 1977; Junaidi et al., 2021; Parmawati R. et al., 2025; Syafei et al., 2025).

The group work approach implemented at this stage also provided its own added value, as it not only accelerated the production process but also allowed for the exchange of experiences and mutual correction among participants during the ingredient mixing process, ensuring that the knowledge gained came not only from the mentoring team but also from fellow participants. The guidance provided by the community service implementation team throughout this process also ensures that the formulation of each product meets standards, so that the resulting products are safe and suitable for use immediately upon the conclusion of the training session. A key finding from the entire activity cycle is the transformation of household waste from being viewed as useless and destined for disposal to becoming a raw material with economic and functional value (Parmawati R. et al., 2025; Syafei, et al., 2025).

The consistent participation of the same 30 participants in both phases of the program with a three-month interval between them demonstrates that this program succeeded in fostering not merely fleeting knowledge but sustainable behavioral change in household waste management among members of the WKRI DPC of the Christ the King Cathedral Parish in Kupang. This achievement serves as a strong foundation for replicating similar programs in other communities under the parish's auspices, as well as for expanding the program's reach to similar religious organizations in the Kupang City area.

CONCLUSION

Based on the implementation of the empowerment activities conducted, the following conclusions can be drawn: Empowerment activities through the use of eco-enzymes successfully enhanced the knowledge and skills of 30 members of the WKRI DPC of the Christ the King Cathedral Parish in Kupang in managing household waste into useful products; The phased approach, implemented in two sessions with a three-month interval (March 7 and June 30, 2026), proved effective, as it aligned with the eco-enzyme fermentation process while ensuring the sustained participation of the attendees; The consistent attendance of all 30 participants throughout both phases of the program from the introductory session and eco-enzyme production to the processing of the eco-enzyme into derivative products (3-in-1 soap, carboxol, and POC) demonstrates the program's success in fostering not only knowledge but also behavioral change toward independent and sustainable household waste management; This program provides dual

benefits: environmental benefits through the reduction of household organic waste volume, and economic benefits through potential savings on household expenses and opportunities for small-scale eco-enzyme-based home industries; This initiative also strengthens the role of WKRI as a parish-based women's organization that actively contributes to environmental issues, in line with the spirit of integral ecology in the social teachings of the Catholic Church.

ACKNOWLEDGMENTS

We extend our gratitude to Widya Mandira Catholic University in Kupang, through its Research and Community Service Institute, for its financial support, which ensured the success of this activity, as well as to the WKRI branch of the Christ the King Parish in Kupang for serving as a partner in this initiative.

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