

Enhancing River Cleanliness and Waste Management: A Community Service Initiative with Plastic Fischer in Lengkong District Bandung

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Abstract

A community service, initiated by the Department of Physics Engineering at Telkom University, addresses the issue of plastic pollution in Lengkong subdistrict, Bandung. Through educational lectures, impactful sanitation activities, and advanced waste management technologies—including partnerships with international organizations—this initiative endeavors to resolve the pressing problem of plastic waste. Among the techniques employed are interactive cleanup days, educational lectures on recycling, and the application of cutting-edge technologies such as incinerators and imidazolium ionic liquids. The partnership with Plastic Fischer Germany, which actualizes SDG 17 (Partnerships for the Goals) and provides advanced technology and global expertise, was crucial for the program's success. The outcomes indicate a reduction in plastic waste, heightened environmental awareness, and the successful implementation of sustainable methods. This study concludes that achieving significant environmental change necessitates the integration of academic research with global cooperation and community engagement. The program's impact can be sustained and amplified through further expansion, ongoing education, and enhanced collaboration.

Keywords: SDGs 17, plastic waste, river sanitation, waste management

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Introduction

Citarum, one of the longest rivers in West Java with 297 kilometers watershed, is severely polluted by plastic waste, affecting water quality that is critical for around 25 million people in West Java while providing 80 percent of the raw water for Jakarta (The Jakarta Post, 2024). Despite the government's promises of improvement through the Citarum Harum program, recent occurrences, such as the waste pile at Sapan Bridge in Batujajar, West Bandung Regency, in June 2024, show that pollution remains a major problem. The Citarum River Basin, home to 18 million people, generates 15,838 tons of waste daily, comprising 55% organic matter and 15.35% plastics (Kerstens et al., 2016). According to Prima Mayaningtias, the region is 3 kilometers long and 60 meters wide. Based on an estimated water density of 0.47 kilograms per cubic meter, the amount of waste is estimated to be between 100 and 200 tons (Kamaludin, 2024). Plastics constitute approximately 60% of this waste, alongside water hyacinth plants and other types of waste (Panuntun & Susanti, 2024).

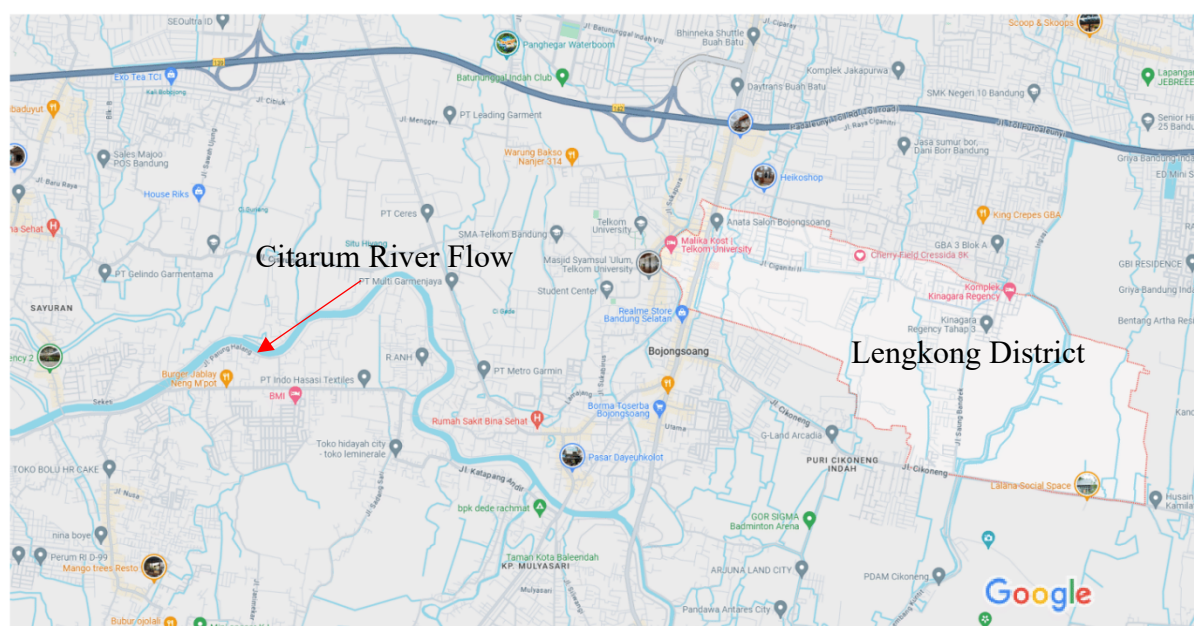


Fig. 1. Map illustrating the river flow in the Lengkong District, which is linked to the Citarum River

The Lengkong River, a tributary of the Citarum River, flows through Bandung resulting in a substantial contribution to the overall Citarum River system. It is important to the local hydrology and the environment since it supplies water for agricultural and commercial uses (Afiatun et al., 2018). As shown in Figure 1, the Lengkong River, as a feeder connected to the Citarum, performs an important role in the river's broad network. The Citarum River's quality

and health are affected by its tributaries, especially the Lengkong River, hence the Lengkong's environmental status has a direct impact on the Citarum River's general condition.

Some of the most serious issues that persist in the Lengkong District river environment are river water pollution, waste accumulation, health consequences, and floods. The Lengkong area is dealing with major challenges caused by waste contaminating the river. Figure 2 shows that the river that passes through this area is frequently loaded with a variety of waste, ranging from domestic trash to industrial waste. The majority of plastic waste is chemically inert; thus, it could take 250 to 500 years for it to degrade completely (Srikanth et al., 2022). Furthermore, plants and animals may bring plastic waste components into the food chain that humans consume (Eze et al., 2024).



Fig. 2. Initial condition of the river banks in the Lengkong area

The community residing in the vicinity of a clean river would profit substantial benefits, particularly if such a river were free from plastic waste. The river of Lengkong District needs to be free of plastic and other waste in order to be in a clean state. Therefore, educational campaigns are required to raise awareness within the community about the importance of river flow purity. Aside from that, an explanation concerning effective river cleaning methodologies and sound waste management practices is necessary. In the long term, the establishment of a comprehensive waste management system within the Lengkong area is crucial to ensure the sustained realization of a waste-free river.

The bachelor program in Physics Engineering at Telkom University, in collaboration with the Solusi Sungai Resik Foundation, representing Plastic Fischer Germany whose team is depicted in Figure 3, is undertaking efforts to establish waterways free from plastic waste. The residents of Bandung City, Lengkong sub-district, West Java, have expressed positive reception towards this initiative. It is anticipated that communities inhabiting the Lengkong River watershed will directly experience the advantages of this endeavor. The following benefits will accrue from effective riverine remediation efforts, such as transforming the perception of the river from a polluted and neglected area into a clean environment where local inhabitants can enjoy various advantages and activities.



Fig 3. Plastic fischer community

The proposed solutions are also based on the research outcomes of a faculty team that has secured patents and produced outputs from the Department of Physics Engineering. These research findings have yielded a plastic waste processing technique utilizing Imidazolium Ionic Liquid (Utami et al., 2023, 2024) and the application of an incinerator for waste combustion, as shown in Figure 4. The former technique diverges from conventional methods by obviating high-temperature heating processes, employing a range of only 90°C to 110°C, and by not generating toxic gases. The latter approach employs an incinerator with a daily processing capacity of one ton of waste, featuring dimensions of 2.10 meters in height, 1.5 meters in width,

and 1.8 meters in length, along with a 7-meter chimney that does not emit smoke. This incinerator requires only 1 liter of fuel per 4 hours of operation, and the combustion process can be augmented by the calorific output of the waste itself as supplementary fuel (Hidayat & Iskandar, 2020).

Activities such as river clean-ups and educational initiatives in some schools in Bandung constitute part of this program. To ensure the sustainability of these activities over the forthcoming years (2025–2027), the primary objective is to increase the number of collaborative partners to enhance alliances in accordance with Sustainable Development Goal (SDG) number 17 (Utami et al., 2024). The aim of all these actions is to mitigate and stop the damaging effects of carelessly discarded plastic waste into the environment without adequate treatment.

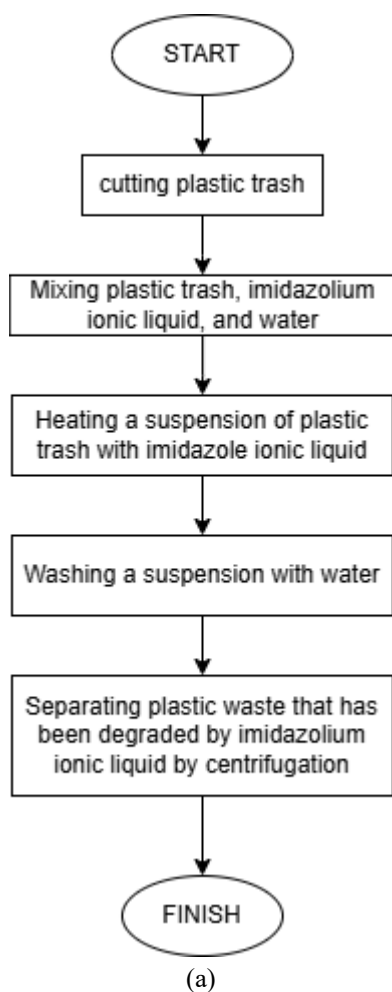


Fig. 4. (a) Flowchart of the processing plastic trash using Imidazolium Ionic Liquid, (b) the combustion process utilizing the incinerator

Methods

The approach implemented in this community service program along the Lengkong River, Bojongsoang, Bandung, is aimed at engaging and empowering the local community through a series of planned activities. These actions are undertaken in accordance with the objective of achieving Sustainable Development Goal (SDG) 17 by the year 2027. Consistent with the initial conditions of the Lengkong area, the focus of the community service initiatives during the 2023-2024 period centered on educational and sanitation activities, conducted in collaboration with environmental organizations to enhance awareness regarding the hazards of riverine waste.

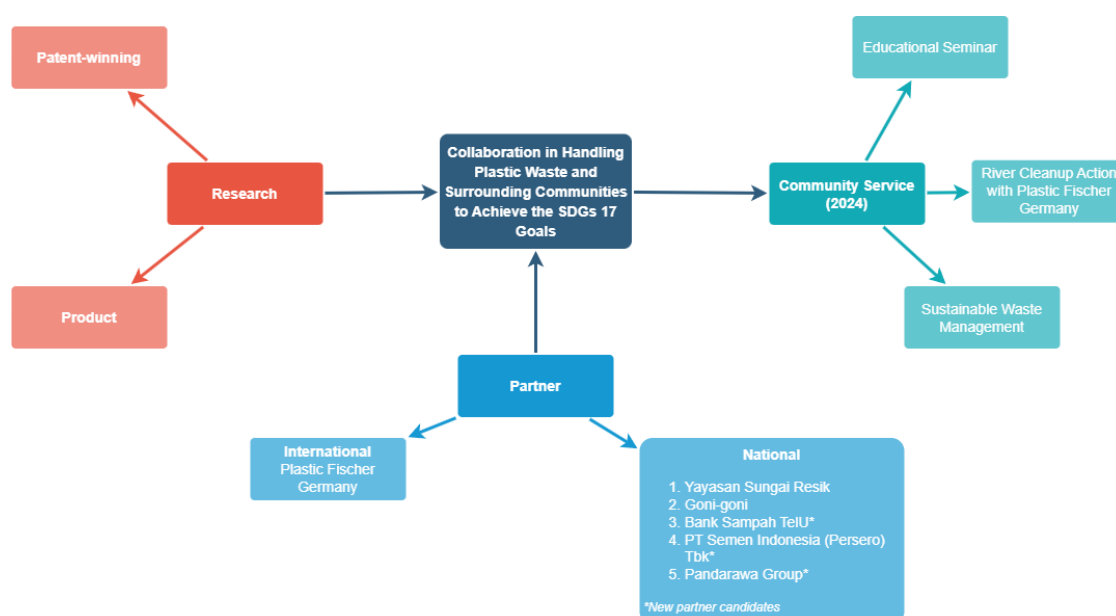


Fig. 5. Scheme of community services in 2024

Figure 5 illustrates the 2023-2024 community service program, encompassing educational seminars designed to elevate environmental consciousness, direct clean-up initiatives executed in partnership with Plastic Fischer Germany, and the implementation of sustainable waste management techniques. These endeavors strive to mitigate pollution, promote environmental stewardship, and improve the overall quality of life for the Lengkong community.

Figure 6 illustrates the stages of the community engagement program for the 2023-2024 period. The initial stage involved the organization of an educational seminar themed "Recycled Plastics: Plastic as a Building Material" held on Saturday, December 9, 2023, at

the Damar Building, Telkom University. The seminar was attended by the academic community of the Bachelor in Physics Engineering program at Telkom University, as well as residents from the Lengkong subdistrict. The seminar aimed to cultivate awareness regarding the environmental benefits of plastic recycling, minimize plastic pollution, and promote sustainable construction methods. The event featured Ahmad Nur Sheha Gunawan, S.T., M.T., a lecturer in interior design at Telkom University and project leader for plastic waste processing, Yuyu Gandis Canceria, S.T., the project manager for Plastic Fischer GmbH Bandung, and Dr. Suwandi, M.Sc., a lecturer in physics engineering and innovator of plastic waste processing equipment at Telkom University.

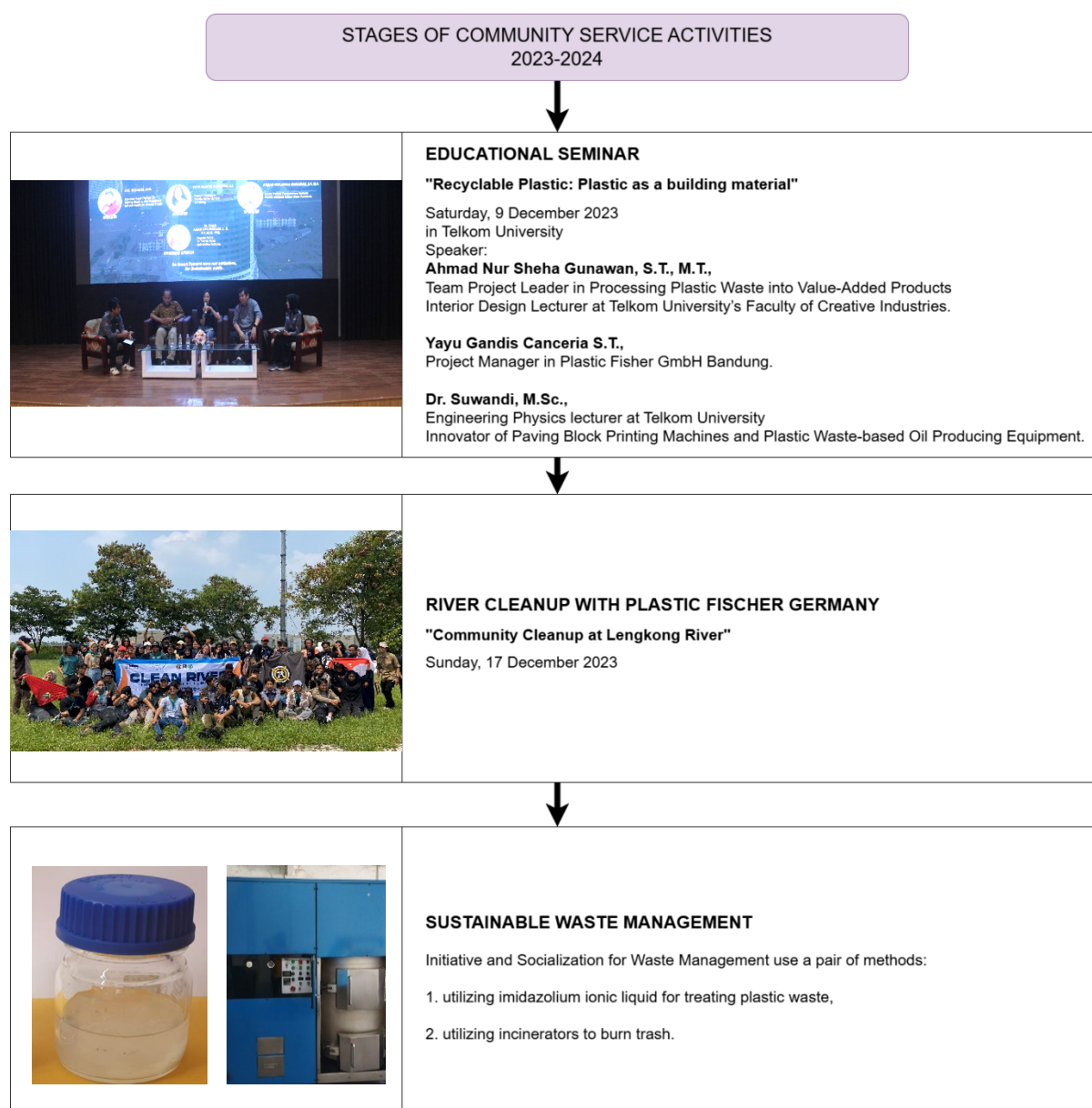


Fig. 6. The community service stages of Physics Engineering Department, Telkom University, in 2023-2024

On Sunday, December 17, 2023, a "Clean-up of the Lengkong River" initiative was conducted, involving the Physics Engineering team from Telkom University and the Plastic Fischer team from Germany. This program aimed to collect plastic waste along the river by deploying volunteers to gather and safely dispose of the plastic debris. This phase underscored the importance of sustainable waste management practices and demonstrated strong community solidarity. Consequently, the river ecosystem experienced a significant improvement, and public awareness regarding plastic pollution increased considerably.

The third stage of this community service program focused on sustainable waste management, employing two key methods: Imidazolium Ionic Liquids for processing plastic waste and incineration for non-recyclable waste combustion. This stage aimed to mitigate pollution and promote enhanced waste management techniques. Through demonstrations and educational seminars, the community of Lengkong subdistrict was encouraged to adopt these sustainable practices.

Results and Discussions

Results

Dr. Eng. Ir. Amaliyah R.I.U., S.T., M.Si., IPM, as the Head of the Department of Physics Engineering at Telkom University, designed a community service program that has yielded significant outcomes across several crucial domains. Residents of the Lengkong sub-district now exhibit an enhanced understanding of sustainable practices and the imperative to reduce plastic waste, attributable to the success of educational seminars in fostering environmental awareness.

As illustrated in Figure 7, a direct clean-up initiative conducted in collaboration with Plastic Fischer Germany garnered the participation of over 100 individuals and provided substantial benefits to the local ecosystem by removing a considerable quantity of plastic waste from the Lengkong River.



Fig. 7. Establishing the Lengkong River cleanup campaign in collaboration with Plastic Fischer Germany

Excellent waste reduction and management strategies have also been demonstrated through the utilization of innovative waste management techniques, such as Imidazolium Ionic Liquids for plastic processing and waste incineration. Beyond the remediation of the river, this initiative has provided the community with valuable tools and information necessary for their continued independent efforts.

Knowledge transfer was facilitated by the collaboration between students and experienced faculty members, ensuring the local community's capacity to sustain this initiative. This project has significantly enhanced the environmental quality within the Lengkong district and has equipped its residents with the necessary knowledge and skills for long-term environmental management.

Discussions

To address the urgent issue of plastic pollution within the Lengkong subdistrict, the community service program has yielded significant insights and impacts, closely aligning with SDG 17: Partnerships for the Goals. The evaluation of the program's implementation has been substantially enhanced by recent studies completed between 2019 and 2023. This research focused on cutting-edge waste management technologies. Notably, the application of Imidazolium Ionic Liquids for plastic depolymerization represents a significant innovation demonstrating promise in transforming plastic waste into valuable byproducts. This study provides a robust foundation for integrating innovative tactics into the program, thereby boosting its sustainability and effectiveness.

The prior Corporate Social Responsibility (CSR) program served as a precedent for community service projects in the Tarumajaya subdistrict. In this project, Telkom Indonesia and the

Department of Physics Engineering, Faculty of Electrical Engineering, Telkom University, collaborated to improve waste management through the implementation of an incinerator. Expanding upon this model, the current initiative in the Lengkong subdistrict illustrates how the concepts of collaboration and innovation can be applied to environmental challenges. A key outcome of this initiative has been the heightened public awareness regarding environmental issues through organized educational sessions. The dissemination of knowledge concerning sustainable practices and innovative uses for plastic waste has been significantly facilitated by these lectures.

The cleanup project, involving over 100 participants, including students, instructors, and the Plastic Fischer Germany team, underscored the importance of teamwork in environmental preservation. As emphasized by SDG 17, this collaboration exemplifies how international partnerships can support and bolster local efforts by providing technical assistance and encouragement.

Furthermore, this program has fostered a sense of community and shared responsibility among the residents of the Lengkong subdistrict. By engaging the community in every phase, from educational seminars to waste management and cleanup campaigns, the program empowers citizens to take ownership of their environment.

Conclusion

The plastic pollution in Lengkong subdistrict has been effectively managed through a community service program conducted by the Department of Physics Engineering, Telkom University. This initiative has yielded a positive impact on enhancing environmental awareness and implementing sustainable waste management solutions.

Furthermore, environmental issues in the area have been efficiently addressed by utilizing research-based technologies, such as Imidazolium Ionic Liquids and incinerators, which effectively process both recyclable and non-recyclable waste.

The program's strategy aligns with the needs and challenges of the community. Educational seminars address knowledge gaps regarding recycling, while direct clean-up operations offer

immediate relief from waste accumulation. The application of novel waste management technologies promptly tackles the difficulties of sustainable waste disposal, showcasing a tailored strategy that efficiently meets community requirements.

It is recommended that the program's scope be expanded to other regions facing similar environmental challenges in the future, that ongoing educational initiatives be sustained, and that collaborations with regional and global organizations be strengthened. To evaluate the long-term impact and enhance future projects, the establishment of a robust monitoring and evaluation system is also crucial. Future community empowerment initiatives can build upon the existing successes to generate greater social and environmental benefits.

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