Type of contribution:
→ •Editorial
•Research Paper
•Case Study
•Review Paper
•Scientific Data
•Tech. Promotion
•Case Opinion
•Short Communication

JURNAL PENGABDIAN DAN PENGEMBANGAN MASYARAKAT
DHARMAKAYANA
Journal of scientists, engineers, educators and scientific activists related to society development
Published by : Mechanical Engineering-Universitas Bengkulu
Jalan W.R. Supratman, Kota Bengkulu 38371 A, Bengkulu, Indonesia
dharmakayana@unib.ac.id
https://ejournal.unib.ac.id/dharmakayana

Optimization of the Octane Cycle Concept as an Integrated Waste Management Strategy Toward a Zero Waste Village in Argosari, Malang

Optimalisasi Konsep *Octane Cycle* sebagai Strategi Pengolahan Sampah Terpadu Menuju Desa *Zero Waste* di Argosari, Malang

Musyaroh[*1], Anisah Nurul Izzah[1], Rizqa Ruviana[1], Luluk Edahwati[1], Dewi Maya Maharani[2]

[1]*Mechanical Engineering Dapertment, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Surabaya, 60294, East Java, Indonesia*
[2]*Agricultural Engineering Department, Brawijaya University, Malang, 65145, East Java, Indonesia*
[*]Corresponding Author: musyaroh.ft@upnjatim.ac.id

This article contributes to:

Main Theme Figures:

Highlights:
- 60 biogas installations in Argosari produce 300–500 kg of slurry daily.
- Additional waste: 687 kg household and 1,919.7 kg agricultural waste per day.
- The Octane Cycle Concept converts organic and inorganic waste into fertilizer, fish feed, compost, mushroom baglogs, and crafts.
- Waste reduced by 51% in 3 months.
- A centralized waste processing unit was established with youth and community involvement.
- The program improved environmental cleanliness, entrepreneurship, and local income.
- Villagers saved Rp 82,500/day (fish feed), Rp 17,000/month (fertilizer), and earned up to Rp 30,000/month (handicrafts).

Article info Submitted: 2025-05-06
Revised: 2025-05-25
Accepted: 2025-05-31

How to cite: Musyaroh. (2025). Optimization of the Octane Cycle Concept as an Integrated Waste Management Strategy Toward a Zero Waste Village in Argosari,

Abstract

Argosari Village faces a critical waste management challenge due to the accumulation of biogas slurr (300–500 kg/day), household waste (687 kg/day), and agricultural waste (1,919.7 kg/day). Limited publi awareness and waste processing capacity have led to uncontrolled environmental pollution. Th community service program introduces the *Octane Cycle Concept*, a novel and integrative waste utilizatio model that transforms both organic and inorganic rural waste into valuable products such as compos fertilizers, fish feed, mushroom media, and handicrafts. The Octane Cycle emphasizes a closed-loop, mult output processing approach that links food, energy, and local economy in a zero-waste framework. Th program was carried out in five phases: preparation, equipment provision, community training, monitorin and evaluation, and reporting. Results show that waste volume in Argosari Village was reduced by 51% within three months. In addition to improving environmental cleanliness, the program fostere entrepreneurship and increased household savings through the production of bio-based products. Th model demonstrates the scientific and practical potential of applying circular economy principles at th village level.

Malang: Dharmakayana, 2(1), 1-8.

Publisher: *Unib Press*

Keywords: *biogas, zero waste, integrated concept*

1. Introduction

Waste management remains a critical issue in many rural areas in Indonesia, including Argosari Village, Malang Regency, which generates a significant amount of biogas slurry (300–500 kg/day), household waste (687 kg/day), and agricultural waste (1,919.7 kg/day). Despite the presence of 60 biogas installations funded by a government sanitation program, most of the resulting waste, particularly organic and inorganic residue, remains underutilized due to limited public awareness and knowledge. This condition leads to environmental degradation, affecting land, air, and water quality, and diminishing the image of the village as part of the Bromo Tengger Semeru National Park conservation area.

In rural waste management, the zero-waste approach has gained global attention as a sustainable framework, aiming to eliminate waste through circular use of resources. Several studies have highlighted the importance of integrated waste handling at the community level, such as composting-based organic waste treatment (Anis Rosyiatul Husna, Pipit F. Wiliyanarti, Ine D. Putri, 2023), optimization of biogas by-products (Harjuni et al., 2022), and upcycling initiatives for economic empowerment (Nurmalasari, 2023). However, most existing models are fragmented—focusing only on either organic or inorganic waste—and lack a closed-loop system that links food, energy, and economy in one integrated village-scale solution.

To address this gap, we introduce the Octane Cycle Concept, a novel, circular economy-based model that continuously transforms both organic and inorganic waste into multiple value-added products. The concept integrates biogas slurry utilization, composting, mushroom cultivation, fish feed production, and handicraft creation into a self-sustaining waste cycle. Unlike conventional models, the Octane Cycle emphasizes multi-output recovery, scalability, and community ownership, designed specifically for rural application with limited infrastructure.

This paper presents the implementation and evaluation of the Octane Cycle Concept in Argosari Village through a structured community service program. The study aims to assess its effectiveness in reducing waste, improving local livelihoods, and fostering entrepreneurship, while contributing a replicable model for other rural areas aiming to achieve zero-waste objectives.

2. Method

2.1. Research Design and Approach

This study employed a participatory action research (PAR) approach, involving continuous collaboration between the academic team, local community, and stakeholders in planning, implementation, and evaluation. The PAR method was chosen to ensure relevance, local ownership, and adaptive learning during the waste management intervention. The Octane Cycle Concept was introduced as a *circular waste management model* integrating biogas slurry, organic, and inorganic waste into a multi-output zero-waste system. To facilitate this, a custom community training module named "Oc-Cycle DEVIL" (*Development of Village Integrated Loop*) was developed, serving as a visual and practical guide.

2.2. Time and Location

This program was implemented in Argosari Village, Jabung Subdistrict, Malang Regency, specifically in Bendrong Hamlet. The community service activity took place over five months,covering the preparation stage up to the program application.

2.2. Tools and Materials

The equipment used for slurry processing technology includes a fish pellet grinder or pellet machine, press tools, plastic drums, 1/2" PVC pipes, funnels, sieves, 3m x 3m tarpaulins, saws, shovels, scissors, and knives. The tools used were the result of collaboration between the community service implementation team and the local mosque youth. The materials used were organic and inorganic waste found in Argosari Village, such as biogas slurry, leftover vegetables, dry leaves, rice straw, and inorganic waste like plastic and rubber.

2.3. Preparation

The preparation stage took about two weeks and included:

2.3.1. Module Development

The module was developed as a supporting medium for the implementation of the Oc-Cycle Devil program. The module introduces the Oc-Cycle Devil concept based on zero waste. It includes methods for converting biogas slurry into fertilizer, fish feed, and vegetable/mushroom growing media; methods for transforming household and agricultural organic waste into compost and animal feed; and techniques for making handicrafts from household inorganic waste.

2.3.2. Selection of Centralized Waste Processing Unit Location

The selection of the centralized waste processing unit location in Argosari Village was conducted at the initial stage before program implementation. A strategic and easily accessible location was chosen to ensure community involvement.

2.4. Implementation Stage

2.4.1. Socialization

1. Introduction to the Octane Cycle Concept Program
   The first stage of socialization introduced the program to all residents of Argosari Village. This session aimed to give a general overview of the Octane Cycle Concept to the target community, laying the foundation for achieving a zero-waste independent village in Argosari.
2. Socialization on the Utilization of Organic and Inorganic Waste
   The second socialization stage was held just before implementation and focused on delivering materials on how to process biogas slurry into fertilizer, fish feed, and planting media; how to compost household and agricultural organic waste; and how to make crafts from inorganic waste. During this stage, questionnaires were distributed to assess the community's baseline knowledge and skills regarding biogas slurry, household, agricultural, and inorganic waste processing in Argosari Village.

2.4.2. Application of the Zero-Waste-Based Octane Cycle Concept

The implementation of the Octane Cycle Concept was divided into two stages:

- The first stage focused on training for utilizing biogas slurry.
- The second stage focused on using household and agricultural organic and inorganic waste.

All waste in Argosari Village was utilized through this concept. The large amount of biogas slurry was processed into fertilizer, fish feed, and mushroom cultivation media. Household and agricultural organic waste was converted into compost and animal feed, while inorganic waste was turned into handicrafts.The utilization cycle operates as illustrated in Figure 1, where all reused waste supports the community's daily food and energy needs.

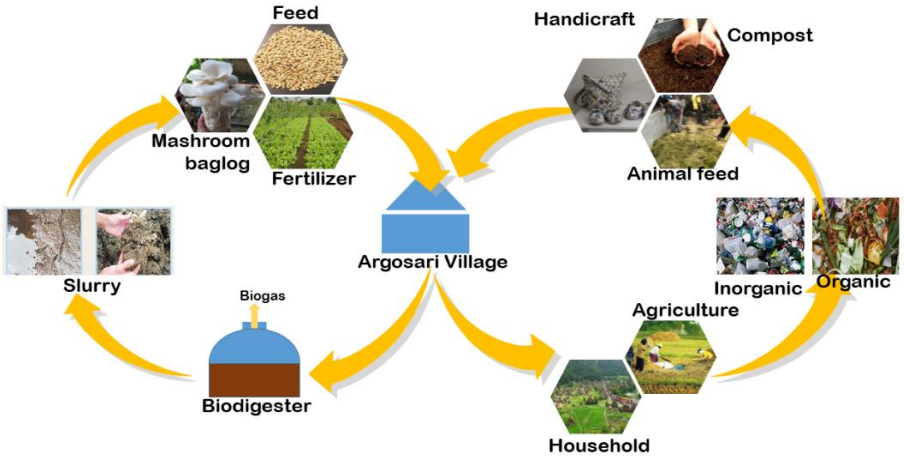

Figure 1. Octane Cycle Concept Scheme

1. *Training Stage I*

a. Liquid and Solid Fertilizer Production Training
This training was conducted through hands-on practice with community members. The slurry was separated using a press tool into solid and liquid components. The liquid slurry was left to settle for 24 hours post-pressing to remove methane gas before use as plant fertilizer. This was followed by direct application of both types of fertilizer to plants such as chili, tomato, eggplant, water spinach, and mustard greens.

b. Fish Feed Production Training
Fish feed production used solid slurry, chicken entrails, and bran. The materials were mixed, ground using a pellet machine, and sun-dried for 3–4 days. Training involved full practical sessions with the community.

c. Planting Media Production Training
This included two types of planting media:
- Potted Plant Media: A 1:1 mixture of solid biogas slurry and soil placed into polybags.
- Mushroom Cultivation Media (Baglog): A mixture of sawdust, lime, and slurry biogas was packed into heat-resistant plastic and sterilized by steaming at 100°C for 8–10 hours to eliminate harmful microorganisms.

2. *Training Stage II*

The application of the Octane Cycle Concept to household and agricultural waste involved the separation of organic and inorganic materials for further processing into animal feed, compost, and handicrafts. This sorting was carried out directly by the villagers, with the mosque youth of Argosari Village acting as coordinators for collecting waste at the centralized Waste Processing Unit. Training and mentoring were conducted during this stage. The training methods provided to the target community were as follows:

a. Animal Feed Production Training
Training was conducted through practical sessions with community members. Agricultural waste such as rice straw, corn stalks, and cassava residues—abundant in Argosari—was collected and fermented into ruminant livestock feed. The fermentation process lasted 21 days with the addition of probiotics and urea in the following ratio: 1 ton of rice straw + 2.5 kg of probiotics + 2.5 kg of urea. The process was carried out in a closed space, away from direct sunlight.

b. Compost Production Training
Compost production was conducted by mosque youth at the centralized Waste Processing Unit in Argosari Village. The separated organic waste from households and agriculture was processed into compost using the Takakura method, which is aerobic, dry, and odorless—making it cleaner and allowing the bins to be kept in kitchens.

c. Handicraft Production Training
Handicraft training was specifically provided to female mosque youth. The materials used included inorganic waste such as plastic, cardboard, and rubber, which were recycled into crafts such as bags, pencil cases, brooches, and piggy banks.

2.4.3. Erterpreneurship Training

This stage aimed to provide the target community with direct understanding of entrepreneurship, including production processes such as manufacturing, packaging, and marketing. Through this training, it was expected that the community could generate additional income and improve their overall welfare.

2.5. Monitoring and Evaluation

Monitoring and evaluation aimed to observe the progress of the Student Creativity Program for Community Service. Through monitoring, challenges faced by community partners could be identified and resolved with appropriate solutions. The issues encountered and the solutions provided are shown in Table 1.

2.6. Cadre Development

The cadre development stage involved forming a management team for the Argosari Village Waste Processing Unit and conducting outreach activities for children in grades 4–6 at SDN Argosari (Argosari Elementary School). This was done through:

- Training in the use of inorganic waste to create crafts for elementary school students.
- Socialization on environmental cleanliness.

This early-stage education was intended to instill a zero-waste mindset in the younger generation of Argosari Village, ensuring the program's sustainability into the future.

2.Results and Discussion

The initial phase of the community service activity involved a structured socialization program aimed at introducing the concept of the Octane Cycle and the importance of zero waste practices. This activity was attended by 45 local residents, including members of the Family Welfare Empowerment (PKK), youth organizations, and village leaders. Participants were introduced to basic principles of waste categorization, organic decomposition, and the potential conversion of organic waste into energy-rich products. The session was highly interactive and generated interest among community members, many of whom had previously disposed of kitchen waste through burning or landfilling. Post-session feedback showed that 91% of participants found the material relevant and understandable, indicating the success of this initial step in building awareness. Furthermore, based on the results of the questionnaire distributed to participants in the socialization stages 1 and 2, the results showed that through this program, public knowledge regarding the implementation of zero waste increased. This can be seen in the figure 2.

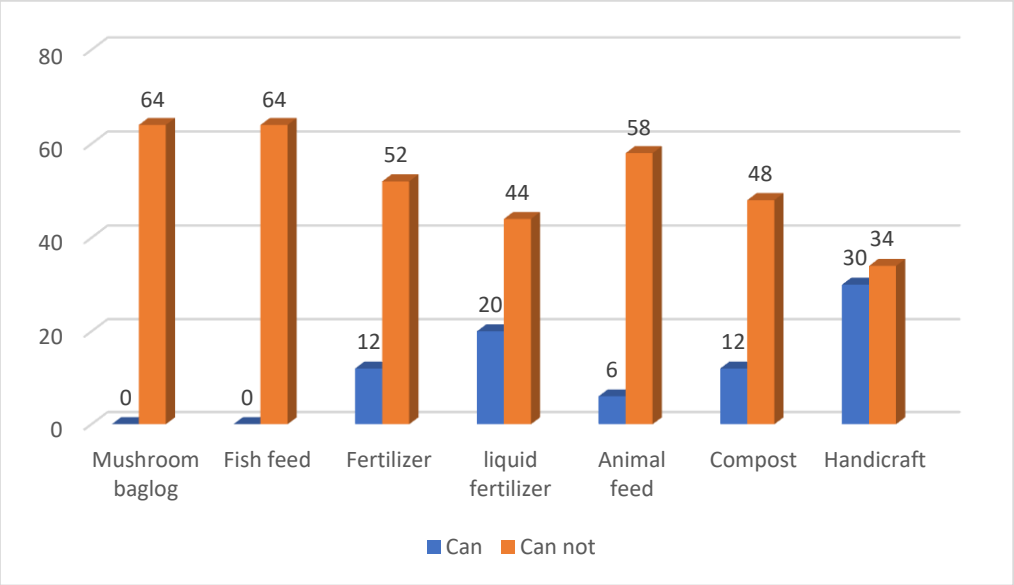

Figure 2. Pre-test results of implementing the zero waste program in Argosari village

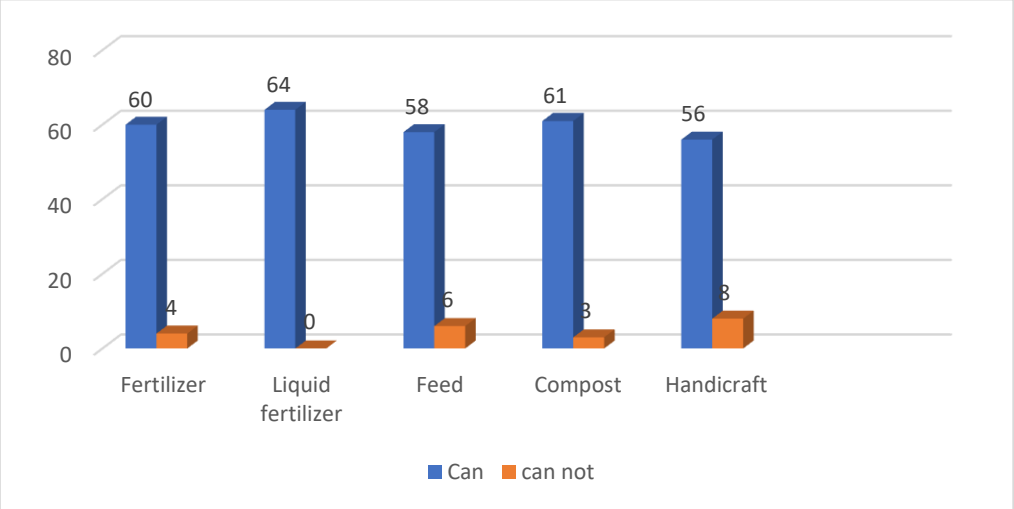

Figure 3. Post-test results of implementing the zero waste program in Argosari village

Following the socialization, the project advanced to the implementation phase, in which residents were trained in the Takakura composting method and the Octane Cycle application using household organic waste. Each household was provided with a Takakura box and guidance on how to convert daily kitchen waste into compost. Within 21 days, over 70% of participants reported successfully producing compost. Moreover, by integrating the Octane Cycle concept, selected waste was also processed into bio-additives, demonstrating the dual benefits of waste reduction and potential energy recovery. This hands-on implementation improved the community's technical skills in sustainable waste management and created a prototype model for zero waste practices in rural settings.

igure 4. Training in compost making using the Tarakura method and oyster mushroom cultivation

Monitoring and evaluation were conducted over a one-month period to assess behavior change, technical adoption, and waste reduction. Observations revealed a 50–60% reduction in household organic waste volume. In response to the sustained community interest, a local waste management committee was established, consisting of 7 core members responsible for routine monitoring, knowledge dissemination, and compost quality control. This committee was formed through consensus during a village meeting and received official endorsement from the village head. Their role will be pivotal in ensuring the continuity of the Octane Cycle practices and in scaling up to other neighborhoods within Argosari village.

Overall, the comparative analysis before and after implementation indicated significant improvement in waste handling and economic value generation. Prior to the program, most households spent IDR 50,000–70,000 per month on fertilizers. After compost production began, residents could save these costs and even produce surplus compost to share or sell. Additionally, households that experimented with Octane Cycle-derived additives for fuel mixing reported minor but measurable fuel efficiency improvements in small engines. The table below summarizes the economic impact.

3. Conclusion

Table. 1 Comparison of Conditions Before and After the Implementation of the Octane Cycle Concept

Type of Waste	Before	After & Benefit
Biogas Slurry	Not utilized	- Fish feed ingredient: Saved 48.3% of feed cost (IDR 82,500/day) - Planting media: Accelerated plant growth - Mushroom media (baglog): Created new jobs, reduced baglog production cost by 25% - Solid & liquid fertilizer: Replaced inorganic fertilizers, saved IDR 17,000/month, and IDR 2,000/day in vegetable purchases
Organic Household & Agricultural Waste	Disposed directly	- Compost: Reduced pollution, can be sold at IDR 2,000/kg - Livestock feed: Reduced feed expenses by IDR 15,000/day
Inorganic Waste	Burned/disposed	- Crafts: Reduced waste & air pollution, added mosque youth funds by IDR 30,000/month

The Octane Cycle Concept has proven to be an effective integrated strategy for waste management in Argosari Village. The program successfully reduced organic and inorganic waste by 51% within three months, involved 45 households in active participation, and generated measurable economic benefits including daily savings of up to IDR 82,500 and

monthly increases in income. The initiative also fostered youth empowerment through the formation of a local waste management unit and school-based environmental education.

Despite its success, the program faced several technical and social challenges, such as variations in compost quality and inconsistent participation during initial phases. Addressing these issues required flexible program adaptation and continuous mentoring.

This model offers strong potential for replication in other rural villages with similar waste generation patterns. Future iterations may benefit from digital monitoring tools and broader inter-village collaboration to scale up the zero-waste movement in Indonesia.

5. Acknowledgement

This work was supported by the Directorate General of Higher Education, Research, and Technology. The author also gratefully acknowledge the very valuable support of Singgih Mahardika, Nestya, Fajar Ardiansyah, and Diki Darmawan for their valuable help in preparing and execution this community service.

References

Anis Rosyiatul Husna, Pipit F. Wiliyanarti, Ine D. Putri, R. N. A.-Z. (2023). Community Empowerment: Processing Household Organic Waste into Compost Using the Takakura Technique. *Journal of Community Empowerment for Multidisciplinary*, *1*(1), 49–55.

Harjuni, F., Huda, M. A., Harahap, H. Y., Ramdhani, F., & Hermala, L. (2022). Utilization of Biogas Waste (Sludge) as an Alternative to Fish Feed in Teluk Roban Sorkam Village , Central Tapanuli Regency. *Jurnal Pengabdian Kepada Masyarakat*, *5*(2), 0–6.

Nurmalasari, I. M. A. S. C. I. R. (2023). Empowering Communities Through Household Organic Waste Management: A Case Study in Kajartengguli Village, Indonesia. *Indonesian Journal of Cultural and Community Development*, *14*(2), 6–14.