TECHNOLOGY BASED RDF WASTE MANAGEMENT FOR COMMUNITY EMPOWERMENT AND CIRCULAR ECONOMY STRENGTHENING IN BANDUNG REGENCY

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ABSTRACT

Waste management has become a critical environmental issue in Bandung Regency due to increasing waste generation and the limited capacity of landfill sites. Improper waste management contributes to environmental pollution, public health problems, and the underutilization of waste as a potential economic resource. This Community Service Program (PKM) aimed to strengthen community capacity and participation in technology-based waste management through collaboration with the Environmental Agency of Bandung Regency by applying Refuse Derived Fuel (RDF) technology. The program was implemented using a participatory approach, including initial socialization and education on waste management and environmental impacts, technical training on the operation and maintenance of RDF machines, and continuous assistance in managing processed waste products with economic value, such as organic compost and plastic pellets. Program evaluation employed a multidimensional impact assessment covering environmental, social, and economic aspects through pre-test and post-test instruments, participatory observation, and activity documentation. The results indicate a significant improvement in community knowledge, awareness, and participation in waste management practices, along with the potential reduction of landfill burden and the creation of new employment opportunities. This program demonstrates that technology-based waste management combined with a community-based waste management approach and circular economy principles can serve as a sustainable solution that delivers environmental, social, and economic benefits for local communities.

Keywords: waste management; refuse derived fuel; community empowerment; circular economy; community service

INTRODUCTION

The issue of waste management in regions such as Bandung Regency is a complex problem involving environmental, social, and economic dimensions. Suboptimal waste management contributes to environmental pollution and public health threats, including respiratory problems, irritation, allergies, and unpleasant odors in surrounding areas (Maziyya, 2025). This aligns with studies showing that poor solid waste management increases the risk of air pollution and negatively impacts the well-being of communities in urban

and suburban areas (Rida & Saputra, 2025).

In the context of waste management technologies such as Refuse Derived Fuel (RDF), research also notes the risk of hazardous emissions if not operated and monitored effectively, including potential pollutants like dioxins and fine particulates that affect public health (Suryawan, 2025).

Technology-based waste management offers opportunities to reduce pressure on landfills by utilizing waste as a valuable resource, such as producing compost from organic waste and extracting plastic ore from inorganic waste, while also creating economic opportunities through job creation at the community level (Rida & Saputra, 2025). This approach reflects the principles of the circular economy, transforming waste into a source of value while reducing long-term environmental impacts (Farahdiba, 2023). However, implementing waste management technology requires local capacity support, community participation, and policy synergy between local governments and communities to

ensure sustainability and tangible benefits for all stakeholders.

This Community Service Program is realized through collaboration between local communities and the Bandung Regency Environmental Agency, aiming to enhance technology-based waste management capacity with environmental and economic value, as well as to reduce landfill burdens.

Figure 1. Waste Management Targets

Public awareness and participation in the implementation of waste processing technologies, (2) optimize the utilization of RDF and related technologies as innovative solutions for waste management, and (3) create employment opportunities for residents through the operation and management of these technologies, thereby improving welfare while protecting the environment.

Through this collaboration, it is expected that a more effective, sustainable, and impactful waste management system will be established

for the local community and the environment. Based on the conditions of landfills in Bandung Regency, which have experienced overcapacity and increasing environmental and health impacts due to suboptimal waste management, the main issues addressed by this community service initiative include high waste generation, low public participation and awareness, and limited utilization of waste processing technologies that are both valuable and sustainable (Rida & Saputra, 2025; Suryawan, 2023).

Additionally, technology-based waste management approaches such as Refuse Derived Fuel (RDF) still face implementation challenges technically, socially, and administratively requiring a collaborative approach between local governments and communities (Farahdiba, 2023).

This program aims to (1) increase public awareness and participation in the implementation of waste processing technologies, (2) optimize the utilization of RDF and related technologies as innovative solutions for waste management, and (3) create employment opportunities for residents through the operation and management of these technologies,

thereby improving welfare while protecting the environment.

Through this collaboration, it is expected that a more effective, sustainable, and impactful waste management system will be established for the local community and the environment. Based on the conditions of landfills in Bandung Regency, which have experienced overcapacity and increasing environmental and health impacts due to suboptimal waste management, the main issues addressed by this community service initiative include high waste generation, low public participation and awareness, and limited utilization of waste processing technologies that are both valuable and sustainable (Rida & Saputra, 2025; Suryawan, 2023).

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Table 1. Role Mapping Matrix of The Environmental Agency and The Community

Activity	Role of Bandung Regency Environmental Agency (DLH)	Role of the Community
Program Planning	Policy facilitator, provider of technical guidance	Provider of field condition information
Socialization & Education	Environmental policy resource person	Active participant and contributor to discussions
RDF Technical Training Product Management	Technical assistant and supervisor Regulatory support and networking	Operator of RDF machinery Production and management of economically valuable products
Monitoring & Evaluation	Joint evaluator and institutional mentor	Activity reporting and participatory evaluation

Therefore, this Community Service Program aims to develop a collaborative model between the Bandung Regency Environmental Agency and the community in implementing RDF-based waste management technology. The goal is to reduce pressure on landfills, enhance community participation and capacity, and create economic value and job opportunities through sustainable waste utilization, in line with the principles of the circular economy and participatory environmental management (Maziyya et al., 2025).

IMPLEMENTATION METHOD

The target participants are the Bandung Regency Environmental Agency and the local community. The activity stages include: (1) initial socialization and education on technology-based waste management and the environmental impacts of unmanaged waste, (2) enhancing community capacity through technical training on the operation and maintenance of RDF machines, and (3) ongoing assistance in managing processed waste into economically valuable products such as compost and plastic ore.

This approach aligns with the community-based waste management concept, which emphasizes that the success of waste management is strongly influenced by active community involvement from planning through program evaluation (Rida & Saputra, 2022; Suryani et al., 2021).

To ensure program success and sustainability, the implementation method also includes a monitoring and evaluation mechanism conducted

periodically by the team in collaboration with the Environmental Agency. Evaluation is carried out by measuring success indicators such as the reduction in waste volume sent to landfills, increased community participation, and the creation of new employment opportunities through RDF machine operations.

Table 2. Activity Stages

Activity Stage	Implementers	Output	Theme
Initial Socialization & Education	PKM Team, Environmental Agency (DLH), Community	Increased community understanding of waste impacts and technology-based management	Initial Socialization & Education
RDF Technical Training	PKM Team, DLH, Community Groups	Community trained in waste sorting, RDF machine operation, and maintenance	RDF Technical Training
Product Management Assistance	PKM Team, DLH, Business Groups	Processed products such as compost and plastic ore with economic value	Product Management Assistance

Furthermore, strengthening local institutions and regional policy support are important factors in ensuring program sustainability, as emphasized in various studies showing that integrating waste management technology with institutional and local economic support can enhance the effectiveness of waste reduction programs and promote a circular economy at the community level (Farahdiba, 2023; Suryawan et al., 2020).

RESULT AND DISCUSSION

The implementation of this program is carried out through a participatory and collaborative approach between the Bandung Regency Environmental Agency and the target community. It includes stages of initial socialization and education on the impacts of waste and technology-based management, enhancing community capacity through technical training on the operation and maintenance of RDF machines, and ongoing assistance in managing processed waste into economically valuable products such as compost and plastic ore.

Figure 2. Waste Management Using RDF Machines

To ensure the success and Sustainability of the program, monitoring and evaluation are conducted periodically by measuring reductions in waste volume sent to landfills, increased community participation, and the creation of new employment opportunities, with institutional and regional policy support serving as key factors in strengthening sustainable waste management.

The success of this Community Service Program is measured through indicators covering process, output, and outcome aspects.

Process Aspect: Success indicators include the level of community participation in socialization activities and RDF-based waste management training, as well as active involvement of the Environmental Agency in program assistance. Waste processing into Refuse Derived Fuel (RDF) involves several stages, beginning with the collection and sorting of inorganic waste and dry residues such as plastics, paper, and wood, which are separated from organic and wet waste. The sorted waste is then shredded to reduce its size, followed by drying—either naturally or mechanically—to lower moisture content, increase calorific value, and reduce odors. Next, screening is carried out to remove non-combustible materials, and magnetic separation is used to eliminate metal components. The final stage is pelletizing, where the clean and dried fine materials are compressed into dense RDF pellets. The utilization of RDF offers several benefits, including reducing the volume of waste sent to landfills, providing an alternative energy source to replace coal—particularly for cement industries and power plants—and supporting more environmentally friendly waste management practices. Measurement tools include activity logbooks recording participant attendance, training activities, and guidance processes, along with implementation checklists to ensure all activity stages are carried out as planned.

Output and Outcome Aspects : Success indicators include increased community knowledge and skills related to waste management, reduction in waste volume sent to landfills, and the creation of economic activities from processed waste. Measurement tools include pre- and

post-tests to assess participant understanding, documentation of program results, and operational records of RDF-based waste processing. This approach aligns with standard program evaluation practices, which emphasize measuring changes in community capacity and tangible impacts following the intervention.

Program Impact Evaluation Model

The impact evaluation of the program is conducted using a multidimensional approach covering environmental, social, and economic impacts. Environmental impact is assessed by measuring reductions in the volume of waste sent to landfills and decreases in potential environmental pollution caused by unmanaged waste. Social impact is evaluated through increases in awareness, participation, and behavioral changes in the community regarding waste management, measured using pre- and post-tests, brief interviews, and participatory observations during program activities.

Meanwhile, economic impact is assessed by identifying employment opportunities created through RDF machine operations and the potential

economic value of processed waste products such as compost and plastic ore. This evaluation model follows the community-based waste management approach and the principles of the circular economy, emphasizing that the success of a waste management program is measured not only by technical outcomes but also by the social and economic benefits directly experienced by the community (Suryani et al., 2021; Farahdiba, 2023).
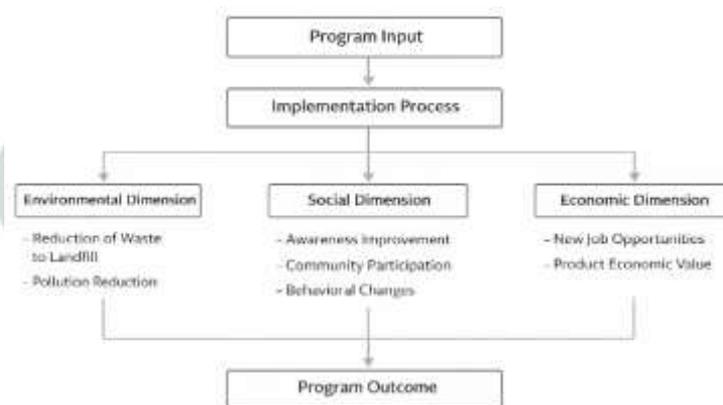

Figure 3. Impact Evaluation Model

The following are the results of the pre-test and post-test conducted on the community as part of the waste management education program:

Table 3. Pre-Test and Post-Test Results

Evaluation Indicator	Pre-Test (%)	Post-Test (%)	Improvement (%)	Notes
Understanding of the environmental and health impacts of waste	42	78	+36	Understanding increased after socialization and education
Knowledge of technology-based waste management concepts (RDF)	35	75	+40	Community began to understand the functions and benefits of RDF machines
Awareness of the importance of waste sorting at the source	48	82	+34	Participants showed increased awareness and readiness to participate
Community participation in waste management activities	40	80	+40	Interest in involvement in activities increased significantly
Understanding of the economic potential of waste (compost & plastic ore)	30	74	+44	Community began to see waste as an economic resource
Knowledge of job opportunities from operating RDF machines	28	70	+42	Participants understood the potential for creating local employment

The evaluation results indicate a significant improvement across all assessment indicators following the implementation of RDF-based waste management education and training activities. The highest increases were observed in the indicators for understanding the economic potential of waste and job opportunities, demonstrating that the community not only gained environmental awareness but also began to recognize waste management as an economic opportunity. These findings align with the community-based waste management approach and the principles of the circular economy, which emphasize the importance of active community involvement and social and economic benefits as key factors for program success (Suryani et al., 2021; Farahdiba, 2023).

CONCLUSION

This Community Service Program demonstrates that technology-based waste management using Refuse Derived Fuel (RDF), implemented through collaboration between the Bandung Regency Environmental Agency and the community, can generate positive environmental, social, and economic impacts. Evaluation results show increased community understanding, awareness, and participation in waste management, as well as the potential to reduce pressure on landfills through the conversion of waste into economically valuable products such as compost and plastic core.

Additionally, the program creates new employment opportunities for the community and promotes the application of community-based circular economy principles. With a participatory approach and institutional support, this program has the potential to be further developed and replicated as a sustainable waste management model in other regions facing similar challenges.

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