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Circular Economy In The Concept of Waste Management : Implementation of Community-Based Environmental Management

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Abstract: This community service activity aims to identify the form of plastic waste management, analyze the optimal circular economy-based waste management scenario and prepare recommendations for sustainable circular economy-based waste management policies in Sungsang IV Village. The method of this community service activity is empowerment and coaching using the coding and theming approach methods. The target audience for this activity is 25 housewives. More optimal circular economy-based waste management in the future can provide a strategic direction to realize a waste management system that is not only effective and efficient, but also sustainable for the community and the environment. The application of a circular economy in plastic waste management offers a solution that not only addresses environmental problems but also provides social and economic benefits for the community. Based on the results of the activity, it was revealed that most participants were motivated and gained new skills in managing waste so that it has utility value. With a combination of educational approaches, infrastructure development, and community empowerment, Sungsang IV Village can become a model for sustainable circular economy-based waste management.

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Introduction

Plastic waste in Indonesia is very high and has a negative impact on the environment. Several countries such as China, Indonesia, the Philippines, Vietnam, and Sri Lanka have contributed more than 56% of global plastic waste, and China alone has produced more than 30 MT of plastic waste annually in recent years (Rhodes, 2018). Compared to recycling of other materials such as paper (60%), glass (50%) and ferrous metals (80%), the recycling rate of plastic waste is only around 14–18% (Hossain et al., 2022), while 24% of plastic waste is managed through energy recovery, and the remaining 58–62% is disposed of directly in landfills or in the natural environment globally (Geyer et al., 2017). Even a number of researchers say that it takes approximately 500 years to decompose plastic waste on earth. Therefore, over time the concept of a circular economy was created, which focuses on reducing waste and pollution and maintaining product materials so that they can be reused.

The circular economy has the slogan "waste = food" which means that waste from a production or consumption process can be input to be used in the next process and continues continuously. This is different from the linear economy which has the slogan "take, make, and dispose". There are several driving factors for the circular economy from external and

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Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

internal. External driving factors are in the form of consistent policies to support the implementation of a circular economy, good tax regulations, to consumer specifications. While the internal driving factors are in the form of corporate responsibility, shareholder pressure, competitiveness, to good culture and behavior. The circular economy also carries the principle that existing raw materials should never become waste by implementing product sustainability. In a circular economy, products and materials continue to circulate through processes such as maintenance, reuse, repair, remanufacturing, recycling, and composting. The circular economy can be an effort to combat climate change and other global challenges such as loss of biodiversity, waste, and pollution.

In addition, there are also obstacles in the implementation of the circular economy from external and internal sources. External obstacles include unsupportive government policies, lack of consumer demand, limited supply chains, and limited technology and infrastructure. While from the internal side, there are very commercial business models to unsupportive cultures and attitudes. Paola said that in Indonesia there are obstacles in the recycling sector, including lack of regulation and implementation, cultural misperceptions related to waste, lack of household participation, and lack of demand for recycled products. Even so, there are several initiatives to support the circular economy, such as the use of eco blocks or environmentally friendly construction blocks made from plastic waste to build a school in Lombok. The existence of a plastic bank to help reduce plastic waste in the sea and have an impact on the environment and society. The large amount of waste generated each year makes waste management activities important to carry out. However, waste management is complex because it is influenced by several aspects such as technical, institutional, regulatory, funding, and community participation (Septiariva et al., 2019). In addition, waste management is also increasingly dynamic due to the increase in population which results in an increase in the amount of waste generated (Khairunisa & Safitri, 2020). The biggest challenge to the current waste management system is that the management system is still not in accordance with the principles of the circular economy. Waste management generally uses the old framework of thinking, namely the end-to-pipe approach method (Darmawan et al., 2020) (Nurjanah, 2020).

Plastic is a material that is often used by people in Indonesia, one of which is in Sungsang Village. Sungsang IV Village is located in Banyuasin II District, Banyuasin Regency, South Sumatra. It has a land topography that is mostly river waters, with mangrove trees around the riverbank, abundant natural resources with the main livelihood as fishermen and 90% of the population are native to the Banyuasin area. Directly bordering Bangka Island makes Sungsang IV Village a strategic place with a marine economy and maritime economy. The many natural potentials of Sungsang IV Village make the charm of the area have its own characteristics. The habit of the surrounding community to open shops or sell for women and men go to sea to catch fish. This interesting potential, there is a fairly high environmental problem in the area. There are many piles of garbage that are stagnant under the community's settlements. Piles of garbage and stagnant garbage will cause environmental pollution and will reduce the level of health in the area. Humans are continually ingesting and inhaling microplastics produced from plastic waste, raising concerns about the health risks of microplastic exposure (Zhu et al., 2024). The garbage problem in Sungsang Village is caused by the bad habit of the community to litter (garbage is thrown under the house) and the effects of garbage sent from the Musi River. The increasing amount of waste is a problem for Sungsang IV Village, especially plastic waste.

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Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

Based on the background of the activity, this community service activity aims to identify the form of plastic waste management in Sungsang IV Village, analyze the optimal circular economy-based waste management scenario in Sungsang IV Village and prepare recommendations for sustainable circular economy-based waste management policies in Sungsang IV Village.

Method

This service activity method is empowerment and coaching with the implementation method of coding and theming approaches. To achieve the expected goals, several activities are carried out according to the flow and schedule of activities, and then the process of this international service activity will be described into three activities. A detailed explanation of these actions is presented in the table format below:

Table 1. Activity Implementation Method

Activities			
1. Selection of activity areas	**2. The Circular Economy underpinned**	**3. Supporting the preparations for activities**	**4. Creating something of value from waste processing**
Activities:	**Activities:**	**Activities:**	**Activities:**
- Area Screening - Interview	Provide understanding to the community, especially housewives, regarding waste, waste sorting and waste processing	Planning and implementing a program to utilize waste into something that has value	Making bags and pencil cases from plastic waste from snack wrappers and making brooches from used bottle caps.
Purpose:	**Purpose:**	**Purpose:**	**Purpose:**
Sorting Eligible Participants and Regions	The aim of this community service activity is to provide understanding and training regarding the piles of rubbish in the area.	In order to carry out joint activities for waste processing, support is expected from village officials to be implemented sustainably so that the mounting waste can be reduced.	This activity is expected to reduce the piles of rubbish in the area and provide skills to increase the income of the local community.
Evaluation			
Material: PPT, Teaching Staff, Product manufacturing practice			
Purpose: International Community Service Contribution			

The target audience selected for this community service activity was the Sungsang IV Village Community, numbering around 25 people.

Evaluation of the success of this activity will be carried out by considering the objectives to be achieved. One of the evaluation methods that will be carried out is to ask for responses from the target audience by filling out a questionnaire as a form of feedback for the next activity. The questionnaire will contain questions regarding the satisfaction and benefits obtained from this activity, as well as suggestions and input for future improvements. The analysis technique used is descriptive analysis technique. The data collected through the questionnaire will be analyzed comprehensively to measure the level of success of the activity and evaluate the extent to which the objectives have been achieved. The analysis technique used is descriptive analysis technique. Data collected through questionnaires will be analyzed comprehensively to measure the level of success of the activity and assess the

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Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

extent to which the objectives have been achieved. The results of the analysis will provide valuable insights in understanding the effectiveness of this activity, correcting weaknesses, and improving similar activities in the future. By involving the target audience directly through filling out the questionnaire, it is hoped that accurate and useful feedback can be obtained to improve the quality of this community service activity.

Result and Discussion

The activities, as part of the community service program, are carried out through a series of predetermined stages. The first stage is preparation, which involves coordination with the Sungsang IV Village Government, represented by the village secretary. This community service activity aims to identify the form of plastic waste management in Sungsang IV Village, analyze the optimal circular economy-based waste management scenario in Sungsang IV Village and prepare recommendations for sustainable circular economy-based waste management policies in Sungsang IV Village.

Table 2 Activity Description

Activity	Activity Description	Purpose/Benefits
Preparation		
1. Community service activity team discussion on the preparation of proposals and preparation of activities (administration, tools and materials and evaluation plans)	Prepare administrative equipment needs, Community service activity proposals, tools and materials	The proposal has been prepared, Division of tasks responsibility for activities, Administrative preparation, tools and materials are ready, Evaluation questionnaire is ready
2. Village Apparatus Visit	Audience and discussion of problem identification and problem solving	Problem identification and problem solving framework
Implementation		
1. Coordination with village officials to prepare for implementing activities	The Community service team and village officials prepare training materials	There is a list of materials needed for implementing community service
2. Socialization and education on circular waste management based on the community in Sungsang Village IV	Village apparatus prepares circular socialization and education strategy for community-based waste management in Sungsang Village IV	The formulation of socialization and circular education on community-based waste management in Sungsang Village IV
3. Socialization and education of circular community-based waste management in Sungsang Village IV	Community service activity team carried out socialization and education on community-based circular waste management in Sungsang Village IV.	Participants understand the circularity of waste management
Community Service Evaluation		
1. Completing the final questionnaire (Post Test) regarding understanding the strategy for socialization and circular education of community-based waste management in Sungsang Village IV	Participants fill out the evaluation questionnaire (Post Test)	List of participant answers in Community service activity Post-Test evaluation Report on the results of the Community Service Evaluation

Jurnal Pengabdian UNDIKMA:
Jurnal Hasil Pengabdian & Pemberdayaan kepada Masyarakat
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Email: pengabdian@undikma.ac.id

Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

Preparation of Community Service Output		
1. Preparation of scientific articles and final activity reports	Community service activity team compiles scientific articles and final activity reports.	The existence of draft scientific articles, and final activity reports

The condition of Sungsang IV Village regarding the waste problem, namely the lack of implementation of a circular economy in community-based waste management, is caused by a combination of factors of awareness, infrastructure, policy, economy, and technology that are not yet adequate. To overcome this, collective efforts are needed from the government, community, and private sector to increase understanding, build supporting infrastructure, create economic incentives, and strengthen policies that support the implementation of a circular economy as a whole. In addition, according to (Lu & Sidortsov, 2019), the co-production approach will be most effective in the early stages of policy implementation to encourage the formation of waste sorting habits in areas where waste collection rates are still low. Thus, the realization of problem solving in this activity is as follows:

1) Before the proposal was prepared, the community service team made an initial visit to Sungsang IV village to discuss problem identification and problem-solving frameworks so that community service proposals could be prepared with an international scheme that was in accordance with the needs of village officials in order to improve their competence.

Figure 1. Discussion on problems in Sungsang IV village with village officials and several village residents

Waste management has long been considered a public service that should be provided by the government (Guerrero et al., 2013). However, it has been found that public services can be provided more efficiently through a co-production approach with community (service recipient) involvement (Pestoff & Brandsen, 2010). Co-production of public services is defined as "community involvement, in the production of public services" (Alford, 1998). The benefits of co-production lie in the provision of public services at lower costs with increased efficiency (Pestoff & Brandsen, 2010), which is important for waste management, as many local governments do not have sufficient funds to meet the increasing demand for waste management (Amoah & Kosoe, 2014).

2) Implementation of community service, in accordance with the problem-solving framework, the activities carried out were in the following stages:
   - Training in making crafts from plastic waste. The initial stage is to provide counseling and knowledge about the types of waste, the effects of short-term and long-term waste

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Email: pengabdian@undikma.ac.id

Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

accumulation and the utilization of waste, especially plastic waste which is abundant in the area.

- Circular training activities for community-based waste management in Sungsang Village IV by using plastic waste as a material that can be utilized or used in everyday life. The training was carried out by providing counseling and direct practice in the form of making bags and crafts using household plastic waste.
- Provide examples of several products made from various plastic waste such as bags, pencil cases, key chains, wallets and others.

Figure 2. Providing material on Circular Economy in the Concept of Waste Management and KGS Waste Bank delivers circular material on community-based waste management in Sungsang IV Village

- The community is given the skills to make something that has value from something that previously had no value, this is what is called added value. With the skills provided, it is hoped that the community can manage waste by producing products so that the accumulation of plastic waste in the area can be utilized and reduced.

Figure 3 shows the results of the skills in the form of sling bags produced by mothers in Sungsang IV Village. Previously, the mothers had also been taught to make brooches from drinking bottles and scraps of cloth, therefore it is hoped that the skills or knowledge provided can be utilized and managed properly to reduce plastic waste.

Figure 3. Provision of Raw Materials

Community service activities were attended by the majority of women, namely housewives. Based on Education Level, the grouping of community service participants based on education level is as follows:

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Jurnal Hasil Pengabdian & Pemberdayaan kepada Masyarakat
https://e-journal.undikma.ac.id/index.php/jpu/index
Email: pengabdian@undikma.ac.id

Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

Table 3 Participants Based on Education Level

No	Education Level	Frequency	Percentage %
1	Elementary School	0	0
2	Junior high school	6	24
3	Senior high school	15	60
4	Bachelor degree	4	16
	Quantity	25	100

Based on Table 3 it can be seen that the level of education of participants in community service is dominated by high school graduates at 60 percent.

This community service activity was carried out systematically. The Student Team who went directly to the field helped direct and guide the participants during the bag-making training. The participants in each training were very enthusiastic in participating in the activities carried out. The training participants understood well the stages of making bags from plastic waste presented by the resource person. From this activity, the training participants can have a high understanding and desire to make their own bags or other crafts to reduce plastic waste in Sungsang Village IV. Based on the results of the questionnaire given to the participants as a form of evaluation so that the next community service activity can be carried out better, the following responses were obtained from the participants:

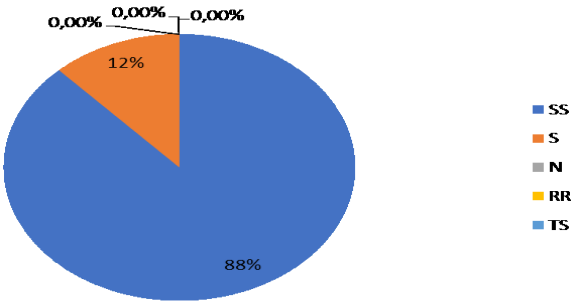

Figure 5. Evaluation 1 (Are these training and community service activities useful for reducing waste in the village environment?)

Figure 5 shows that the implementation of training and community service activities has provided benefits for waste reduction in Sungsang IV village, this can be seen from the participants who chose strongly agree (SS) which is 88%, which means that 22 participants chose strongly agree that this community service activity is beneficial for the village, and 12% of participants chose agree, and no participants chose disagree regarding the benefits provided by the service activities.

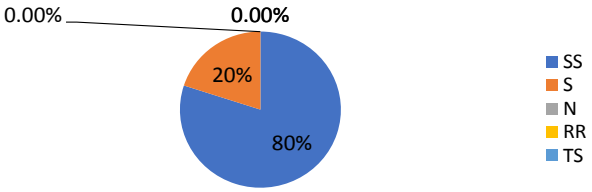

Figure 6. Evaluation 2 (Training and community service activity materials are relevant to the activities carried out?)

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Email: pengabdian@undikma.ac.id

Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

The results of the questionnaire related to training and community service materials were relevant to the activities carried out, it was found that 80% (20 participants) chose to strongly agree and 20% (5 participants) chose to agree.

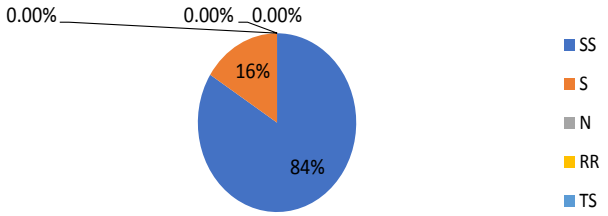

Figure 7. Evaluation 3 (Is the implementation and delivery of the material effective and efficient in providing understanding to participants?)

Figure 7 reveals that, as many as 84% of participants chose to strongly agree that the material delivered was effective and efficient and 16% stated that they agreed that the delivery of the material was effective and efficient in providing the material.

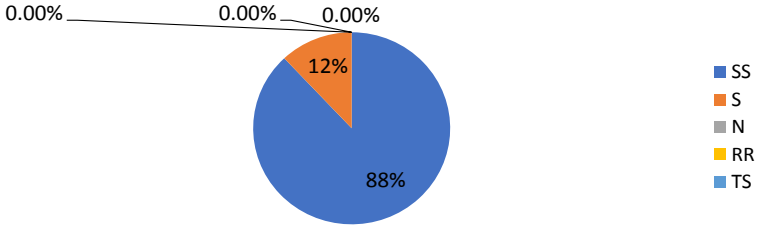

Figure 8. Evaluation 4 (Do these community service activities help participants gain new skills regarding waste processing?)

The questionnaire results stated that 88% of participants stated that the material provided by the resource person was in accordance with the participants' needs so that it provided new skills and 6 participants chose to agree. This means that the material presented is in accordance with the participants' expectations and the material is in accordance with the participants' needs. Participants gain skills to process plastic waste that has value so that in the future participants can apply these skills sustainably to reduce the piles of waste in the area.

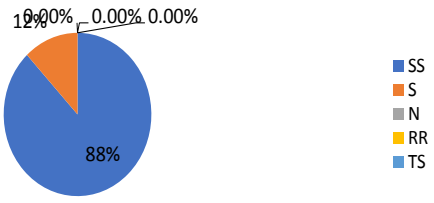

Figure 9. Evaluation 5 (Are the participants willing to carry out this activity sustainably to reduce waste and sustainably process waste?

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Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

The technical training was carried out well, as seen from the statements of the participants, 88% stated that they strongly agreed and 12% stated that they agreed. This means that the technical training on making bags and pencil cases from plastic waste and brooches from plastic bottles as community-based circular waste management in Sungsang IV Village was carried out well and the participants were willing to carry out the activities sustainably.

Discussion

Participants in the community-based circular waste management training in Sungsang IV Village were very enthusiastic about the material that had been presented. Based on the questionnaires that had been distributed and the results of the questionnaire responses, most participants were motivated and gained new skills in managing waste so that it had value. Understanding how to process waste, namely making bags and pencil cases from plastic waste and brooches from plastic bottle caps based on the community in Sungsang IV Village is very useful for the community to reduce waste. Thus, it can be concluded that the training participants have sufficient understanding of community-based circular waste management in Sungsang IV Village.

The identification results show that plastic waste management in Sungsang IV Village is still conventional. Although there are multiple uses, plastic waste and the resultant pollution can clogs up our rivers, oceans, lands and adversely affects the biodiversity. Therefore, we need to plan for the implementation of affordable, effective and truly sustainable waste management practices especially in developing countries (Singh & Sharma, 2016).

Plastic waste management in Sungsang IV Village has the following main challenges, Limited Management System: Plastic waste is generally collected without being sorted and then disposed of in open landfills or burned, causing environmental pollution. Limited Infrastructure: There are no adequate waste sorting facilities, waste banks, or recycling centers. Low Public Awareness: The majority of people still do not understand the importance of 3R-based waste management (Reduce, Reuse, Recycle) or a circular economy. Lack of Policy Support: Regional regulations related to waste management are still ineffective in addressing the problem of plastic waste.

Based on the analysis, the implementation of a circular economy can be an optimal solution for plastic waste management in Sungsang IV Village with the following scenarios:

- Waste Sorting at Source: Communities are encouraged to separate plastic waste from organic waste at the household level.
- Waste Bank Development: Establish a waste bank as a center for collecting, sorting, and storing recyclable plastic. Waste banks can also provide economic incentives to the community.
- Waste Recycling and Utilization: Utilizing used plastic to create value-added products, such as handicrafts, paving blocks, or alternative fuels.
- Local Community Empowerment: Providing training to communities to recycle plastic waste independently or through small business groups.
- Collaboration with External Parties: Involving local governments, NGOs, and the private sector to support waste management programs with technology and funding.

The implementation of the circular economy model requires the development and application of new knowledge, leading to innovative, technologically advanced and sustainable processes, products and services (Kwarteng et al., 2022). Combination of

Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

scenarios above can make circular economy-based waste management be more effective in Sungsang Village. (Hossain et al., 2022) suggested that plastic waste management depends not only on the efficiency of local goverments and recyclers, but also on community partisipation and national, regional or global strategies. Industry professionals, governments, customs agencies, leg islators, intergovernmental organizations, non-governmental organizations, and civil society must work together. To tackle plastic waste, we need a combination of interventions, global cooperation, and goal-oriented measures.

Conclusion

More optimal circular economy-based waste management in the future can provide strategic direction to realize a waste management system that is not only effective and efficient, but also sustainable for the community and environment of Sungsang IV Village. The application of a circular economy in plastic waste management in Sungsang IV Village offers a solution that not only addresses environmental problems but also provides social and economic benefits for the community. With a combination of educational approaches, infrastructure development, and community empowerment, Sungsang IV Village can become a model for sustainable circular economy-based waste management. The results achieved are (1). The community can make various crafts such as bags, pencil cases and beautiful brooches with a simple system using plastic waste (2). The community can reuse plastic waste which is turned into something valuable such as ecobricks which in the future can be increased to produce more which can be used as substitutes for bricks, making chairs and tables from ecobricks. (3). The community's ability to manage waste to produce added value and increase income.

Recommendation

The following are policy recommendations for sustainable plastic waste management based on a circular economy:

- Public Education and Campaign: Implement education and campaign programs to increase public awareness of the importance of circular economy-based waste management.
- Strengthening Regional Regulations: Implement mandatory waste sorting at the household level and reduce the use of single-use plastics.
- Infrastructure Development: Build recycling facilities, waste banks, and integrated waste collection systems.
- Community Empowerment: Support the formation of waste-based businesses that can provide direct economic benefits to the community.
- Multi-stakeholder Collaboration: Involve the private sector to invest in plastic waste processing technology and marketing of recycled products.
- Monitoring and Evaluation: Form a special team to monitor the implementation of the policy and evaluate its success periodically.

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Vol. 6, No. 2 (May 2025)
E-ISSN : 2722-5097
Pg : 247-257

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