Saguling Empowerment Program: Community-Based Organic Waste Management Best Practices as an Effort to Preserve the Saguling Reservoir by PT PLN Indonesia Power UBP Saguling

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Abstract

Waste management, especially organic waste, remains a significant challenge in the Greater Bandung area. This study aims to analyze the role of community-based waste management in reducing organic waste generation at the Sarimukti landfill and its impact on the lifespan of the Saguling Reservoir. The research method involved analyzing primary and secondary data, including the amount of organic waste generated, the quantity of chicken feed produced from maggot processing, chicken farmers' income, and electricity production at Saguling Reservoir. Primary data were obtained from surveys of 26 Waste Bank Units throughout Greater Bandung and PT PLN Indonesia Power UBP Saguling, which initiated the Saguling Berdaya program. The results showed that the program successfully managed community organic waste using the maggot bioconversion method from 2023 to July 2025, achieving a total of 887.03 tons, with an average of 28.61 tons/month converted into layer chicken feed. The production of 50 kg/day of fresh maggots was used to feed 1,200 laying hens, which produced 62 kg of eggs/day. In 2024, PT. PLN IP UBP Saguling successfully collected 660.48 tons of organic waste. This result contributed to reducing the organic waste load at the Sarimukti landfill by 0.09% of the total organic waste, which was 724,598 tons. This implementation had a significant economic impact, as farmers were able to save Rp122,148,000.00 per month in feed costs. From an environmental perspective, organic waste processing contributes to a reduction in sedimentation at the Saguling Reservoir by 0.11-0.50%. This reduction in sedimentation has a direct impact on extending the life of the reservoir and enhancing the efficiency of electricity production, resulting in economic benefits of IDR 115,027,450 in 2023, IDR 247,713,748 in 2024, and IDR 183,338,955 in 2025. Thus, community-based organic waste management through the Saguling Berdaya Program not only supports environmental sustainability but also strengthens food security and provides economic benefits for the surrounding community.

Keywords: *Maggot, Livestock Feed, Organic Waste, Sedimentation, Saguling Reservoir.*

A. INTRODUCTION

Waste generation in the Greater Bandung area (comprising Bandung City, Bandung Regency, West Bandung Regency, and Cimahi City) in 2024 is expected to reach 1,384,226 tons/year, equivalent to 4.04% of the national waste generation. This waste is transported to the Sarimukti final processing site (TPA) located in Cipatat

District, West Bandung Regency. The Sarimukti TPA can accommodate 1,390 tons/day of waste, which accounts for a total of 1,400-1,600 tons/day of waste transported. In fact, only 30-40% of the waste is transported by the Regional Environmental Management Agency (Dinas Lingkungan Hidup/DLH), while the rest remains uncollected, resulting in people dumping waste into rivers. According to the Citarum River Basin Water Resources Management Plan (2016), the amount of waste dumped into the Citarum River is 8,763 m^3 per day.

The waste received at the Sarimukti landfill consists of a mixture of organic and inorganic materials, making it difficult to process effectively. Ideally, waste should be sorted based on its type and potential for utilization or economic value. With proper processing, only residual waste or the remains of sorted waste will be disposed of at the landfill. Such efforts may significantly reduce the volume of waste at the Sarimukti landfill, allowing it to operate at full capacity and preventing the community from dumping waste into the Citarum River, which flows into the Saguling Reservoir.

A reservoir serves as a water storage facility and a water supplier (Putri et al., 2023). The operational lifespan of reservoirs may be compromised by sediment accumulation (Juldah et al., 2023). The Saguling Reservoir is currently facing a critical reduction in its operational lifespan. The Saguling Reservoir, located in West Bandung Regency, serves as the site of the Saguling Hydroelectric Power Plant (PLTA).

Based on data from the Ministry of Environment and Forestry (KLHK, 2024), households are the primary source of waste in Indonesia, accounting for 56.24% of the total, with organic waste being the most significant component, reaching 39.23% of the total national waste. Organic waste originates from living organisms, such as food scraps and leaves (Adzim et al., 2023), and is naturally biodegradable (Rahmat et al., 2023). As the population increases, the volume of waste, especially household organic waste, has also increased significantly. Larger quantities of organic waste emphasize the importance of more integrated and source-based organic waste management.

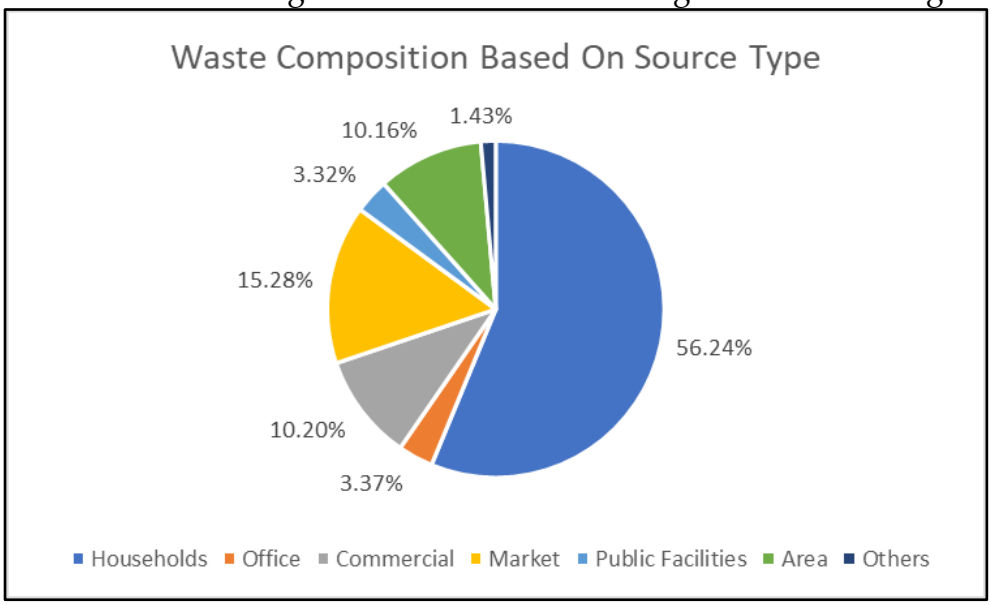

Figure 1. Waste Composition Based on Waste Source
Source: Ministry of Environment and Forestry, 2024

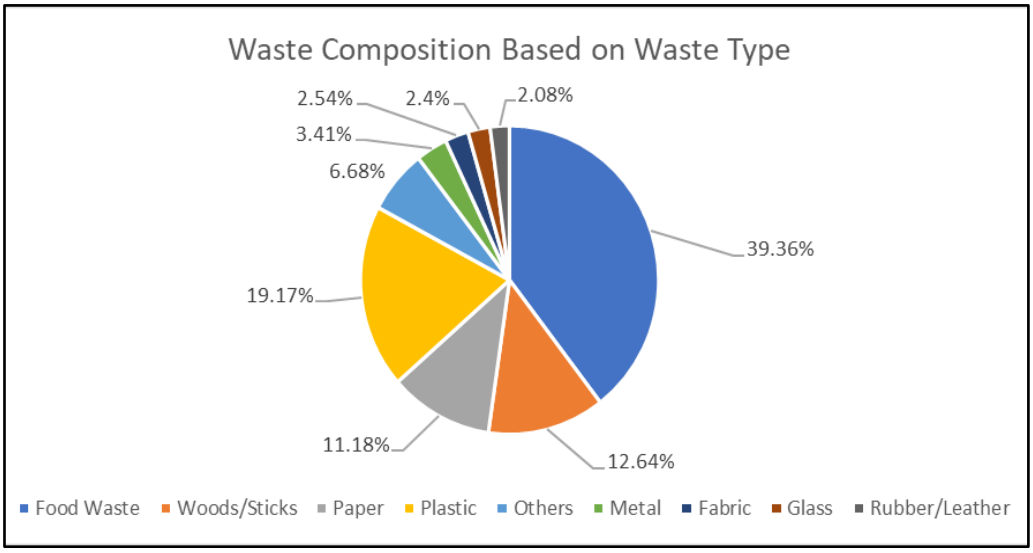

Figure 2. Waste Composition Based on Waste Type

Source: Ministry of Environment and Forestry, 2024

Organic waste that is not managed correctly has the potential to cause significant environmental impacts, particularly by accelerating sedimentation and eutrophication in water bodies such as reservoirs and rivers. According to Smith et al. (1999), the entry of organic matter into water bodies increases nutrient concentrations particularly nitrogen and phosphorus which triggers excessive algae growth (algal blooms). The decomposition process of algal biomass then consumes large amounts of dissolved oxygen, resulting in hypoxic conditions that are detrimental to aquatic organisms (Diaz & Rosenberg, 2008). In addition, settled organic particles contribute to the sediment load, accelerating siltation and reducing reservoir storage capacity, thereby threatening the reservoir's lifespan.

Organic waste management at the source is a crucial strategy to mitigate sedimentation in the Saguling Reservoir and alleviate the pressure on the Sarimukti landfill. Currently, organic waste at the Sarimukti landfill is not processed separately, but is mixed with other waste in the active zone. According to Hoornweg and Bhada-Tata (2012), reducing organic waste directly at the source through sorting and independent processing can reduce the burden on landfills while also reducing the risk of environmental pollution from leachate and greenhouse gas emissions. Sorting organic waste upstream also has other positive impacts on inorganic waste. Separated inorganic waste has better *value* and facilitates the recycling process in the future. Therefore, source-based organic waste management such as household composting or maggot bioconversion by the community is a more effective and sustainable solution than final disposal in landfills (Zurbrugg et al., 2012). The use of *Black Soldier Fly* (BSF) maggots as high-value economic biomass larvae can serve animal feed, particularly for laying hens (Khan et al., 2022). In addition to reducing waste volume, this technology supports the circular economy and strengthens local food security.

PT PLN Indonesia Power UBP Saguling, through the Saguling Berdaya program, has become the first company in Indonesia to provide a comprehensive alternative solution to waste management issues, covering the upstream, midstream,

and downstream processes. In the upstream phase, the program prioritizes a circular economy approach by involving 26 Waste Bank Units (Bank Sampah Unit or BSU) across the Greater Bandung area as collection points for waste sorted by the community. In the processing stage, organic waste collected from each waste bank is integrated and managed at four processing points to be used as maggot feed, livestock feed, and other derivative products–creating an environmentally friendly and economically valuable waste management chain. Meanwhile, in the downstream phase, the program focuses on environmental education and campaigns through various conservation events that involve multiple elements of society, including Waste Management Go to School (reaching 16,352 people), the Citarum Festival, Environment Day celebrations, and National Waste Awareness Day. More than just waste management, this program positions the Saguling Hydroelectric Power Plant as a national education and demonstration center for implementing environmentally friendly and sustainable practices to ensure the sustainability of the reservoir as a source of new and renewable energy.

B. LITERATURE REVIEW

1. Organic Waste from Saguling Reservoir

Waste is material left over from human activities or natural processes that has no further value and is discarded by its owner (Sigit, 2021). Organic waste originates from living things humans, animals, and plants such as food scraps, leaves, and agricultural waste. This substrate decomposed easily through microbial activity within a relatively short time. In practice, organic waste is classified into two types: wet (e.g., food scraps, feces) and dry (e.g., dry leaves, twigs) based on their moisture content (Prodyanatasari et al., 2024). Inorganic waste consists of non-living materials, such as plastic, metal, glass, and dust, which are generally difficult or very slow to decompose naturally. The decomposition process takes decades or even hundreds of years.

2. Community-Based Organic Waste Management

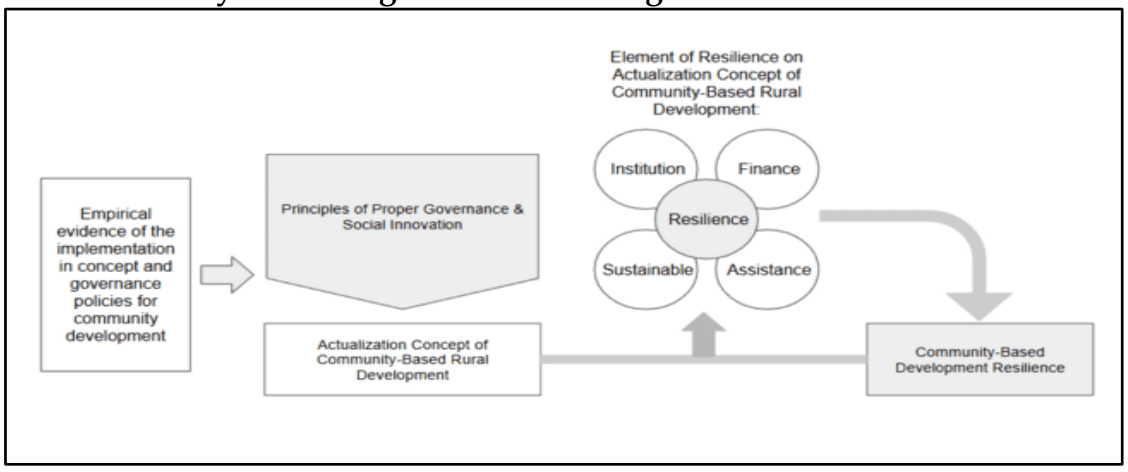

Figure 3. Community-Based Development Plus (CBD+)
Source: Purwanto et al. (2023)

Purwanto et al. (2023) explain that Community-Based Development Plus (CBD+) is a framework for rural community empowerment that emphasizes strengthening community capacity through the application of good governance principles and social innovation. It is based on empirical evidence from the implementation of existing community empowerment policies and concepts. The framework assesses the success of rural development not only through program implementation, but also through resilience–measured by four key elements: strong institutions, financial support, sustainability, and assistance. By integrating these elements, CBD+ aims to foster adaptive, inclusive, and sustainable community-based resilience.

3. Waste Management Hierarchy

The waste hierarchy is a framework that ranks waste management strategies from the most sustainable to the least desirable: prevention, reduce, reuse, recycle, recovery, and disposal. Its goal is to maximize material benefits while minimizing final waste, supporting energy conservation, reducing greenhouse gas emissions, and preserving resources. This approach emphasizes reducing waste generation at the source (e.g., sorting organic/inorganic waste early) and prioritizing reuse before final disposal.

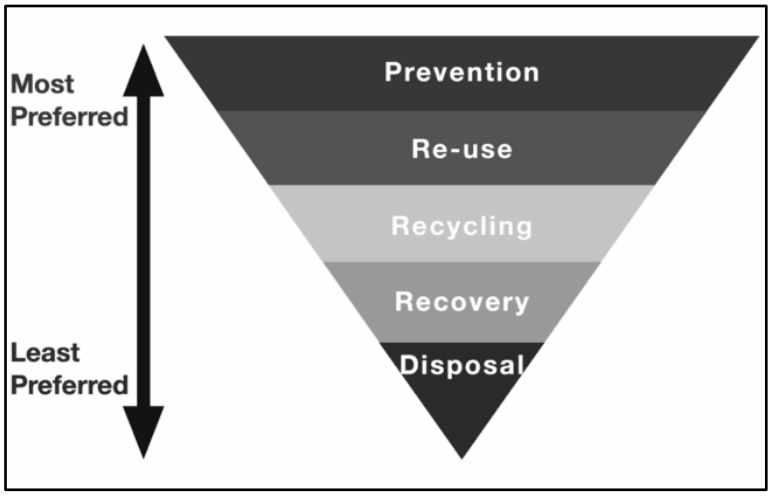

Figure 4. Waste Management Hierarchy

The implementation of waste management at Saguling Reservoir aligns with the following waste management hierarchy.

a. Prevention & Reduce

At this stage, the community is encouraged to sort organic and inorganic waste at the source, such as household organic waste, to facilitate effective waste management. This is essential to prevent mixing, ensuring that organic waste remains within an optimal management flow.

b. Reuse & Recycle

Recycling in the form of composting: Black Soldier Fly (BSFL) larvae, also known as maggots, can consume organic waste, reducing its volume by approximately 50% in a short period (Amrul et al., 2022). Reuse as animal feed:

Mature maggots contain a high protein level (above 35%–40%) and are suitable for use as poultry feed, including laying hens (Kahar et al., 2020).

c. Recovery

Transforming waste into two value-added products maggots as feed and frass as fertilizer is a powerful form of value recovery. This reduces reliance on disposal and fosters a circular economy that supports sustainability (Sukardi, 2025).

d. Disposal

By implementing the above approach, the amount of organic waste entering landfills is significantly reduced, making disposal a last resort when other operations fail to address residual waste (Pasymi et al., 2022).

Community-based organic waste management is a participatory approach that positions the community as the primary actor in sorting, processing, and utilizing waste at the local level (Wydya & Kartika, 2025). Bioconversion using Black Soldier Fly (BSF) larvae or maggots is a widely used method because it can process organic waste quickly, efficiently, and in an environmentally friendly manner. Maggots are the larvae *of* black soldier flies that can convert organic material from waste into economically valuable products (Auliani et al., 2021). Organic waste biomass is converted into larvae and residue. The larvae contain approximately 35% protein and 30% crude fat. The protein in these insects is of high quality and serves as an important source of feed for livestock (Dortmans et al., 2021). BSF larvae can reduce waste volume by up to 50% within 12–15 days, producing high-value biomass, such as maggots for animal feed, and residue (frass) as an organic fertilizer (Amrul et al., 2022). The conversion of organic matter yields protein-rich larvae for feed and nutrient-rich material for natural fertilizer.

In a community-based organic waste management scheme, the bioconversion process using Black Soldier Fly (BSF) larvae typically begins with the collection and sorting of organic waste at the source by community members, ensuring that only suitable materials (excluding plastic and contaminants) enter the cultivation container. Next, the sorted waste is placed in a biopond container, where BSF larvae are fed daily under optimal temperature (±27–30 °C) and humidity conditions to maximize larval growth. Within approximately 12–15 days, the larvae can reduce the volume of waste by around 50–70% while increasing the protein and fat content in their biomass (Satori et al., 2021). After that, the larvae are harvested and separated from the residue (frass) using a sieve. The larvae are prepared as animal feed, and the frass is processed as fertilizer. The residue also undergoes secondary fermentation to reduce the organic nitrogen content and increase stability as a biofertilizer (Amrul et al., 2022).

4. The Effect of Organic Waste on Reservoir Sedimentation and Electricity Production Time

Organic waste that enters water bodies undergoes decomposition by aerobic bacteria, which utilize dissolved oxygen in the water (Iswanto et al., 2007). When

organic matter levels are high, oxygen consumption increases, reducing dissolved oxygen and leading to a decline in water quality (Iswanto et al., 2007). Excessive organic matter can also trigger eutrophication, leading to increased biomass and organic sediment accumulation at the bottom (Patro et al., 2022). Sediment accumulation (including organic fractions) reduces the effective storage volume of reservoirs. The reduction in the effective capacity of the reservoir can limit operational flexibility, for example, during peak operating hours and the volume of water available for hydroelectric power plants (HPPs). Additionally, sediment can abrade turbines/intakes, reducing the operational efficiency of HPPs and increasing operational maintenance costs (Dorji & Ghomashchi, 2014), thus increasing electricity production time.

C. METHOD

This research was conducted in four regions: Bandung City, Bandung Regency, West Bandung Regency, and Cimahi City. These locations were selected because they deposit waste at the Sarimukti landfill. The research sites include one sub-district in Bandung City, six sub-districts in Cimahi City, one village in Bandung Regency, and six villages in West Bandung Regency.

The types of data used are primary and secondary data. The primary data required includes the amount of organic waste generated, the amount of chicken feed produced from maggot processing, the income of egg-laying chicken farmers, and data on sedimentation and electricity production at the Saguling Reservoir. Primary data were obtained through surveys of 26 waste banks and PT PLN Indonesia Power UBP Saguling, which served as the program organizer. In addition, secondary data on reservoir sedimentation were also required. Secondary data was obtained from a 2022 study by PT Indra Karya on sedimentation at the Saguling Reservoir.

Primary data was collected through direct observation and interviews with the community and relevant agencies. The sampling method used was purposive sampling, whereby samples were selected based on specific objectives or characteristics relevant to the study. Interviews were conducted with the communities managing maggot farming and PT PLN Indonesia Power UBP Saguling, which served as the program organizer.

The amount of household organic waste produced in the area around the Saguling Reservoir and processed through maggot farming was analyzed descriptively and quantitatively. The calculation was as follows.

Organic waste requirements for *maggot* feed	=	Number of *maggot farming* locations x (*Maggot farming* operation days/365 days) x Organic waste requirements in one cycle

After obtaining this value, we can determine the impact before and after *maggot farming*. The analysis can be done using the following formula (Sumarwoto, 2003).

$$\Delta Q = Qdp - Qtp$$

Explanation:
ΔQ = Impact
Qdp = Environmental conditions at time t "with the project"
Qtp = d Environmental Conditions at time t "without the project"

D. RESULTS AND DISCUSSION

1. Saguling Empowerment Program

The Saguling Berdaya Program was launched in 2023 in response to the current serious challenge of waste management in the upstream region, particularly due to low public interest and awareness regarding waste sorting at the source. The Saguling Berdaya Program is an initiative of PT PLN IP UBP Saguling, providing an integrated solution from upstream to downstream processing. In the upstream phase, the Saguling Berdaya Program prioritizes a circular economy approach by establishing 26 BSUs across the Greater Bandung area to manage community waste in the vicinity of the Saguling Reservoir. The waste managed consists of organic and inorganic waste. Organic waste is the most significant component of total household waste accumulation in this case study, specifically in the Greater Bandung area, which encompasses Bandung City, Bandung Regency, West Bandung Regency, and Cimahi City. If not properly managed, organic waste can cause various environmental problems, including air pollution due to unpleasant odors, increased greenhouse gas emissions (mainly methane from decomposition in landfills), and the spread of disease, facilitated by the growth of vectors such as flies and rats. Therefore, community-based organic waste management through the waste bank mechanism is a highly promising strategy for reducing environmental burdens while enhancing local economic value. Additionally, the community is increasingly encouraged and accustomed to sorting waste at home for productive utilization by the nearest BSU.

One of the innovations implemented in organic waste management by PT PLN IP UBP Saguling through the Saguling Berdaya program in 26 BSUs throughout Greater Bandung is maggot cultivation, specifically the larvae of the *Black Soldier Fly* (BSF), also known as *Hermetia illucens*. The use of BSF maggots produces feed that is used to feed residents' laying hens and sold commercially. The utilization of organic waste to create an economically valuable product in the form of maggots for animal feed is a solution at the processing stage carried out by PT. PLN IP UBP Saguling. BSF maggots are known for their extraordinary ability to consume and decompose large amounts of organic waste in a relatively short time. This process begins with sorting organic waste from households or markets, including food scraps, vegetables, and fruits. This waste must not be mixed with inorganic or hazardous materials such as plastic, metal, or chemicals, to avoid disrupting the maggot life cycle and maintain the quality of the final product.

After sorting, the organic waste can be fed directly to the maggot colony or fermented first using a bioactivator solution to increase its nutritional value. Maggots are kept in special containers placed in a closed cultivation area with good air circulation. Under ideal conditions, maggots can consume approximately twice their

body weight in organic waste daily. During the 10–14 day rearing period, maggots grow from young larvae into adult larvae that are rich in protein (around 40–45%) and fat (around 25–30%), making them a highly potential feed source for livestock, especially laying hens.

Once they reach optimal size, the maggots are harvested and usually dried through sun drying or a special oven to prevent the growth of pathogenic microorganisms. The dried maggots are then ground into flour or fed whole as a mixture in layer feed rations. Research shows that maggot-based feed can replace some or even all animal protein components in commercial feed without reducing egg production performance or egg nutritional quality. Additionally, the use of maggots as feed is more economical and environmentally friendly because it utilizes locally available organic waste.

At both the upstream and processing stages, an approach at the downstream level is also necessary. The Saguling Berdaya program has consistently carried out education as a strategic step to build public awareness of the importance of responsible waste management. This education aims to change the mindset and habits of the community, which has been littering, especially in waterways that flow directly into the Citarum River and Saguling Reservoir. These educational activities are conducted through various environmental conservation events held regularly, such as the Citarum Festival, Environment Day, and National Waste Awareness Day (HPSN), as well as education from an early age through the Waste Management Go to School program.

Waste Management Go to School is the first educational initiative in 32 junior high schools in West Bandung Regency, focused on early waste management education. This program has successfully reached 16,352 students with direct instruction on the importance of sorting waste, processing waste, managing household waste, and understanding the environmental impact of littering.

2. Organic Waste Generated by Communities Around Saguling Reservoir that is Managed

Organic waste managed by 26 waste banks under PT PLN IP UBP Saguling totaled 323,006 kg in 2023, 661,236 kg in 2024, and 481,174.5 kg from January to July 2025. Meanwhile, there are 15 BSUs that have been integrated into PT PLN IP UBP Saguling's program, with the following details.

Table 1. Waste Banks Integrated with the Organic Waste Program of PT PLN IP UBP Saguling

No	Waste Bank Name	Organic Waste Collected (kg)		
		2023	2024	2025
1	BSU Darul Halim	31,680	35,280	3,465
2	BSU Sinar Harapan	14,400	12,000	3,750
3	GPS Unit 16	8,977	10,464	9,744
4	BSU Pondok Mutiara	12,000	18,000	24,000

No	Waste Bank Name	Organic Waste Collected (kg)		
		2023	2024	2025
5	BSU Safamarwa	31,200	57,600	12,900
6	Phiesaw	0	0	7,820
7	BSU KOI RW 13 KBB	12,000	12,000	8,800
8	BSU Bukit Berlian	2,600	67,000	50,000
9	BSU Gogogreen	16,800	28,800	14,400
10	BS Manggotsuka	28,460	26,700	13,480
11	BSU Bukit Indah	8,800	10,560	1,320
12	BSU Puspa Resik Alami	5,532	6,966	4,987.5
13	BSU Tabula	24,300	36,000	28,200
14	BSU Hanjuang Wangi	0	64,000	96,000
15	BSU Sukamaju Sejahtera	3,210	25,200	840
TOTAL		196,749	410,570	279,706.5

Source: PT. PLN IP UBP Saguling, 2025

In its implementation, PT PLN Indonesia Power UBP Saguling has collaborated with 26 Waste Bank Units (BSU) across the Greater Bandung area. Of these, 15 BSUs have been integrated into the organic waste management program. This integration is achieved through weekly transportation using PT PLN's organic waste vehicles, which collect 1.2 tons per trip. The collected waste is then processed into chicken feed, generating economic value and increasing community income.

The total organic waste successfully collected from the 26 waste banks under PT PLN IP UBP Saguling's supervision is as follows.

Table 2. Total Organic Waste from 26 Waste Bank Units

Year	Total Organic Waste (kg)
2023	322,286
2024	660,486
2025	480,390
Total	**1,465,416.5**

Source: Primary Data, 2025

In practice, not all waste banks decompose their organic waste using BSF maggots. Some are processed into compost, ecoenzymes, or transported by third parties. The amount of organic waste through BSF maggot bioconversion is as follows.

Table 3. Total Organic Waste Converted into Animal Feed by BSF Maggots

Year	*Total Organic Waste (kg)*
2023	*196,749*
2024	*410,570*
2025	*279,707*
Total	***887,026***

Source: Primary Data, 2025

3. Community-Based Development at Saguling Reservoir

Organic waste management around Saguling Reservoir remains a significant challenge, directly affecting the quality of its ecosystem. The application of the *Community-Based Development Plus* (CBD+) concept in waste management through the establishment of 26 waste banks offers a strategic framework for achieving sustainable environmental management based on community empowerment.

The existence of 26 waste banks around the Saguling Reservoir has established an institutional network that functions as a hub for coordination, education, and operational waste management. This institution has facilitated waste sorting at the source through the maggot system and the distribution of processed products for animal feed and fertilizer. Surveys of maggot waste bank programs in several regions of Indonesia indicate that household participation increases when there are rules for periodic collection, profit sharing from product sales, and reporting of maggot and frass production indicators that mark a functional institution (Auliani et al., 2021; Sari et al., 2022).

CBD+ is a key factor in ensuring program sustainability. At Saguling Reservoir, funding for waste bank activities is sourced from member contributions, village funds, and the sale of derivative products, such as maggot feed and chicken eggs. Studies show a measurable increase in income among actors involved in utilizing organic waste at 26 waste bank sites through income diversification via the sale of compost, maggot feed, and eggs.

The processing of organic waste using *black soldier flies* (*Hermetia illucens*) effectively reduces the organic load entering reservoir waters, thereby reducing the potential for eutrophication and extending the reservoir's lifespan. Based on the analysis provided, the sustainability of the Community-Based Development Plus (CBD+) program at Saguling Reservoir is demonstrably strong, covering economic, social, and environmental aspects. From a financial perspective, this program not only reduces the volume of organic waste but also generates new income streams for the community through the processing of waste into high-value products such as maggot feed, eggs, and compost. This model creates a self-sustaining local economic cycle, minimizing reliance on external funding and supporting the continuous operation of the waste bank. Thus, financial sustainability is achieved through income diversification and the application of circular economy principles that transform waste into valuable assets.

Socially and institutionally, the existence of 26 community-managed waste banks reflects the strong independence and empowerment of the community. This institutional network forms a robust foundation for coordination, education, and program sustainability. Partnerships with various parties, including PT PLN IP UBP Saguling and the local government, reinforce the legitimacy and operational stability of this initiative. Environmentally, this program directly contributes to improving the quality of the Saguling Reservoir ecosystem by reducing waste entering it, in line with the waste management hierarchy. Through the synergy of strong institutional frameworks, stable funding, and sustained support, this program not only

successfully addresses waste issues but also serves as a replicable model for community empowerment.

Technical assistance and guidance provided by PT PLN IP UBP Saguling, environmental organizations, local governments, and universities have strengthened the capacity of waste bank managers. Program evaluations show that waste banks receiving regular assistance were able to significantly increase waste conversion using maggots and access local markets for feed and fertilizer more quickly. Waste banks that receive regular assistance tend to have more diverse product innovations and can survive despite fluctuations in feed or egg prices. The integration of the four pillars of CBD+ in 26 waste bank units has resulted in synergies that not only reduce the volume of organic waste entering reservoirs but also create local economic value chains.

The integration of the four pillars of CBD+ in 26 waste banks has resulted in synergies that not only reduce the volume of organic waste entering reservoirs but also create a local economic value chain. → The cycle of organic waste → maggots → layer chicken feed → layer chicken eggs → consumption of eggs reflects *c*ircular economy principles that are adaptable to the rural context. With a solid institutional foundation, stable financing, sustainable practices, and consistent mentoring, this CBD+ model has the potential to be replicated in other areas facing similar challenges.

The implementation of waste bank management groups in the area around the Saguling Reservoir serves as a key strategy in advancing integrated waste management, particularly organic waste. Through a partnership with PT PLN IP UBP Saguling, the waste banks focus not only on reducing waste volume but also on enhancing added value by processing waste into valuable products. The following coverage areas illustrate the scope of this initiative.

Table 4. Coverage Area of Waste Banks established by PT PLN IP UBP Saguling

No	Waste Bank Name	Location
1	BSU Darul Halim	Darul Halim Housing Complex, Cihanjuang Village, Parongpong Subdistrict, West Bandung Regency
2	Sinar Harapan BSU	Citapen Village, Cihampelas District, West Bandung Regency
3	GPS Unit 16	RW 16, Cihanjuang Village, Parongpong Subdistrict, West Bandung Regency
4	BSU Pondok Mutiara	RW 23, Cibabat Village, North Cimahi District, Cimahi City
5	BS Anjelir RW 17	Cigugur Tengah Village, Cimahi Tengah District, Cimahi City
6	BSU Safamarwa	RW 2, Sukamaju Village, Cigugur Tengah Subdistrict, Cimahi City
7	Phiesaw	Cisasawi Permai Housing Complex, Cihanjuang Village, Parongpong District, West Bandung Regency
8	BSU SEHATI	RW 3, Utama Village, South Cimahi District, Cimahi City

No	Waste Bank Name	Location
9	BSU KOI RW 13 KBB	RW 13, Cihanjuang Village, Parongpong District, West Bandung Regency
10	BSU Bukit Berlian	Bukit Berlian Housing Complex, Kertamulya Village, Padalarang Subdistrict, West Bandung Regency
11	BSU Marsa 7	RW 7, Cimahi Village, Cimahi Tengah Subdistrict, Cimahi City
12	BSU Korobokan	Korobokan Plot RT 1 RW 18, Citeureup Village, North Cimahi District, Cimahi City
13	BSU Gogogreen	Terusan Regency Housing Complex, Cimahi Village, Central Cimahi District, Cimahi City
14	BSU Bintang 9	Tanimulya Village Housing Complex, Tanimulya Village, Ngamprah Subdistrict, West Bandung Regency
15	BS Maggotsuka	RW 7, Padasuka Village, Cimahi Tengah Subdistrict, Cimahi City
16	Nanjung Jemar Lestari (Jurig Runtah)	Dara Ulin Village, Margaasih Village, Margaasih District, Bandung Regency
17	BSU Bukit Indah	Lembah Hanjuang Housing Complex, Sariwangi Village, Parongpong Subdistrict, West Bandung Regency
18	BSU Puspa Resik Alami	Puspa Regency Housing Complex, Batujajar Timur Village, Batujajar Subdistrict, West Bandung Regency
19	BSU Puspa Bukit RW 22	Bukit Permata Housing Complex, Cilame Village, Ngamprah Subdistrict, West Bandung Regency
20	Masagi	Cibogo Village, Sukajadi District, Bandung City
21	Pangauban Berkah Berseri	Pangauban Village, Batujajar Village, Batujajar District, West Bandung Regency
22	BSU Lavender	RW 19, Cigugur Tengah Village, Cimahi Tengah Subdistrict, Cimahi City
23	BSU Tabula	Bukit Lagar, Lagadar Village, Margaasih District, Bandung Regency
24	BSU Sikat	Nusa Hijau Housing Complex, RW 18, Citeureup Village, North Cimahi District, Cimahi City
25	BSU Hanjuang Wangi	Cibaligo Permai Housing Complex, Cihanjuang Village, Parongpong Subdistrict, West Bandung Regency
26	BS Sukamaju Sejahtera	Sukamaju Village, Padalarang Village, Padalarang Subdistrict, West Bandung Regency

Source: PT. PLN IP UBP Saguling, 2025

The distribution of 26 Community-Based Waste Banks across the Bandung Metropolitan Area in the vicinity of Saguling Dam illustrates the reach of community-managed waste services supported by PT PLN IP UBP Saguling's program. Each waste bank has regular customers who consistently deposit their waste. The number of customers at each waste bank is presented below.

Table 5. Coverage Area of Waste Banks under the Guidance of PT PLN IP UBP Saguling

No	Waste Bank Unit	Number of Customers		
		2023	2024	2025
1	BSU Darul Halim	15	19	24
2	BSU Sinar Harapan	10	21	29
3	GPS Unit 16	13	18	25
4	BSU Pondok Mutiara	24	39	48
5	BSU Anjelir RW 17	26	56	83
6	BSU Safamarwa	21	35	58
7	BSU Phiesaw	17	45	53
8	BSU SEHATI	16	27	34
9	BSU KOI RW 13 KBB	11	16	23
10	BSU Bukit Berlian	18	26	37
11	BSU Marsya 07	9	19	26
12	BSU Korobokan	7	17	24
13	BSU Go Go Green	21	37	53
14	BSU Star 9	26	47	63
15	BS Maggotsuka	12	18	28
16	Jurig Runtah	34	56	64
17	BSU Bukit Indah	46	75	87
18	BSU Puspa Resik Alami	19	46	65
19	BSU Puspa Bukit RW 22	10	25	40
20	MASAGI BSU	35	67	90
21	BSU Pangauban Berkah Berseri	26	94	193
22	BSU Lavender	35	65	84
23	BSU Tabula	27	65	73
24	BSU Brush	16	29	40
25	BSU Hanjuang Wangi	15	27	45
26	BSU Sukamaju Sejahtera	226	808	1061
Total		**755**	**1797**	**2450**

Source: PT. PLN IP UBP Saguling, 2025

Based on Table 5, there has been a consistent increase in the number of customers each year. In 2025, the total customers at 26 BSUs is 2,497 people. This shows that the benefits of the Saguling Berdaya program are becoming more widespread. To visually illustrate the distribution of locations, Figure 5 shows a map

of the 26 waste bank locations covered by the organic waste management guidance program in this area.

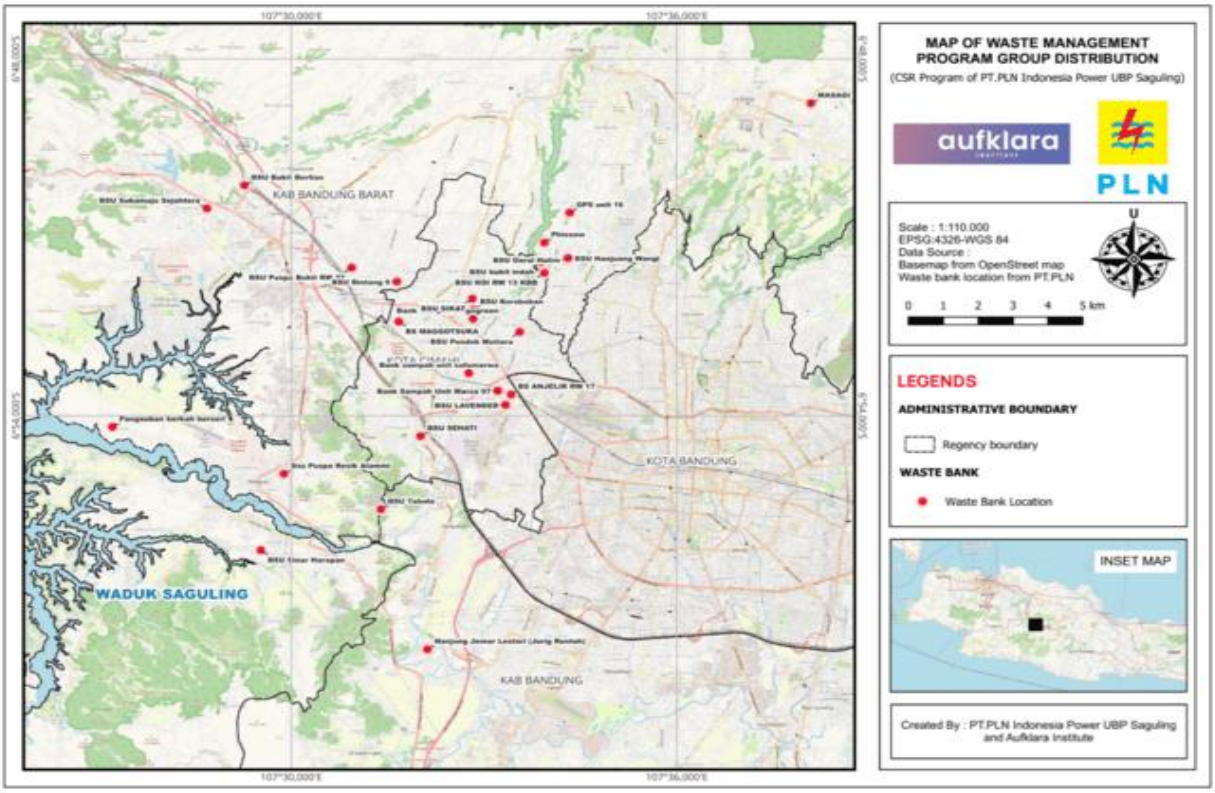

Figure 5. Map of the Distribution of Waste Banks Developed by PT PLN IP UBP Saguling

In its implementation, waste management at the waste bank established by PT PLN IP UBP Saguling has followed the *waste hierarchy* framework, encompassing prevention, reduction, recycling, and disposal. Further details are as follows.

a. *Reduce*
   Separation of organic and inorganic waste is carried out at 26 waste banks spread across four cities: Bandung City, Bandung Regency, West Bandung Regency, and Cimahi City. This separation has a positive impact on optimizing organic waste management.
b. *Recycle*
   Organic waste collected at 26 waste banks is given to maggots or *black soldier fly larvae* to decompose. *The maggots* are then consumed by laying hens. The transformation of organic waste into feed for laying hens is one example of *recycling*.
c. *Disposal*
   The decomposition of organic waste through the cultivation of maggots can reduce the volume of organic waste entering the Sarimukti landfill.

4. Environmental Impact of Organic Waste Management by the Community Around the Saguling Reservoir Through the Saguling Berdaya Program

Based on data obtained from the Ministry of Environment and Forestry (2024), projections were made for organic waste generated in Greater Bandung. Organic waste in the form of food scraps and twigs entering the Sarimukti landfill amounted to approximately 724,598.9 tons/year. The total waste generated at the Sarimukti landfill in 2024 is 1,384,226 tons/year, with organic waste accounting for 52.35%.

The 26 waste banks established by PT PLN IP UBP Saguling, spread across West Bandung Regency, Bandung Regency, Bandung City, and Cimahi City, are working to reduce the amount of organic waste entering the Sarimukti landfill. In 2024, these waste banks are projected to manage approximately 660.48 tons of organic waste annually. This organic waste is processed into maggots, which serve as feed for laying hens. However, the amount of waste converted into animal feed by BSF maggots in 2024 is 410 tons.

Based on Table 2, the total organic waste collected by the waste bank over the past three years amounts to 1,463,162 kg. Meanwhile, the organic waste processed by *maggots* into animal feed reaches 28.61 tons/month. The amount of organic waste decomposed by maggots is 28.61 tons/month. These maggots are then utilized as feed for laying hens. A total of 50 kg of fresh maggots is used daily to feed 1,200 laying hens, which are capable of producing approximately 62 kg of eggs per day, equivalent to around 1,080 eggs per day.

In 2024, the organic waste collected annually by 26 Waste Banks covered by PT PLN IP UBP Saguling's organic waste program totaled 660,486 kg/year, equivalent to 660.48 tons/year. During the same year, the total organic waste entering the Sarimukti landfill reached 724,598.9 tons/year. Based on this, the waste banks contributed to reducing the burden of organic waste entering the Sarimukti landfill by 0.09% in 2024.

5. Economic Impact of Organic Waste Management by the Community Around the Saguling Reservoir through the Saguling Berdaya Program

The utilization of organic waste in animal feed products through the Saguling Berdaya program by PT PLN IP UBP Saguling offers economic potential for residents, as farmers no longer need to purchase industrial feed. The Saguling Berdaya Program has 122 members, including 26 Waste Banks across Greater Bandung, which have managed 1,475,539 tons of organic waste between 2023 and June 2025. Through maggot farming, the concept of a circular economy can be realized–organic waste is processed into feed for chickens, which then produce eggs that can be consumed by residents or sold. This cycle not only reduces the amount of waste disposed of but also increases food self-sufficiency and community welfare. Substituting industrial feed with maggot feed has benefited chicken farmers. Within one month, they can save up to IDR 122,148,000.00, with monthly egg sales revenue of IDR 305,370,000.00 and a net profit of IDR 74,826,960.00.

Overall, the Saguling Berdaya program serves as a concrete example of the application of circular economy principles. This system transforms waste into

valuable resources, reduces dependence on synthetic feed and fertilizers, and strengthens food security and the local economy. However, the model also faces challenges, including the need for technical training, strict sanitation management, and policy support from local governments to enable broader and more sustainable implementation.

The effectiveness of this system has been demonstrated in various regions, including Indonesia, which continues to face significant issues with large-scale household organic waste. The waste management model, which utilizes community-based waste banks that integrate BSF maggot cultivation, demonstrates that this approach is not only effective in reducing waste volume and producing high-value products but also empowers communities and creates economic value (Maharani & Dinanti, 2025). Maggot bioconversion opens up local economic opportunities through the sale or utilization of maggot products and processed fertilizers. Therefore, community-based waste management through maggot bioconversion reflects circular economy practices that integrate social, economic, and ecological aspects of sustainability. The success of this approach is determined by residents' awareness in sorting waste at the source, the availability of cultivation facilities, and collaboration among community members.

6. The Effect of Organic Waste on Reservoir Sedimentation and Electricity Production Time

Organic waste management based on utilization at the source, currently being implemented in the Saguling Berdaya Program through the cultivation of Black Soldier Fly (BSF) larvae at waste banks, plays a crucial role in reducing the amount of organic waste that ends up in water bodies, such as the Saguling Reservoir. This reduction in organic waste input has a direct impact on sediment control. The organic material that would usually settle at the bottom of the reservoir is reduced, thereby slowing down the rate of siltation. With the reduction of sediment in the Saguling Reservoir, the water intake and processing capacity will increase, allowing for more efficient electricity production at the Saguling Hydroelectric Power Plant. The following calculation estimates the reduction in sediment deposited in the Saguling Reservoir and the benefits in terms of electricity production time at the Saguling Hydroelectric Power Plant, expressed in rupiah, with waste management at the source.

Area of Saguling Reservoir = 5,343.00 hectares

Sedimentation per Year = 1,733,714.00 m^3 (Sedimentation Study by Indra Karya, 2022)

Sedimentation per Hectare $= \frac{1.733.714{,}00\ m^3}{5.343\ hectares}$ = 324.48 m^3

The Saguling Berdaya Program focuses on the Saguling Reservoir water body, located near the entrance of the Saguling Hydroelectric Power Plant. Therefore, the area of the Saguling Reservoir that is positively affected by waste management is the area itself.

Program Area Size = 533.48 hectares
Program Area Sedimentation = 533.48 hectares x 324.48 m^3 = 173,104.16 m^3
Average Electricity Production of Saguling Hydroelectric Power Plant = 7,291,858.93 kWh/day
Electricity Selling Price = 489.42 per kWh
Electricity Selling Price in Rupiah = 7,291,858.93 kWh/day x 489.42 per kWh = 3,568,781,599.66 Rupiah/day = 148,699,233.32 Rupiah/hour

Table 6. Calculation of Sedimentation Reduction and Electricity Production Time Savings at Saguling Hydroelectric Power Plant from the Saguling Berdaya Program

Description	2023	2024	2025
Total Plastic Waste	15,850 kg	217,056 kg	108,528 kg
Total Organic Waste	382,742 kg	824,242 kg	610,042 kg
Total Dry Organic Waste Weight 20%	76,548 kg	164,848 kg	122,008 kg
Waste Specific Gravity	400 kg/m^3	400 kg/m^3	400 kg/m^3
Specific Gravity of Organic Waste	500 kg/m^3	500 kg/m^3	500 kg/m^3
Volume of Plastic Waste	40 m^3	543 m^3	271 m^3
Organic Waste Volume	153 m^3	330 m^3	244 m^3
Annual Sedimentation Volume	1,733,714 m^3	1,733,714 m^3	1,733,714 m^3
Daily Sedimentation Volume	4,749.90 m^3	4,749.90 m^3	4,749.90 m^3
Program Area Sedimentation	173,104.16 m^3	173,104.16 m^3	173,104.16 m^3
Percentage Reduction in Sedimentation Area Program	0.11	0.50	0.30
Comparison of Additional Production Time Related to Plastic Waste Management	0.2002 hours	2.7418 hours	1.3709 hours
Comparison of Additional Production Time Related to Organic Waste Management	0.7736 hours	1.6659 hours	1.2330 hours
Benefits of Plastic Waste on Additional Electricity Production Time	Rp 29,771,770	IDR 407,706,076	IDR 203,853,038
Benefits of Organic Waste on Additional Electricity Production Time	IDR 115,027,450	IDR 247,713,748	IDR 183,338,955

Calculation Method:

Waste Volume = $\frac{Waste\ Mass\ (kg)}{Waste\ Density\ (kg/m^3)}$

Percentage Reduction in Sedimentation Area Program = $\frac{Waste\ Volume\ (m^3)}{Program\ Area\ Sedimentation\ (m^3)}$

Comparison of Additional Production Time Related to Waste Management = $\frac{Waste\ Volume\ (m^3)}{Daily\ Sedimentation\ Volume\ (m^3)}$ x 24 hours

Plastic Waste Benefit Against Additional Electricity Production Time = Electricity Selling Price in Rupiah x Comparison of Additional Production Time Related to Waste Management

E. CONCLUSION

The Saguling Berdaya Program was initiated by PT PLN Indonesia Power UBP Saguling in 2023, covering 26 Waste Banks in the Greater Bandung area to manage community waste in the vicinity of the Saguling Reservoir. Organic waste is managed at the Waste Banks through maggot bioconversion, and the resulting material is used as feed for laying hens. Organic waste managed by 26 Waste Banks under PT PLN UP UBP Saguling from 2023 to 2025 (as of July) totaled 887.03 tons. In its implementation, organic waste decomposed by maggots and used as chicken feed amounted to 28.61 tons/month. The amount of organic waste decomposed by maggots is 28.61 tons per month. These maggots are then used as feed for laying hens. There are 50 kg of fresh maggots used as feed for 1,200 laying hens, which can produce 62 kilograms of eggs per day, or 1,080 eggs per day.

The processing of organic waste into maggots for chicken feed has had a significant impact on chicken farmers. Within one month, chicken farmers can save as much as IDR 122,148,000 per month by switching from industrial feed to maggots. Egg sales are reaching IDR 305,370,000 per month and a net profit of IDR 74,826,960 per month. Waste management in the Saguling Reservoir area is expected to reduce reservoir sedimentation by 0.11% in 2023, 0.50% in 2024, and 0.30% in 2025. Additionally, the reduction in sedimentation from organic waste provides electricity production time savings of IDR 115,027,450 in 2023, IDR 247,713,748 in 2024, and IDR 183,338,955 in 2025.

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