Community Empowerment Model in the RefuseDerived Fuel Waste Management Program in Indonesia

by Cek Turnitin

Submission date: 13-Oct-2025 10:47PM (UTC+0700)
Submission ID: 2779947123
File name: Dikhorir_Afnan_CLWAS.pdf (377.87K)
Word count: 10481
Character count: 60324

Community Empowerment Model in the *Refuse-Derived Fuel Waste Management Program* in Indonesia

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Abstract

This study aims to formulate a community empowerment model for the waste treatment of refuse-derived fuel (RDF) programs. Previous research has not specifically explored community empowerment in the context of RDF-based waste management, particularly in developing countries like Indonesia. This sector exhibits unique characteristics, including low public awareness about waste management, limited infrastructure, and the necessity for cross-actor involvement. These challenges highlight the need for an empowerment model specifically designed to address these complexities. The researcher employed a non-probability sampling method, a technique that does not provide every member of the population with an equal chance of being selected. Data collection techniques in this study included in-depth interviews, observations, and document analysis. Data analysis was conducted through data reduction, data presentation, and drawing conclusions. The main findings of this study emphasize community capacity building and the development of waste treatment units. A key strategic initiative is the provision of training on waste sorting based on the principles of the circular economy. This training equips the community with the necessary skills to sort waste according to RDF requirements, enabling stakeholders to actively participate in the program.

Keywords: Community empowerment; Circular economy, Indocement Cirebon Indonesia; Refuse-derived fuel; Waste management

Introduction

This study aims to formulate a community empowerment model within the refuse-derived fuel (RDF) waste treatment program. The RDF waste management program serves as a successful example of the contribution of the business sector and stakeholders in reducing the volume of illegal waste in Cirebon Regency, West Java Province, Indonesia. In this region, daily waste production reaches 1,200 tons, with 65 percent consisting of inorganic waste, such as plastics, cans, and styrofoam. The local Environment Agency recorded the highest waste volume in 2022, amounting to 503,060 tons, compared to 497,747 tons in 2021 and 480,509 tons in 2023. The issue of illegal waste has become increasingly unmanageable due to the limited number of waste collection officers—only 35 individuals are available to serve 424 villages.

To address this challenge, the business sector plays a strategic role through the implementation of corporate social responsibility (CSR). CSR refers to a company's specific actions and policies designed to meet stakeholder expectations (Cheng et al., 2021). This program supports environmentally-based waste management policies in line with Law No. 40 of 2007 concerning Limited Liability Companies, particularly Article 74 on Social and Environmental Responsibility, which mandates businesses to fulfill social and environmental obligations. In addition to reducing dependence on fossil fuels (coal), the RDF waste management program promotes a circular economy and generates positive impacts, including new job opportunities and improved community welfare.

Despite its positive impacts, the RDF waste processing program, which has been in operation since 2008, continues to face several challenges, particularly regarding the public's low awareness of sorting waste materials according to cement factory specifications. Household waste delivered to waste treatment units is often mixed with materials unsuitable for RDF production, such as iron, glass, stones, batteries, and cans. Certain types of metal waste can degrade RDF quality, potentially damage machinery, and disrupt the production process. These issues highlight the need for a well-regulated and optimized waste management system, emphasizing capacity-building initiatives

to improve the community's ability to sort waste in accordance with cement factory standards.

In cybernetic theory, the control of a system is carried out by utilizing feedback information, which serves to identify errors and inconsistencies in the process, as well as enabling continuous improvement to help the system adapt more effectively. This concept of feedback, as described by Wiener (Nurmalina, 2017), emphasizes that each element within a system communicates with others and responds to the input it receives. In this context, society can be viewed as a dynamic social system, where the flow of information between individuals or groups acts as a control mechanism to achieve stability and adaptation to environmental changes. According to Parsons (Satria, 2020), social systems naturally emerge through collective agreements that reflect shared values and norms, ultimately leading to equilibrium. Society is composed of interconnected and interdependent parts that influence one another.

Waste is essentially not a problem to be overly concerned about, provided that it is accompanied by optimal management efforts. Waste can be transformed into valuable resources, thereby reducing its negative impacts on the environment and simultaneously improving the community's quality of life. Therefore, empowerment programs that prioritize education and training can significantly enhance people's skills and awareness in waste sorting.

Referring to Ife's opinion (Dina et al., 2023), empowerment is fundamentally oriented toward two main concepts: strength and inequality. Ife emphasizes the importance of empowering communities to manage resources and make decisions that affect their lives. Community empowerment strategies can include fostering awareness through a comprehensive educational process (Hardiansyah et al., 2023). A strategy can be viewed as a means to mobilize manpower, funds, power, and equipment to achieve specific goals, while empowerment is a process that strengthens a community's capacity to participate dynamically in development processes. This allows communities to solve problems and make decisions freely and independently (Rahabav et al., 2021).

From Rappaport's perspective (Margayaningsih, 2018), community empowerment is a way to help individuals, organizations, and communities gain control over their lives. Mardikanto and Soebiato (2019) classify five empowerment strategies: (1) human resource development; (2) group institutional development; (3) fostering community capital; (4) developing productive businesses; and (5) providing appropriate information.

In Indonesia, several sectors contribute to the rise in greenhouse gas (GHG) emissions, including energy, industry, agriculture, land use, and waste management (Mustikaningrum et al., 2021). As part of its mitigation efforts, the Government of Indonesia issued Presidential Regulation No. 61 in 2011, establishing the National Action Plan for Reducing Greenhouse Gas Emissions. This plan aims to reduce emissions by up to 29% independently and up to 41% with international support by 2030. These policies encourage various sectors to adopt greener practices as part of a collective effort to combat climate change (Edi & Haryuni, 2023).

Literature Review

a. Enablement model and process

The community empowerment model is an example, a reference pattern, and a variety of efforts to improve capabilities and independence so that the individual or institution involved can optimally develop their abilities (Ritonga, 2022). The use of the empowerment model can be implemented in three ways: centralization, participation, and community development (Yefni, 2018). Essentially, the model represents a tangible form of program planning. More emphatically, it is stated that in-depth identification and analysis produce a framework for achieving change. The community empowerment model ideally focuses on developing community potential, raising awareness, and enhancing the community's ability to manage resources and develop their own capacities (Herlon et al., 2023).

Referring to Ife's opinion (Dina et al., 2023), empowerment is oriented towards two main concepts: strength and inequality. Ife emphasized the importance of empowering communities to manage resources and make decisions that affect their lives. According to Calves (Sany, 2019), community empowerment does not only focus on social and political aspects but is also closely related to economic issues and poverty. In this context, the RDF waste management program is expected to serve as a driving force for local economic improvement. This concept aligns with the new paradigm of development that is people-centered, participatory, empowering, and sustainable (Habib, 2021).

From Rappaport's perspective (Margayaningsih, 2018), community empowerment is a way to help individuals, organizations, and communities gain control

over their lives. This process includes planning, implementation, monitoring, and evaluation designed to ensure that communities possess the skills, knowledge, and access needed to actively participate in development. Subejo and Supriyanto (2020) describe community empowerment as a deliberate effort to assist local communities in planning, decision-making, and managing local resources through networking and collective action, enabling them to ultimately develop economic, social, and ecological capabilities. The foundation of community empowerment is the belief that if communities are empowered to control their resources and use them for development, development will proceed autonomously (Pathony, 2020). The independence in question is not limited to the economic aspect but also encompasses social, cultural, and political rights, including the right to voice opinions and the community's ability to determine its political rights (Hamid, 2018).

According to Sen (Fadilla & Hasan, 2023), there are four key components of the human development paradigm, which are referred to as holistic concepts: increasing productivity, equal distribution of opportunities, sustainable development, and human empowerment. The empowerment strategy supports these four components of human development by ensuring that the community has the skills, knowledge, access, and ability to actively participate in the development process, in terms of the economy, society, and the environment. The success of development is measured by the increased freedom of individuals to participate and make choices in various aspects of social, economic, and political life. The capability approach is an appropriate normative evaluative approach for welfare, social regulation, and social justice (Kimhur, 2020).

In general, the community empowerment process includes planning, implementation, monitoring, and evaluation. Efforts to empower the community can be carried out in three ways: (1) Creating an atmosphere or environment that allows the potential of the community to develop, (2) Strengthening the potential or power possessed by the community by implementing concrete measures, accommodating various inputs, and providing good infrastructure and objectives, and (3) Empowering the community in the sense of protecting and defending the interests of the vulnerable (Sulaeman et al., 2019). The process of community empowerment is, in essence, an effort to strengthen the community's entire existence. It focuses on activities that should be in the hands of the community, carried out by the community, and beneficial to the community.

According to Carlzon and Macauley (Putra & Ismaniar, 2020), empowerment is the liberation of a person from strict control, giving people the freedom to take responsibility for their decisions, ideas, and actions. Empowerment is a process of gaining power, or the process of transferring power from those who have it to those who are less empowered (Sulistyani & Wulandari, 2017). The term "process" refers to a series of actions or steps carried out chronologically and systematically that reflect the stages of efforts to transform a less or underpowered society toward empowerment.

As a process, empowerment involves a series of activities aimed at strengthening the power or empowerment of weak groups in society, while as a goal, empowerment refers to the circumstances or results that a social change seeks to achieve (Suharto, 2020). Community empowerment, according to Supriyanto (Lukman, 2021), is a deliberate effort to facilitate local communities in planning, deciding, and managing local resources through collective action and networking, so that ultimately the community gains economic, ecological, and social independence.

b. RDF waste for alternative fuels

According to the World Health Organization (WHO), waste is defined as anything that is unused, unwanted, disliked, or discarded as a result of human activity and does not occur naturally. Waste is typically considered unusable, expired, damaged, or lacking value, which leads to its accumulation. However, this perspective is not entirely accurate, as many waste materials are reusable, have other uses, and even have resale value (Hasnam et al., 2017). Waste management must be approached by creative and innovative individuals with an entrepreneurial spirit to increase income opportunities for the community. Community participation is crucial in supporting a region's waste management program.

Based on its characteristics, waste can be classified into three types: organic, inorganic, and hazardous (B3) waste. Organic waste consists of materials from living organisms, including animals, plants, and humans, that can decompose naturally (biodegradable). Organic waste can then be divided into two categories: dry organic waste and wet organic waste. Dry organic waste contains less moisture than wet organic waste.

RDF is a waste treatment technology that involves homogenizing waste into smaller sizes.

As a renewable energy source, RDF serves as a substitute for coal in the combustion process. The development of RDF technology in Indonesia has significant potential as an alternative energy source because it utilizes household waste, which has traditionally been difficult to manage. This potential positions RDF as a viable energy alternative for industries, especially those that have traditionally relied on fossil fuels, such as cement plants.

An example of the implementation of RDF in the cement industry can be seen at the Cilacap RDF Plant, which supports PT SBI Cilacap with an RDF capacity of 120 tons per day. The facility utilizes a bio-drying process to produce RDF with consistent quality that meets the technical standards of the cement industry. Bio-drying is part of mechanical-biological treatment (MBT), which increases the calorific value of waste by reducing moisture content through a biological process that utilizes the heat generated by microbial activity (Khikma et al., 2022).

At Indocement Citeureup, for example, RDF is processed using the bio-drying method, with the expectation that RDF usage will replace up to 15% of fossil fuels in the coming years. In addition, RDF shows great potential in reducing emissions. According to research from the European Recovered Fuel Organization, every ton of RDF used in co-processing in a cement kiln can reduce emissions by 1.75 tons of CO_2. Given the potential utilization of 8,000 tons of RDF per day, the cement industry in Indonesia has the opportunity to reduce emissions by up to 14,000 tons of CO_2 per day, equivalent to 5.1 million tons of CO_2 per year (Widowati, 2023).

c. Research gaps, and novelty of the work

This research originated from the urgent need to address the waste problem, which is a major challenge in Indonesia, especially in densely populated urban areas. The waste treatment sector, particularly refuse-derived fuel (RDF), has great potential as a sustainable solution to reduce solid waste while producing alternative energy sources. However, the success of this program is highly dependent on the active participation of local communities. Given the importance of empowerment in various development contexts, this study aims to explore how the community empowerment model can be effectively integrated into RDF-based waste management programs. This aligns with the view that community empowerment is a key element for the sustainability of various development initiatives.

Although many previous studies have addressed community empowerment in different contexts, such as gender empowerment in agriculture (Tesafa et al., 2025; Nanyonjo & Nchanji, 2023), which focuses on strengthening the role of women in accessing agricultural resources and sustainability through a gender-sensitive approach; in the tourism and community revitalization sector (dos Santos et al., 2024; Ataöv et al., 2022), emphasizing the importance of collaboration between local communities and governments to address social injustices and structural barriers; and in the health and technology sector (Luisi & Hämel, 2021; Eccher et al., 2020), providing insights on the importance of inclusive participation strategies and the use of technology to improve service accessibility.

No previous research has specifically explored community empowerment in the context of RDF-based waste management, particularly in developing countries such as Indonesia. In fact, this sector has unique characteristics, such as low public awareness about waste management, limited infrastructure, and the need for cross-sector involvement (government, community, and private sector). This gap highlights the need for an empowerment model specifically designed to address these complexities.

This research offers novelty in several key aspects, such as the integration of community empowerment with RDF technology. Unlike previous studies that focused on empowerment in traditional sectors such as agriculture or health, this study combines community empowerment with modern waste management technology. This approach creates synergies between environmental awareness, economic empowerment, and technological solutions. The research designs a community empowerment model that includes environmental education, technical training, and institutional capacity building. This model focuses not only on short-term outcomes but also on long-term sustainability through increased community self-reliance.

Methodology

The research locus is located in three assisted villages of PT. Indocement Tunggal Prakarsa in Cirebon, West Java Province, Indonesia. These villages include Palimanan Barat Village, Kedungbunder Village, and Cupang Village. Palimanan Barat Village is the central location of this research because it is where the UPS has been operating since 2008. Meanwhile, Kedungbunder Village and Cupang Village are suppliers of RDF raw materials, facilitated by the Indah Makmur Waste Bank and Alkarimah Waste Bank. The selection of these three locations, as noted by Patton (Heryana,

2020a), was based on geographical significance (geographically focused) and the primary activities (activity-focused) related to RDF waste management in Cirebon Regency, Indonesia. From these three locations, the researcher obtained a natural background to understand the phenomenon, applying various methods to interpret and describe waste management activities.

Regarding the selection of informants, the researcher used a non-probability method, a sampling technique that does not give each member of the population an equal chance of being selected. The sample selection is based on the subjective judgment of the researcher. The number of informants in qualitative research is flexible, depending on the requirements of adequacy and suitability. The informants in question are research subjects who can provide information about the phenomena or problems addressed in the research (Heryana, 2020b).

The data collection techniques used in this study include in-depth interviews, observations, and document analysis. The interview, as described by Creswell (Ardiansyah et al., 2023a), is a direct interaction between researchers and participants aimed at exploring a deep understanding of individual experiences, views, and perspectives related to certain phenomena. Observation also plays an important role in qualitative research. Morris (Hasanah, 2017) defines observation as the activity of recording a symptom with the help of an instrument and documenting it for scientific purposes. The next data collection technique is documentation analysis. According to Bogdan and Biklen (Ardiansyah et al., 2023b), this technique involves collecting data from documents or archives related to the research phenomena.

Interviews were conducted with the leadership of the CSR Unit and several other stakeholders. Hands-on observation at UPS West Palimanan helped researchers understand how the policy is implemented in daily practice. In addition, documentation in the form of company policies and regulatory reports was used to complete the understanding of the impact of these policies on the environment. This combination of data collection techniques ensures the validity and reliability of the data and provides rich and deep insights to answer the research question thoroughly. The validity and reliability testing in this study concerns several criteria, namely the degree of trust, distraction, dependence, and certainty (Saadah et al., 2022).

The researcher adopts the data analysis approach proposed by Miles and Huberman (Cecariyani & Sukendro, 2019), which includes data reduction, data presentation, and drawing conclusions. This process starts from the data collection stage, continues during field activities, and concludes with the writing of the final report. As explained by Nasution (Sutriani & Octaviani, 2019), data analysis is carried out continuously and covers every phase of the study, allowing researchers to gain a deep and thorough understanding of the data collected.

Findings and Discussion

a. Human resource development

The results of the interview with the General Manager of Operations (Ass) of Indocement Cirebon, Rita Widjaja, indicated that the limited technical skills of the local community, especially UPS workers in handling machine damage, are one of the challenges in the waste treatment program. Therefore, it is important to conduct training that focuses not only on waste sorting but also on the introduction and maintenance of waste processing tools. This kind of training can reduce dependence on external technicians and improve the sustainability of waste management programs at the village level.

> "We give them training. We will accompany them for three months to study at UPS," said Rita in an interview on October 1, 2024.

One of the main challenges faced is the community's inability to sort waste properly. Organic and inorganic waste are often mixed, even though the Indocement program specifically requires waste with a low humidity level, below 5%. According to him, this is because wet waste requires additional time and energy to be burned before the clinker burning process can be carried out. Therefore, the public is expected to understand the importance of sorting waste properly to ensure the humidity remains low.

> "For internal employees, we have undergone several training sessions. Some of our agents have been sent to Heidelberg (Germany) to learn about alternative fuels and waste management. Currently, waste management would be more effective if it were community-based," said Rita in an interview on October 1, 2024.

Rita explained that training for the community is conducted by expert employees via Zoom. If specialized competencies are required, licensed external parties, such as teachers from Jogja with certification from the National Professional Certification Agency (BNSP), are invited to provide training. Waste sorting training is carried out by utilizing both internal and external expertise flexibly. This approach not only improves the technical skills of the community but also ensures that the quality standards of the training are professionally recognized, thereby equipping the community with adequate competence in waste management according to the program's needs. 40

According to Rita, the community is involved in the entire waste processing process, from the initial stage (upstream) to the final stage (downstream). In the downstream stage, the community acts as a supplier (off-taker) distributing the processed waste. This approach aims to build community awareness and responsibility throughout the entire waste processing chain. For this role to be effective, targeted training is necessary to equip the community with the skills to sort, process, and distribute waste according to the expected standards. This training will enhance understanding of sustainable waste management and strengthen the community's role as an active part of the alternative fuel supply chain, while promoting their independence and involvement in environmental protection.

> "We still prioritize community empowerment. The circular economy benefits them by providing transport facilities to bring waste to UPS. We also have local heroes related to waste management who have been certified by BNSP," said Rita in an interview on October 1, 2024.

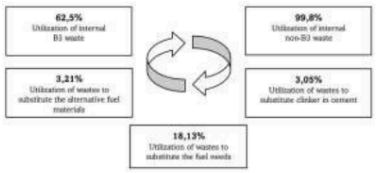

Figure 1. Circular economy business model
(Source: Indocement sustainability report 2023)

Figure 1 shows that, in an effort to preserve the environment while increasing operational efficiency, the company has implemented an optimal waste management strategy through various reuse methods. For waste classified as B3 (hazardous and toxic materials), the company has successfully reused 62.5% of the total B3 waste internally. This approach not only reduces dependence on external parties but also ensures that hazardous waste is managed safely within the company's facilities, thereby minimizing adverse environmental impacts.

On the other hand, the company also utilizes some waste as a substitute material to meet its energy needs. About 3.21% of the total waste has been reused as alternative fuels, helping to reduce reliance on conventional energy sources, which typically have a higher carbon footprint. Additionally, around 18.13% of the waste is used as a substitute for the company's primary fuel needs. This strategy not only contributes to cost savings but also reduces energy consumption from less environmentally friendly sources.

The company has also established a highly efficient non-B3 waste utilization system, successfully reusing 99.8% of the non-B3 waste generated from its operational activities. This impressive figure reflects the company's commitment to recycling, ensuring that non-hazardous waste is processed and reused as part of the production chain rather than being disposed of. Some of this waste is used to replace clinker in the cement production process, achieving a utilization rate of 3.05%. Since clinker is a key ingredient in cement and has a significant carbon footprint, using waste as a substitute for some of this clinker not only reduces carbon emissions but also decreases dependence on mineral resources.

The community does not receive direct monetary benefits when bringing waste to the Waste Management Unit (UPS). However, the

community still needs to dispose of daily household waste, which can serve as an opportunity to empower youth in every Rukun Tetangga (RT). The most important factor is to ensure that there are parties willing to manage the process from the beginning. This program not only helps address the problem of household waste but also provides empowerment opportunities for the younger generation. Through structured waste sorting training, local youth can be taught to manage waste independently in their environment, ultimately creating a sustainable waste management cycle.

In the waste treatment system at UPS, revenue is generated from the sale of products produced from waste processing. Workers involved in this program receive salaries based on two payment systems: wholesale and daily. Under the wholesale system, payments are made based on the weight of the waste managed, for example, IDR 200 per kilogram. So, if workers process 10 tons of waste in one day, their total income is calculated based on the amount of waste that has been successfully processed. For daily-paid workers, salaries are calculated based on the regional minimum wage, divided by the number of working days.

To equip factory personnel with the necessary skills to master UPS engine operational techniques, Indocement offers a variety of training materials through the Indocement Internship School (SMI) program. This initiative is designed to improve workers' skills. Employees at UPS have participated in at least three machine training sessions, covering topics such as an introduction to engine problems, machine repair requirements, and waste sorting techniques. During these training sessions, participants gather in a designated room at the Indocement Factory, where they receive direct guidance from company mentors. The training provides practical insights that focus not only on the technical aspects of waste management but also on the concept of machine maintenance related to industrial operations.

Indocement also engages the younger generation in environmental education from an early age by collaborating with schools to emphasize the importance of waste segregation and the benefits of alternative energy. Educational activities in schools teach students how waste can be transformed into a valuable energy source while inspiring them to protect the environment. Young people from every neighborhood participate in the sorting process, contributing to the creation of a sustainable waste management system at the community level. Through this initiative, Indocement not only acts as a business entity but also as a catalyst for positive change in the community and the surrounding environment.

In an interview with Sulaela, the manager of the Indah Makmur Waste Bank in Kedungbunder Village, on September 28, 2024, it was revealed that the training provided to the community related to waste management is generally brief, lasting only one day for each session. The training provided by the Environment Agency (DLH) focuses on waste sorting, offering basic knowledge about the importance of separating organic and non-organic waste. Meanwhile, Indocement's training is more focused on the use of organic waste, particularly in the production of liquid organic fertilizers, adding value to organic waste that was previously considered unusable. Despite the short duration, the training materials have a positive impact by equipping the community with practical skills to manage waste more efficiently and economically.

Tati Sumiati, the manager of the Alkarimah Waste Bank in Cupang Village, stated that the results of the waste sorting training not only provide environmental benefits but also improve the economic welfare of the community. By disciplining waste separation based on type, the community can increase the value of waste that was previously considered low-value. For example, waste that was originally priced at around two thousand rupiah can, after sorting, be sold to collectors or larger vendors at a higher price. Additionally, the profits from the sale of this waste are used to fund the compensation for the waste bank management team, providing incentives for members directly involved in waste management. This not only supports the sustainability of the program but also positively impacts community income through more efficient waste management.

> "In 2023, we again participated in DLH activities, which included various training sessions from both DLH and Indocement. Alhamdulillah, we were given assistance from Indocement for a comparative study in Bandung, which has now boosted our spirit of sustainability," said Tati in an interview on September 26, 2024.

According to local resident Suhaimi, Indocement has provided support by offering to continue waste management activities through this program. The offer was enthusiastically received by the community, and its

implementation was carried out through an existing forum, namely the Alkarimah Waste Bank. With this support, the waste management program has become more structured, involving more parties in efforts to increase public awareness and skills in managing waste. This support from Indocement is a crucial factor in strengthening the sustainability of the program and expanding its impact at the village level. The community is not only invited to participate in waste management but also offered incentives that encourage further involvement. The circular economy emphasizes sustainable business practices and prioritizes ecological considerations. Some of the key benefits of adopting a circular economy model include lowering overall production costs, increasing market competitiveness, and promoting ethical and sustainable processes.

To achieve success in community empowerment strategies, three main aspects must be considered: development, capacity building, and fostering self-reliance. The aspect of self-reliance is essential in creating a society that can overcome short-term challenges and ensure long-term sustainability (Saeful et al., 2020). Community empowerment through RDF waste treatment must be viewed as a sustainable process. As stated by 12ppaport (Margayaningsih, 2018), community empowerment is a means to enable individuals, organizations, and communities to take control of their lives.

Forms of community participation in waste management and disposal include awareness of waste and cleanliness, timely payment of waste levies, contributions from community units, community service activities, and the provision of garbage cans (Setyaningrum, 2015). By exchanging waste for money or valuables, people are educated to appreciate waste and encouraged to sort it appropriately. Moreover, effective waste management holds significant economic potential for the community. The establishment of a waste treatment unit must not operate in isolation; rather, it should be integrated with the 3R movement (reduce, reuse, recycle), promoting a comprehensive approach among community members (Saputro et al., 2015).

There has been a shift in mindset and collective awareness regarding more responsible waste management, ensuring that it no longer harms the environment or the surrounding community. The increase in the number of customers is clear evidence that the waste sorting program is not only relevant but also well-received by the community, which is becoming increasingly aware of the importance of sustainable waste management. This success demonstrates that collaboration between various parties, such as43LH, Polres, and social media, can accelerate awareness about the importance of waste sorting and increase community participation in the program. The growth in the number of participants indicates that the program has not only succeeded in creating a positive environmental impact but also highlights the significance of the right communication strategy in expanding the program's reach and attracting active community participation. The increase in the number of workers reflects efforts to boost waste processing capacity at UPS, while also providing employment opportunities for more local residents.

Community involvement in the waste sorting and processing process is vital to enhancing local capacity and capabilities. Indocement collaborates with BUMDes Palimanan Barat to utilize household waste as an alternative fuel. The program aims to reduce reliance on fossil fuels while promoting responsible waste management. Waste treatment operations are carried out using a well-integrated system that involves trained local workers. Although RDF feedstocks come from household waste, which is often less marketable, it is important to note that not all types of waste are accepted at Waste Management Units (UPS) for processing into RDF.

These empowerment strategies align with Hanna and Robinson's views, which emphasize the need for structural and systematic change in society. According to Ife (Hardiansyah et al., 2023), three types of empowerment strategies can be identified: (a) Empowerment through planning and policy, which 4nvolves the development or modification of structures and institutions to provide equal access to resources, services, and opportunities for participation in people's lives; (b) Empowerment through social and political actions, which involves political struggles and movements aimed at building effective power; and (c) Empowerment through education and awareness, focusing on a broad educational process in various aspects of life.

According to Sen (Fadilla & Hasan, 2023), there are four key components of the human development paradigm, referred to as holistic ideas: increased productivity, equal distribution of opportunities, sustainable development, and human empowerment. The success of development is measured by increasing individua3' freedom to participate and make choices in various aspects of social, economic, and political life. The capability approach serves as an appropriate normative evaluative

framework for welfare, social regulation, and social justice (Kimhur, 2020).

In general, the community empowerment process consists of planning, implementation, monitoring, and evaluation. Community empowerment efforts can be carried out in three ways: (1) creating an atmosphere that fosters the development of community potential; (2) strengthening existing community capacities through concrete measures, accommodating inputs, and providing adequate infrastructure and clear objectives; and (3) empowering the community by protecting and advocating for the interests of vulnerable groups (Sulaeman et al., 2019).

Referring to Ife's view (Dina et al., 2023), empowerment focuses on two main concepts: "power" and "disadvantaged" (inequality). In the context of community empowerment through waste management, especially Refuse-Derived Fuel (RDF), these two aspects must be considered to ensure that communities can compete effectively and access the necessary resources. According to Calves (Sany, 2019), community empowerment is closely related to economic issues and poverty. In this context, the RDF waste management program is expected to act as a catalyst for improving the local economy. This aligns with the new paradigm of development, which is people-centered, participatory, empowering, and sustainable (Habib, 2021).

Ife (Salan et al., 2023) defines community empowerment from four perspectives: pluralist, elitist, structuralist, and post-structuralist. Subejo and Supriyanto (2020) describe community empowerment as a deliberate effort to enable local communities to plan, make decisions, and manage local resources through networks and collective action, ultimately improving their economic, social, and ecological capabilities. The foundation of community empowerment rests on the belief that when people are empowered to control their resources and use them for development, development will unfold independently (Pathony, 2020). This independence encompasses not only economic aspects but also social, cultural, the right to voice opinions, and community autonomy in determining their political rights (Hamid, 2018).

According to Carlzon and Macauley (Putra & Ismaniar, 2020), empowerment involves freeing individuals from strict control, giving them the freedom to take responsibility for their decisions, ideas, and actions. It is both a process and an outcome: as a process, it involves a series of activities aimed at strengthening the power of marginalized groups in society; as an outcome, it represents the conditions or results that social change seeks to achieve (Soeharto, 2020). Supriyanto (Lukman, 2021) emphasized that community empowerment is a deliberate effort to facilitate local communities in planning, decision-making, and resource management through collective action and networks, which ultimately leads to the economic, ecological, and social independence of the community.

According to Chambers (Efri, 2019), the concept of development in the community empowerment model is more than just meeting the basic needs of the community; it seeks to identify alternatives for local economic growth. This model serves as a reference for various efforts aimed at improving capabilities and independence, enabling individuals or institutions to develop their abilities optimally (Ritonga, 2022). The empowerment model can be implemented through three main approaches: centralization, participation, and community development (Yefni, 2018). Ideally, the community empowerment model focuses on developing community potential, raising awareness, and enhancing individuals' ability to manage resources and improve their own skills (Herlon et al., 2023).

Indocement's sustainability strategy in its community empowerment program aligns with Heidelberg Materials' 2030 sustainability commitment, which outlines the company's long-term goals and objectives. Indocement maps material topics based on stakeholder needs and adopts an approach to address risks, changes, and opportunities related to environmental, social, and governance issues through focused group discussions that include both internal and external stakeholders. The company's response is integrated into its daily operations and culture, supporting the achievement of the Sustainable Development Goals (SDGs). Priorities for material topics and support for the SDGs are further strengthened by a range of strategies and innovations designed to meet sustainability targets by 2030.

b. Business unit development

In 2022, the company decided to revitalize the waste processing unit (UPS) facility. This initiative aims to increase production capacity, improve infrastructure, and ensure that the facility operates more efficiently and meets the growing demand for alternative fuels. The revitalization is also part of the company's ongoing efforts to support its sustainability commitments and create a positive impact on the environment and the surrounding community.

"The UPS must be rejuvenated. We are in the process of revitalizing it, and by 2023, production is expected to increase. Starting from 2-3 tons, the capacity has grown to 5 tons, then to 7 tons, and currently, it is capable of producing 10 tons per day. We use RDF as an alternative fuel, substituting coal. However, the substitution currently accounts for only around 2%," said Rita Widjaja, General Manager of Operations (Ass) at Indocement Cirebon, in an interview on October 1, 2024.

Figure 2. The condition of the *cruiser* engine looks better after revitalization UPS Palimanan Barat (Source: doc. 2024 researcher)

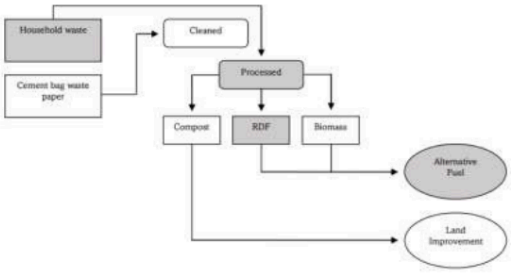

Figure 3. RDF waste processing process flow at UPS Palimanan Barat

The RDF waste processing process, as shown in Figure 3, begins with waste received from the community. The waste is first fed into Crusher Machine 1. Next, it is transferred to BC 2 and then processed further in the composting machine, where it is sorted to separate materials suitable for composting. Large plastic waste is directly transferred to BC 3 and then fed into Crusher Machine 2, which breaks the waste into pieces approximately 3 cm in size. After the shredding process, the resulting material, known as Municipal Solid Waste (MSW), is used as raw material for the production of RDF. Before being used as an alternative fuel, the MSW is mixed with rice husks. The final product is then transported by motor to Indocement for further processing and use as an alternative fuel in cement production. Based on the researcher's observations, the available machinery at the UPS Palimanan Barat includes two shredders, four crushers, two compost screeners, and one presser.

Table 1. Analysis of Heating Values, Proxies, and RDF Elements for Cement Plants

Aspects	Data	Information
Heating Value (Heat)	RDF calorific value: 2,500 to 3,500 kcal/kg	The heating value of RDF is lower than that of coal (4,500 to 5,000 kcal/kg). This has implications for the need to increase the amount of RDF burned or mix it with other fuels that have a higher calorific value, such as biomass or other industrial wastes.
Proximate Analysis	Levels of undesirable compounds: phosphates, chlorine, heavy metals	RDF proximate analysis reveals the presence of harmful compounds such as phosphates, chlorine, and heavy metals. Therefore, RDF quality control is essential to minimize contamination of hazardous compounds before they are burned in cement kilns.
Elemental Analysis	Harmful compound content: phosphates, chlorine, heavy metals	The phosphate, chlorine, and heavy metal content contained in RDF has the potential to interfere with the chemical processes in the cement kiln (kiln) and the quality of the clinker. Therefore, elemental analysis needs to be carried out to identify content that has the potential to interfere with the production process.
Effect on Clinker Quality	Effect of harmful compounds on clinker quality and cement kiln process	The harmful compounds contained in RDF (such as chlorine and heavy metals) can cause corrosion in kiln equipment, affect the quality of clinker, and damage the clinkerization process. Therefore, the quality of RDF must be paid close attention so as not to affect the quality of the final cement product, namely clinker.
Changes to the Cement Kiln Process	Equipment design modification and adjustment of kiln operating conditions	The process of burning RDF as a coal replacement fuel requires adjustments in the design of kiln equipment and the regulation of operational conditions. This change also involves increased control over the composition and quality of RDF before it is put into the kiln.

As shown in Table 1, RDF has a lower combustion potential than coal. Consequently, cement plants would need to use more RDF to achieve the same energy output as coal. Alternatively, RDF can be mixed with other fuels that have a higher calorific value, such as biomass or industrial waste. This is crucial for planning the energy requirements and improving operational efficiency in RDF combustion.

Harmful compounds in RDF can disrupt the stability of the kiln combustion process, as they may settle and cause corrosion in cement plant equipment. For example, chlorine can react with other compounds in the kiln to form corrosive substances, damaging equipment and increasing maintenance costs. Heavy metals can also contaminate clinker products, compromising the quality of the final cement. Therefore, closely monitoring RDF quality and refining it before use in cement kilns is essential to minimize these harmful compounds.

The phosphate and heavy metal content in RDF, such as cadmium and lead, can interfere with the clinkerization process in the kiln. These heavy metals may accumulate in the clinker, damaging the quality of the cement. Thus, elemental analysis is vital to ensure the RDF composition meets the quality standards required for deep combustion in the kiln. A procedure to separate or reduce harmful compounds in RDF is necessary to make it safe for use in cement production.

The clinkerization process is a critical stage in cement production, where raw materials are heated in a kiln to form clinker. The quality of the clinker is highly dependent on the stability of the combustion process. The presence of harmful compounds, such as chlorine and heavy metals, in RDF can disrupt temperature stability and chemical reactions in the kiln, which can negatively affect clinker quality. This, in turn, impacts both the quality of the cement produced and the energy efficiency of the plant.

Using RDF as a substitute for coal requires adjustments to kiln equipment design and operational conditions. Cement kilns that were originally designed for coal may need modifications to ensure that RDF burns efficiently and to mitigate the impact of harmful compounds. These adjustments may include optimizing temperature and heating times in the kiln, as well as improving control over the composition of RDF to minimize potential disruptions in the clinkerization process. Such modifications aim to ensure that the combustion process remains efficient and that the clinker yield meets quality standards.

Iin Farikhin, Head of UPS Palimanan Barat, stated that the company has an ambitious goal of producing up to 30 tons of RDF per day from waste processing. However, to achieve this target, the company faces a major challenge: the limitations of the current equipment. The existing machines are insufficient to support the desired production capacity. To reach the target of 30 tons per day, the company recognizes the need to increase the number of machines, which will require a significant investment.

Table 2. RDF daily production capacity development at UPS Palimanan Barat

Year	Production Capacity (Ton)	Information
2008	0.5	RDF production capacity at the beginning of establishment
2021	5	Average capacity before revitalization
2022	7	Average capacity after revitalization
2023	10	Daily capacity to date
2030	30	The expected future target has been achieved in 2030

(Source: Processed by the researcher)

Waste processing efforts at UPS Palimanan Barat have successfully reduced the volume of illegal waste in the landfill by approximately 5 tons per day. This achievement is considered significant because it not only reduces the amount of waste but also contributes to broader environmental sustainability goals. Furthermore, Indocement supports several other villages in implementing similar waste management systems. The company assists these villages by providing facilities and training to build waste management capacity. This initiative aims to expand the positive impact of sustainable waste management, which, in turn, reduces the amount of waste disposed of in landfills and creates more environmentally friendly alternative solutions.

The Gunungsantri Landfill covers more than 4 hectares, with around 2.5 hectares dedicated to the controlled landfill waste disposal system, while the remainder is used for reforestation. Waste management at this landfill involves pilfering, leveling, and compacting waste, followed by soil covering at scheduled intervals to reduce negative environmental impacts such as insect breeding, methane gas pollution, odors, and aesthetic damage. The success of the waste management program is heavily influenced by the quality of the field personnel managing it. One positive indicator is the growth in the number of waste banks in villages, which has significantly increased from around 20 waste banks in previous years to approximately 50 waste banks in 2023. While this progress is encouraging, efforts to maintain consistency and encourage community participation are ongoing. This highlights the importance of qualified field workers and the need for continuous encouragement to ensure villages remain committed to educating and engaging the community in independent waste management.

According to the 2023 Off-taker Waste Derivative Fuel Potential Analysis for supporting the development of integrated climate-friendly waste management (Widowati, 2023), coal used in the cement industry has a calorific value of around 4,500 to 5,000 kcal/kg, while the calorific value of RDF ranges from 2,500 to 3,500 kcal/kg. Therefore, replacing coal with RDF requires a higher mass of RDF or a mixture of RDF with biomass or other waste materials with a higher calorific value, such as sludge oil. Additionally, RDF often contains unwanted compounds, including phosphates, chlorine, heavy metals, and other minor components, which can negatively affect the clinkerization process in the kiln. As a result, it is crucial to modify the supporting equipment design in the cement kiln and adjust plant operating conditions to ensure the quality of the clinker products. Quality control of RDF is paramount before it is combusted in the cement kiln.

In the RDF production process, several key stages—including collection, sorting, biodrying, and the formation of pellets or briquettes—are essential for producing efficient alternative fuels. The RDF generated from this process has a low moisture content and a high bound carbon content, making it an effective substitute for coal. RDF has already been successfully utilized in several coal-fired power plants in Indonesia, including the Suralaya and Cilacap power plants, where it has been able to replace at least 3% of coal consumption. This substitution not only contributes to reducing energy costs but also lowers carbon emissions (Tri Ariyani & Yushardi, n.d.).

According to Indocement's 2023 sustainability report, RDF is one of the company's strategic initiatives aimed at reducing CO_2 emissions from coal use. In 2023, the RDF program succeeded in replacing 18.3% of fossil fuel consumption with alternative fuels, with targets set at 25% by 2025 and 42% by 2030. In its carbon emission control efforts, Indocement has also launched a cement and alternative fuel

mixture project as part of the Clean Development Mechanism (CDM). Additionally, the company introduced Portland Composite Cement (PCC), a cement product with lower clinker content, which significantly reduces CO_2 emissions.

For every ton of cement produced, the difference in CO_2 emissions between Portland Cement and Portland Composite Cement (PCC) can be as much as 200 to 250 kilograms. The biodrying method has shown significant advantages over the One-Day Process in producing high-quality RDF, achieving a calorific value of over 4,000 cal/gram and lower moisture content without requiring electricity, which helps reduce operational costs (Walid et al., 2020).

Combining RDF materials from organic and inorganic waste—such as wood, fabric, rubber, and paper—results in a higher calorific value and more uniform heat distribution. This type of RDF has a higher heat flow velocity of 0.472 m/s compared to the theoretical RDF value of 0.413 m/s, increasing combustion efficiency by 14.28% (Maulana et al., 2021). Furthermore, composition analysis of RDF reveals a mixture consisting of 15.35% waste paper, 1% wood, 2% fabric, 2.35% rubber/leather, and 8% plastic, which results in a calorific value of 3,973.45 kcal/kg. This exceeds the optimal combustion requirements for a pyrolysis incinerator (Rania et al., 2019).

Innovation in waste sorting technology plays a crucial role in enhancing RDF quality. The introduction of helical blades in waste sorting machines has proven effective in reducing blockages and increasing sorting capacity to 2 tons per hour. As a result, the RDF produced is cleaner and more consistent, making it a more reliable alternative fuel for cement plants. Additionally, this innovation creates economic value through by-products such as maggots and organic fertilizers (Sugiantoro et al., 2022).

Waste from deeper depths has shown higher calorific values, ranging from 5.25 to 6.31 kcal/ton, while lower moisture content results in higher quality RDF. As such, RDF from these zones holds great potential as an alternative fuel (Hutabarat et al., 2018). Similar studies indicate that reducing the moisture content in wastewater can significantly improve RDF efficiency as an energy source, thus meeting the minimum standards for Waste-to-Energy applications (Andrianingsih et al., 2018).

The biodrying method for RDF production relies on the heat generated by microbial activity to reduce moisture content, thereby increasing the calorific value of RDF. To ensure efficiency, temperatures must be maintained between 30°C and 45°C, along with an optimal aeration pattern. This approach not only produces high-quality RDF but also reduces waste volume, making transportation easier. As a relatively new technology in Indonesia, biodrying shows significant potential in processing urban waste with high moisture content (Chaerul & Wardhani, 2020).

Based on these findings, the community empowerment model for the RDF waste management program can be visualized as follows:

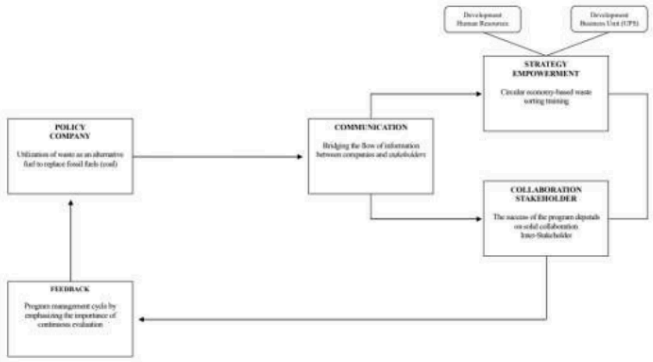

Figure 4. Community empowerment model in the RDF waste management program

Based on Figure 4, the community empowerment model in the RDF waste management program is designed to support the implementation of the company's policy, which aims to utilize waste as an alternative fuel, replacing fossil fuels such as coal. This model emphasizes the importance of synergy between corporate policies, effective communication, community empowerment, collaboration among stakeholders, and a continuous feedback process. Below is a detailed explanation of each component in this model:

1. The company has established a policy that supports the use of waste as Refuse-Derived Fuel (RDF), which serves as an alternative energy source. This policy not only aims to reduce dependence on coal, but also serves as a step towards addressing environmental issues by converting waste into a more environmentally friendly energy source.
2. Communication acts as a liaison between the company and its stakeholders. In this model, communication is carried out to ensure a clear and transparent flow of information regarding policies, strategies, and program implementations.
3. The empowerment strategy focuses on increasing community capacity and developing waste processing units (UPS). One of the strategic steps taken is to provide training on waste sorting based on the principles of the circular economy. Through this training, the community is equipped with the skills to sort waste according to RDF requirements, enabling them to actively participate in the program.
4. The success of this program is highly dependent on the strength of collaboration between various stakeholders, including companies, local governments, communities, academics, media, and other related parties. This collaboration enables stronger support, both in terms of policies, resources, and technical implementation on the ground.
5. The feedback process is a key element of this model. Through periodic evaluations, companies and stakeholders can assess the effectiveness of the program and identify areas for improvement. This process ensures that the program remains relevant, adaptive, and capable of achieving the set goals.

Conclusion and Recommendations

1. The training, which combines internal and external expertise, has had a positive impact, including increasing the technical capacity of the community and enhancing their understanding of sustainable waste management. The active involvement of the community in the entire waste management process, from upstream to downstream, has fostered the creation of a circular economy system that empowers local communities. Nevertheless, Indocement Cirebon still needs to strengthen more intensive and sustainable technical training programs, particularly those focused on machine maintenance and waste sorting according to industry standards. This training should include professionally recognized certifications to improve community competencies and support the program's sustainability through knowledge transfer to the younger generation. In this way, community-based waste management programs can have a broader impact.
2. The revitalization of waste processing unit (UPS) facilities by Indocement has yielded positive results, including an increase in RDF production capacity. This achievement also contributes to the reduction of illegal waste volumes, improves the quality of waste management around the landfill area, and supports other villages in implementing similar waste management systems. However, the biggest challenge facing the company is the current limitation in machinery, which hinders its ability to meet the ambitious production target of 30 tonnes per day. To achieve a higher RDF production target and enhance sustainability commitments, the company needs to urgently improve its infrastructure, particularly by increasing the number of waste processing machines.

Acknowledgments

My deepest gratitude goes to the sponsors: Indonesian Education Scholarship, Center for Higher Education Funding and Assessment, and Indonesian Endowment Fund for Education

Conflict of Interest

The authors state that there are no conflicts of interest associated with the publication of this work

Reference

Andrianingsih, R. T., Samudro, G., Budihardjo, M. A., Lokahita, B., Syafrudin, S., Hadiwidodo, M., & Wardhana, I. W. (2018). Potential for Combustible Waste in Active Zone 1 of the Jatibarang Semarang Landfill as RDF Raw Materials (Refuse Derived Fuel). *Jurnal Teknik Mesin*, *7*(1), 15. https://doi.org/10.22441/jtm.v7i1.2239

Ardiansyah, Risnita, & Jailani, M. S. (2023). Data Collection Techniques and Educational Scientific Research Instruments on Qualitative and Quantitative Approaches. *Jurnal Ihsan : Journal of Islamic Education*, *1*(2), 1–9. https://doi.org/10.61104/ihsan.v1i2.57

Ataöv, A., Kahraman, Z. E. H., & Osmay, S. (2022). Empowering the community through participation and action in historic neighbourhood conservation planning. *Frontiers of Architectural Research*, *11*(3), 492–508. https://doi.org/10.1016/j.foar.2021.12.001

Cecariyani, S. A., & Sukendro, G. G. (2019). Analysis of Creative Strategies and Objectives of Youtube Content (Case Study of Yudist Ardhana's Prank Content). *Prologia*, *2*(2), 495. https://doi.org/10.24912/pr.v2i2.3735

Chaerul, M., & Wardhani, A. K. (2020). Refuse Derived Fuel (RDF) from Urban Waste using Biodrying Process: Review. *Journal of Precipitation : Communication Media and Environmental Engineering Development*, *17*(1), 62–74. https://doi.org/10.14710/presipitasi.v17i1.62-74

Cheng, Y., Hung-Baesecke, C.-J. F., & Chen, Y.-R. R. 2021. Social Media Influencer Effects on CSR Communication: The Role of Influencer Leadership in Opinion and Taste. *International Journal of Business Communication*, 1–24

Dina, P. K., Syukur, A., & Makleat, N. (2023). Community Empowerment Through the Sewing Training Program in the Theoretical Study of Jim Ife (Case Study at the Women's Social Home, Naibonat, East Kupang District, Kupang Regency). *Jurnal Prodi PLS Universitas Nusa Cendana*, *3*(2), 21–24

dos Santos, E. R. M., Pereira, L. N., Pinto, P., Boley, B. B., & Ribeiro, M. A. (2024). Imperialism, empowerment, and support for sustainable tourism: Can residents become empowered through an imperialistic tourism development model? *Tourism Management Perspectives*, *53*(June), 101270. https://doi.org/10.1016/j.tmp.2024.101270

Eccher, C., Gios, L., Zanutto, A., Bizzarri, G., Conforti, D., & Forti, S. (2020). TreC platform. An integrated and evolving care model for patients' empowerment and data repository. *Journal of Biomedical Informatics*, *102*(January), 103359. https://doi.org/10.1016/j.jbi.2019.103359

Edi, D. N., & Haryuni, N. (2023). Estimation of Greenhouse Gas Emission Burden of Livestock Sector in East Java Province, Indonesia: Estimasi Beban Emisi Gas Rumah Kaca dari Sektor Peternakan di Provinsi Jawa Timur, Indonesia. *Jurnal Teknologi Lingkungan*, *24*(2), 157–165. https://ejournal.brin.go.id/JTL/article/view/1004%0Ahttps://ejournal.brin.go.id/JTL/article/download/1004/551

Efri, Syamsul Bahri. (2019). *Sustainable Community Empowerment*. FAM Publishing

Fadilla, D., & Hasan, M. (2023). Creative Economy-Based Community Empowerment Strategy to Support the Tourism Sector in Wajo Regency. *Ilmiah Ilmu Pendidikan. Vol.17*, 296–301. https://doi.org/10.19184/jpe.v17i2.40291

Habib, M. A. F. (2021). Theoretical Study of Community Empowerment and Creative Economy. *Journal of Islamic Tourism Halal Food Islamic Traveling and Creative Economy*, *1*(2), 82–110. https://doi.org/10.21274/ar-rehla.v1i2.4778

Hamid, Hendrawati. (2018). *Digital Books. Community Empowerment Management*. Makasar: De La Macca. Anggota IKAPI Sulsel

Hardiansyah, R., Nurwati, R. N., & Taftazani, B. M. (2023). The Success of the Socio-Economic Vulnerable Women Empowerment Program (Prse) in Tarunajaya Village. *Focus : Jurnal Pekerjaan Sosial*, *6*(1), 125. https://doi.org/10.24198/focus.v6i1.40141

Hasanah, H. (2017). Observation Techniques (An Alternative Method of Qualitative Data Collection in the Social Sciences). *At-Taqaddum*, *8*(1), 21. https://doi.org/10.21580/at.v8i1.1163

Hasnam, L. F., Syarief, R., & Yusuf, A. M. (2017). Waste Bank Development Strategy in the Depok Region. *Jurnal Aplikasi Bisnis dan Manajemen*, *3*(3), 407–416. https://doi.org/10.17358/jabm.3.3.407

Herlon, M., Khairunnas, K., Ridho, Z., & ... (2023). Land Ownership-Based Community Empowerment Model in Pelalawan Regency, Ria Provinceu. *Jurnal …*, 109–122. http://journal.unilak.ac.id/index.php/agr/article/view/16351%0Ahttps://journal.unilak.ac.id/index.php/agr/article/download/16351/5473

Heryana, A. (2020). Informants and Selection of Informants in Qualitative Research. *Esa Unggul University*, *December*, 1–14

Hutabarat, I. N., Priyambada, I. B., Samudro, G., Lokahita, B., Syafrudin, S., Wardhana, I. W., & Hadiwidodo, M. (2018). Potential of Combustible Waste Materials in the Passive Zone of the Jatibarang Semarang Landfill as Raw Materials for RDF (Refuse Derived Fuel). *Jurnal Teknik Mesin*, *7*(1), 24. https://doi.org/10.22441/jtm.v7i1.2241

Khikma, I., Sudarti, S., & Yushardi, Y. (2022). Analysis of Physics Education Students' Critical Thinking Skills on Waste Management into Refuse Derived Fuel (RDF) with Biodrying Treatment. *Silampari Jurnal Pendidikan Ilmu Fisika*, *4*(2), 98–113. https://doi.org/10.31540/sjpif.v4i2.1695

Kimhur, B. (2020). How to Apply the Capability Approach to Housing Policy? Concepts, Theories and Challenges. *Housing, Theory and Society*, *37*(3), 257–277. https://doi.org/10.1080/14036096.2019.1706630

Luisi, D., & Hämel, K. (2021). Community participation and empowerment in primary health care in Emilia-Romagna: A document analysis study. *Health Policy*, *125*(2), 177–184. https://doi.org/10.1016/j.healthpol.2020.11.007

Lukman, A. I. (2021). Community Empowerment through Non-Formal Education at PKBM Tiara Dezzy Samarinda. *Diklus: Jurnal Pendidikan Luar Sekolah*, *5*(2), 180–190. https://doi.org/10.21831/diklus.v5i2.43669

Mardikanto, Totok dan Poerwoko Soebiato. 2019. *Community Empowerment in the Perspective of Public Policy*. Bandung: Alfabeta Publisher

Margayaningsih, D.I. (2018). The Role of the Community in Community Empowerment Activities in the Village. *Jurnal Publiciana*, *11*(1), 72–88

Maulana, E., Suwandi, A., Rahmalina, D., Ode, L., Firman, M., Suyitno, B. M., & Mahandika, D. (2021). Performance Analysis of Refuse Derived Fuel (RDF) from Organic and Non-Organic Waste with Software Simulation Approach. *Jurnal Teknologi*, *13*(1), 110–114. https://dx.doi.org/10.24853/jurtek.13.1.109-114

Mustikaningrum, D., Kristiawan, K., & Suprayitno, S. (2021). Greenhouse Gas Emissions from the Agricultural Sector in Tuban Regency: Inventory and Potential Mitigation Actions. *Jurnal Wilayah Dan Lingkungan*, *9*(2), 155–171. https://doi.org/10.14710/jwl.9.2.155-171

Nanyonjo, G., & Nchanji, E. (2023). Seed credit model in Uganda": Participation and empowerment dynamics among smallholder women and men farmers. *Global Food Security*, *39*(June), 100720. https://doi.org/10.1016/j.gfs.2023.100720

Nurmalina, R. (2017). SYSTEM THINKING in a SYSTEM APROACH. *Agribusiness Series, Faculty of Economics & Management IPB, Towards Competitive Indonesian Agribusiness*, 15–23

Pathony, T. (2020). Community Empowerment Process through the Family Empowerment and Welfare Movement (PKK) in Subang Regency. Ijd-Demos, 1(2), 262–289. https://doi.org/10.31506/ijd.v1i2.23

Putra, W. T., & Ismaniar. (2020). Community Empowerment Through Waste Management in the Waste Bank. *Jambura Journal of Community Empowerment*, *1*(2), 1–10. https://doi.org/10.37411/jjce.v1i2.569

Rahabav, B. P., Rorong, A. J., & Laloma, A. 2021. Village Community Empowerment Strategy by Village Government in the Midst of the COVID-19 Pandemic. *Jap*, 7(111), 116–123

Rania, M. F., Lesmana, I. G. E., & Maulana, E. (2019). Analysis of the Potential of Refuse Derived Fuel (RDF) from Waste at Final Disposal Sites (TPA) in the District. *Sintek Journal: Scientific Journal of Mechanical Engineering*, *13*(1), 51–59

Ritonga, A. H. (2022). Model of Community Empowerment Based on Local Wisdom Through Lubuk Larangan in Padangsidimpuan City. *Jurnal At-Taghyir: Journal of Da'wah and Village Community Development*, *4*(1), 69–92. https://doi.org/10.24952/taghyir.v4i1.4715

Saadah, M., Prasetiyo, Y. C., & Rahmayati, G. T. (2022). *Strategies in Maintaining the Validity of Data in Qualitative Research. Al-'Adad : Journal of Mathematics*, *1*(2), 54–64. https://doi.org/10.24260/add.v1i2.1113

Saeful, A. dan Sri Ramdhayanti, D. (2020). The Concept of Community Empowerment in Islam. *Achmad Saeful and Sri Ramdhayanti SYAR'IE*, *3*, 1–17. https://stai-binamadani.e-journal.id/Syarie

Salan, P., Syukur, A., & Makleat, N. (2023). Community Empowerment Through Computer Course Program in the Framework of Jim Ife Theory (Case Study at the Center for Community Learning Activities Bintang Flobamora Kupang City). *Journal Parodi PLS Universitas Nusa Cendana*, *3*, 11

Sany, U.P. (2019). Principles of Community Empowerment in the Perspective of the Qur'an. *Journal of Da'wah Science*, *39*(1), 32. https://doi.org/10.21580/jid.v39.1.3989

Saputro, Y. E., Kismartini, Syafrudin. (2015). Community-Based Waste Management Through Waste Bank. *Indonesian Journal of Conservation*, *4*(1), 83–94

Satria, A. P. (2020). Talcott Parsons' Cybernetics: An Analysis of the Implementation of the Omnibus Law in the Formation of the Job Creation Law in Indonesia. *Indonesian State Law Review* (ISLRev), 2(2), 111–118. https://doi.org/10.15294/islrev.v2i2.37317

Setyaningrum, I. (2015). Characteristics of Improving Waste Management by the Community through Waste Banks. *Jurnal Teknik PWK*, *4*(2), 2015. http://ejournal-s1.undip.ac.id/index.php/pwk

Subejo dan Supriyanto. (2020). Methodology of Community Empowerment Approach, https://subejo.staff.ugm.ac.id

Sugiantoro, B., Supriyana, N., & Sutisna, U. (2022). Application of Waste Sorting Machine for Optimization of Refuse Derived Fuel (RDF) Raw Materials and Maggot Derivative Products at Tps 3R Bumdes Berkah Maju Bersama, Banyumas. *Budimas*, *04*(02), 1–11

Suharto, Edi. (2020). *CSR & Comdev: Corporate Creative Investment in the Era of Globalization*. Alfabeta: Bandung

Sulaeman, Z., Mustanir, A., & Muchtar, A. I. (2019). Community Participation in the Realization of Good Governance in Damai Village, Watang Sidenreng District, Sidenreng Rappang Regency. *PRAJA: Jurnal Ilmiah Pemerintahan*, *7*(3), 88–92. https://doi.org/10.51817/prj.v7i3.374

Sulistyani, A. T., & Wulandari, Y. (2017). The Process of Community Empowerment in Sitimulyo Village, Piyungan District, Bantul Regency in the Formation of an Independent Waste Management Group (KPSM). *Jurnal Pengabdian Kepada Masyarakat (Indonesian Journal of Community Engagement)*, *2*(2), 146. https://doi.org/10.22146/jpkm.27024

Sutriani, E., & Octaviani, R. (2019). Data Analysis and Data Validity Check. *INA-Rxiv*, 1–22

Tesafa, F., Mulugeta, M., & Tsehay, S. (2025). Women empowerment, efficiency and food security nexus in rural Ethiopia: A generalized structural equation modeling. *Heliyon*, *11*(1), e41273. https://doi.org/10.1016/j.heliyon.2024.e41273

Tri Ariyani, D., & Yushardi, dan. (n.d.). *Mechanism and Application of Refuse Derived Fuel (RDF) in the Power Plant Industry as an Alternative to Waste Management*. *7*(2), 318

Walid, A., Turahmah, F., & Ismarliana, P. (2020). Ecology: Scientific Journal of Basic Sciences and the Environment. *Ekologia: Jurnal Ilmiah Ilmu Dasar Dan Lingkungan Hidup*, *20*(1), 40–44. https://journal.unpak.ac.id/index.php/ekologia

Widowati, Lusy. (2023). Study on the Potential Analysis of Off-taker Refuse Derived Fuel (RDF) to Support the Development of Integrated Climate-Friendly Waste Management

Yefni, Y. (2018). Analysis of Community Empowerment Model. *Civil Society: Jurnal Kajian Islam dan Pengembangan Masyarakat*, *3*(2), 42. https://doi.org/10.24014/jmm.v3i2.6362

Legal:

Law Number 40 of 2007 concerning Limited Liability Companies

Presidential Regulation Number 61 of 2011 concerning the National Action Plan for Reducing Greenhouse Gas Emissions

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RDF ERiC DKTI Offtaker Analysis Study

https://indocement.co.id/Tentang-Kami/Sekilas-Indocement/Sekilas-Perseroan (Quoted on July 26, 2024 at 18.50 WIB)

https://waste4change.com/blog/sampah-pengertian-jenis-hingga-peraturannya-di-indonesia/ (Quoted on October 8, 2024 at 08.40 WIB)

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