



## Evaluation of the CIPP Model in Waste Management in Lebak Regency, Banten Province



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**Abstract:** This study aims to evaluate the implementation of Lebak Regency Government policies and strategies in waste management as stipulated in Regional Regulation No. 4/2018 and Regent Regulation No. 30/2018. The management-oriented evaluation approach proposed by Daniel Stufflebeam, also known as the Context, Input, Process, Product (CIPP) model evaluation, is used to assess the context, input, and process of policy products related to waste management in Lebak Regency. The research method used is qualitative with a descriptive approach. Data were collected through documentation studies, field observations, and quantitative data from official reports. The evaluation results show that contextually, waste management policies are in line with the phenomenon of increasing waste generation due to population growth in Lebak Regency caused by urbanization that has an impact on changes in consumption patterns from community activities. However, the input of policies and strategies of the Lebak Regency Government in waste management are not in line with the processes carried out. Therefore, waste management policy products and strategies in Lebak Regency have not been running optimally including the provision of services and infrastructure facilities, increasing public awareness, and optimizing financial resources. Recommendations that can be given are to create a waste management system using a collaborative governance method.

**Keywords:** Policy evaluation; CIPP model; Waste management; Waste management facilities; Community participation; Financial resources; Collaborative governance; Circular economy

### 1 Introduction

Global emphasis on environmental sustainability and circular production has prompted many industries to re-evaluate traditional practices to reduce waste and improve operational efficiency [1, 2]. Waste is defined as materials that are no longer wanted or used by their owners; the large volume generated requires effective mitigation strategies [3, 4]. Population growth driven by urbanization has changed consumption patterns and significantly increased the volume of waste produced by community activities [5–7].

If not managed properly, waste causes environmental pollution and includes diverse types such as hazardous packaging and non-biodegradable plastics. Because commonly used plastics are not biodegradable, they tend to accumulate in landfills and the natural environment; widely used methods to reduce plastic volume include destructive thermal processes such as incineration or pyrolysis [8]. Similarly, organic waste, such as agricultural residues, household food waste, and human or animal waste, can pollute the environment if not properly managed. Through a circular economy approach, organic waste can be transformed into valuable resources such as biogas, compost, and liquid fertilizer [9–11].

In Indonesia, Article 28H paragraph (1) of the 1945 Constitution guarantees every person the right to a good and healthy living environment [12]. This includes waste management, particularly household waste and household-like waste. To implement this principle, the Government enacted Law No. 18/2008 on Waste Management [13], followed by Government Regulation No. 81/2012 on Household Waste and Waste Similar to Household Waste, and Presidential Regulation No. 97/2017 on its implementation.

Population growth and urbanization have changed consumption patterns and increased waste generation. Nationally, waste generation in 2024 reached 35,313,107.58 tons, of which 13,642,363.47 tons (38.63%) were managed, while 21,670,744.11 tons (61.37%) remained unmanaged [14]. The higher proportion of unmanaged waste indicates persistent problems in Indonesia's waste management, which are closely linked to local government performance in policy implementation.

At the regional level, integrated and comprehensive waste management requires a legal framework in the form of regional regulation to fulfill community rights and obligations as stipulated in Article 47(2) of Law No. 18/2008. Regional policymaking is further guided by the Regulation of the Minister of Environment and Forestry No. P.10/2018 on regional waste policies and strategies, and the Regulation of the Minister of Public Works No. 03/PRT/M/2013 on technical and funding strategies. In addition, the Ministry of Environment and Forestry issued Regulation No. P.75/2019 on the Roadmap for Waste Reduction by Producers, which targets a 30% reduction from 2020 to 2029 [15]. Based on these frameworks, the Government of Lebak Regency issued Regional Regulation No. 4/2018 on Waste Management and Regent Regulation No. 30/2018 on Regional Policies and Strategies for household and household-like waste management.

In Banten Province, total waste production in 2024 reached 2,159,859.18 tons across eight regions. The distribution was as follows: Tangerang City (798,405.91 tons), Serang Regency (438,206.52 tons), South Tangerang City (373,267.45 tons), Serang City (225,318.46 tons), Lebak Regency (219,931.19 tons), and Cilegon City (104,729.66 tons), while data for Tangerang Regency and Pandeglang Regency were unavailable [16]. Lebak Regency ranked fifth in waste generation. However, in terms of managed waste, it ranked second from the bottom at 24.72% in 2024, higher than Serang Regency (3.16%) but far below other regions, which exceeded 69% [17].

Several factors challenge waste management in Lebak Regency, including limited waste-management facilities [18, 19], low public awareness and participation [20, 21], and constrained financial resources. Effective policy implementation is essential to reduce waste generation. To assess whether waste management has achieved its objectives and produced positive environmental and social impacts, policy evaluation is necessary.

Despite the fact that previous research has reviewed the Context, Input, Process, Product (CIPP) evaluation model considering various aspects, there are still significant gaps in practice. Hakan and Seval focused only on one aspect of the methodological dimension and worked on the development as well as validation of a CIPP-based scale for curriculum evaluation along with an emphasis on the reliability and the statistical robustness of the instrument, rather than on its direct application to policy problems [22]. In contrast, Stufflebeam outlines the CIPP model as a scientific framework for educational and human service evaluations, indicating it as a decision-oriented tool that aims "not to prove but to improve," however, without empirical testing in particular governance contexts. The current study, nevertheless, utilizes the CIPP model to assess the implementation of waste management policies in Lebak Regency, Indonesia, with emphasis on context, input, and process dimensions in a local policy environment. Such a stance fills the void of literature in the field by demonstrating how the CIPP framework can be put into practice in environmental governance to uncover the disconnection of policy inputs and processes and provide suggestions that are feasible such as collaborative governance. In effect, this study thereby enlarges the coverage of previously published work by moving away from instrument and conceptualization toward practical policy evaluation and improvement in the local government waste management context.

A management-oriented evaluation approach can assist regional agencies responsible for planning, implementing, and assessing waste-management policies and strategies. The goal is to analyze each element in order to provide a clearer picture of the effectiveness and efficiency of existing policies. This study applies the CIPP model pioneered by Stufflebeam as a framework for evaluating waste management in Lebak Regency. The results are expected to provide evidence-based recommendations for improving future policies. Therefore, the problem identification in the waste management evaluation in Lebak Regency is how is waste managed in Lebak Regency? which includes problem questions, namely: How are the services and infrastructure facilities provided by the Lebak Regency Government in waste management? How is the involvement of the Lebak Regency community in waste management? Have the financial resources allocated to waste management met the needs?

## **2 Literature Review**

### **2.1 Policy Evaluation**

Waste management policies in every region in Indonesia take into account the funding, manpower, and costs involved. Waste management in Lebak Regency is no exception. Success and failure in waste management implementation are typically measured by the adequacy of the facilities needed to achieve results, and the presence of positive or negative factors that influence the implementation process is one of the reasons for the situation. It would be good if waste management implementation is successful based on positive factors, but if it fails due to an inability to analyze negative factors, it can lead to inaccurate proposed solutions. However, efficiently utilizing contemporary conditions and facilities can contribute to problem-solving [22].

Therefore evaluation is carried out to analyze these negative things. Evaluation in waste management is realized to define, clarify, and carry out a criterion and based on these criteria, to determine the objective value, quality, benefits, performance, and importance of evaluation [23]. In addition, evaluation is used to periodically check program effectiveness and identify areas for improvement as a continuous process [24]. Evaluation is divided into six group approaches such as goal-oriented, management-oriented, consumer-oriented, expertise-oriented, opponent-oriented, and participant-oriented approaches.

Let's start with goal-oriented evaluation. In understanding the proper role of evaluation, it is important to consider the goal program evaluation aims to achieve—a comprehensive evaluation program should serve multiple stakeholder objectives [24]. Besides education, it can also be used to evaluate other programs, with the main characteristic remaining the same: if an activity or program already has a goal to be achieved, the evaluation focuses on whether that goal has been achieved [25]. Perhaps this evaluation is more closely used as a model for evaluating waste management in Lebak Regency. However, it is known that waste management policies in Lebak Regency have not achieved the stated goals. For example, the Ministry of Environment has targeted 30% waste reduction in each region [15], while the waste reduction target in Lebak Regency by 2024 is only 3.15% [14].

Expertise-oriented evaluation, for example, traditionally, such as the design of a car's style is chosen based on expert assessments conducted by car manufacturers [26, 27], who assess product quality based on professional standards and experience. With a simple index, the expertise-oriented approach is too subjective to meet the need for precise consumer-oriented evaluation. That the suggestions and opinions of consumers, as buyers and users, can influence decisions about products to some extent [28]. Participant-oriented evaluation is to actively involve and empower service users in programs that directly impact them and their communities, designed to integrate literature and participant experiences in the revision and evaluation of existing programs to strengthen their suitability and effectiveness [29]. In waste management, the expertise-oriented approach, consumers, and participants are less appropriate to use. This is related to the community of Lebak Regency itself as consumers and participants, most of whom still consider waste to be useless waste. Of course, it is related to experts who have the expertise to socialize this to the community, but the problem has not been resolved.

Meanwhile, an opponent-oriented evaluation is conducted by bringing together two parties who are pro and contra to the program. The opponent approach emphasizes transparency by presenting the positive and negative sides of the program in a balanced manner. However, this research article, the evaluation of waste management in Lebak Regency serves to diagnose the strengths and weaknesses of policies and strategies to be implemented and determine the efficiency of the results after implementation. The purpose of collecting data related to the strengths and weaknesses of waste management in Lebak Regency is to ensure that policy makers decide whether policies and strategies should be revised, compared, continued, or completed [30]. The diversity in the development of waste management evaluations requires choosing the most appropriate model for the objectives and conditions or developing a model and utilizing it. It is very important to be aware of the fact that the adopted evaluation model and the accepted program planning model must comply, otherwise there will be inconsistencies and distortions between these models [31].

The management-oriented evaluation approach is one of the most important approaches serving the Lebak Regency Environmental Agency (DLH) (as a regional agency with duties and authority in the field of waste) which is responsible for planning, implementing, and evaluating programs. Stufflebeam has become a pioneer of the management-oriented evaluation approach so that it helps managerial decision-makers (in this case, the Lebak Regency DLH) to make the right decisions about the program [23]. The evaluation approach is known as the CIPP Evaluation Model.

The purpose of the CIPP model, which emphasizes the importance of process evaluation, is to examine all evaluation strategies and components and seek answers to questions such as: Is the evaluation design working well? What points might be problematic and how can they be addressed? Is there a more efficient way to collect data? [32] The strength of the CIPP model is that it is a useful and simple tool to help evaluators generate the most important questions to ask in an evaluation process. The CIPP model allows evaluators to intervene in the evaluation process when necessary, both before and during the program, and also allows for the evaluation of only one component [33]. A weakness of the CIPP model is the evaluator's inability to address some significant questions or issues. In planning evaluation procedures, evaluators need to consider available resources and time. If this model requires more time or resources than are available, another model may need to be considered [23].

## 2.2 Waste Management

Waste can basically be said to be a burden, but it can also be a valuable resource depending on how it is managed [34]. The concept of waste itself was initiated by humans and created from community activities. Many consider waste to be something less useful and valuable [35], but the author assumes that waste consists of the same materials as useful items, the difference is only in its value. The lack of value is caused by the mixing of waste and the unknown composition of waste. Anything that is discarded, rejected, ignored, unwanted, or unused material to be sold, recycled, reprocessed, repaired or refined by a separate activity that produces the material [36]. Therefore, waste that can be sold, recycled, reprocessed, repaired or refined by a separate activity can be valuable. Therefore, waste is

material that is discarded and reduced in value.

Waste has high value and is valuable, even equal to food [37]. If waste is managed properly, it can have added value, can be reused, and does not pollute the environment. Waste management is identified with engineering functions. Increased production has created problems that require landfills. Waste is generated during the extraction of raw materials and during the production process. After raw materials are obtained, more waste is produced during the processing of goods that will then be consumed by the community. The most effective way to reduce the waste problem is to reduce the amount and toxicity of waste produced. However, with the increasing desire for a better standard of living, humans have higher consumption levels and produce more waste. Consequently, society must seek effective waste management methods and ways to reduce the amount of waste that needs to be disposed of in landfills [38]. Article 4 of Law No. 18/2008 states that waste management aims to improve public health and environmental quality and to turn waste into a resource.

Solid waste management is a complex process encompassing many technologies and disciplines. It encompasses the technologies associated with controlling the generation, storage, collection, transfer and transportation, processing, and disposal of waste, in an acceptable manner consistent with principles of public health, economics, engineering, aesthetics, and other environmental considerations, as well as responsiveness to the general public [38]. Waste management fails when waste is too much, in the wrong places, not close enough to points of sale, or not sufficiently recycled [37]. The solution lies in redesigning products, packaging, and processes to make them suitable for input into the value chain. Initiatives and tools can also be used to support the success of sustainable waste management strategies.

In addition to strategic approaches through tools and initiatives, waste management uses the term waste hierarchy, a concept and priority tool that can guide the development of waste management strategies aimed at reducing resource consumption and protecting the environment. There are four waste management options: source reduction, recycling, waste-to-energy, and landfilling, which can be implemented interactively or hierarchically. In areas without a focus on economic aspects, waste management tools are selected based on the level of clarity of environmental acceptance. Source reduction will be the most important step to prevent waste problems from being managed. Recycling, including composting, will be the next management option because it can return resources to commercial use after the original product has no further use. Waste-to-energy is the next option because waste can generate energy rather than simply being burned or buried. Landfilling is the last option, which is neither better nor worse than incineration [38, 39].

### 3 Methodology

This study employs a qualitative approach with a focus on document analysis. The CIPP evaluation model developed by Stufflebeam was applied to analyze waste-management policies in Lebak Regency. The CIPP model fits better because it offers a more extensive and decision-dependent framework that looks at not only the results (as in the Logic Model and Result-Based Evaluation) but also the context, inputs, and processes that account for the effectiveness of the policy. The Logic Model highlights sequential cause-effect relationships and RBE concentrates primarily on the accountability of outputs and results, whereas the CIPP model gives the evaluators the opportunity to reflect on requirements, funds, quality of the implementation, and results at the same time.

The data sources consist of official documents related to waste management in Lebak Regency, including policy documents and annual reports. Only government-issued official documents were used. These documents are categorized into three aspects: first, political, primary documents on regional strategies and policies such as regional and regent regulations; second, financial, documents from the Central Statistics Agency (BPS) and the Regional Financial and Asset Management Agency (BPKAD) from 2020–2024; and the third, waste management, data from the National Waste Management Information System (SIPSN) managed by the Ministry of Environment of the Republic of Indonesia (2020–2024) and the Regional Environmental Management Performance Information Document (DIKPLHD) of Lebak Regency (2024) obtained from the Lebak Regency Environmental Service.

Data were analyzed using thematic analysis, involving coding based on existing policies and triangulation by comparing findings from different document sources. To ensure validity, several measures were taken, including an audit trail to guarantee that the research process was accountable and transparent. Internal validity was further ensured through the clarity and consistency of the document analysis. Although this study did not directly involve human participants, the confidentiality of all documents was maintained, and the data were used solely for research purposes. Documents obtained from government agencies and related institutions were analyzed objectively without altering their context or content. A limitation of this study is the difficulty in obtaining data on the number of waste-processing facilities operated by individuals or community organizations, as well as documents related to cooperation in waste management between the Environmental Agency and private parties.

## 4 Result and Discussion

### 4.1 Context Evaluation

Context evaluation assesses needs, problems, assets, and opportunities within a defined environment. The needs dimension refers to what is required to achieve sustainable goals. The problems dimension relates to barriers that must be addressed to meet these needs. The assets dimension refers to available expertise and services, usually at the local level, that can support the achievement of goals. Finally, the opportunities dimension includes funding programs and other resources that can be leveraged to meet needs and overcome challenges [39].

The context of this study is household and household-like waste management in Lebak Regency. Lebak Regency covers 3,312.64 km<sup>2</sup>, or about 31.51% of Banten Province, making it the largest district in the province. Population growth in Lebak Regency has altered consumption patterns and economic activities, leading to increased waste generation. Specifically, population growth has directly contributed to rising waste production, as shown in Table 1.

**Table 1.** Population, growth rate, population density, and waste generation in Lebak Regency 2020–2024 [40]

Year	Total Population	Growth Rate (%)	Density (/km <sup>2</sup> )	Waste Generation (Tons/Day)	Waste Generation (Tons/Year)
2020	1,386,793	1.38	455	514.26	187,706.21
2021	1,407,857	2.03	426	-	-
2022	1,433,853	3.39	471	591.47	215,885.24
2023	1,433,698	1.22	420	597.99	218,266.50
2024	1,449,205	1.11	437	602.55	219,931.19

Table 1 indicates that population growth from 2020 to 2024 is directly proportional to the increase in waste generation. Beyond higher waste volumes, changes in consumption patterns have produced a heterogeneous waste composition. Waste is dominated by organic materials (57%), such as food waste, wood/twigs, paper/cardboard, and rubber/leather. Inorganic waste accounts for 38%, including plastic, metal, textiles, and glass, while the remaining 5% is classified as other waste. The detailed composition is shown in Table 2.

**Table 2.** Waste composition based on waste type in Lebak Regency [41]

Organic Waste		Inorganic Waste	
Leftovers	30%	Plastic	15%
Wood/Twigs	12%	Metal	8%
Paperboard	10%	Cloth	5%
Rubber/Leather	5%	Glass	10%
Other	5%		

The main issue in waste management in Lebak Regency is that managed waste cannot keep pace with growing waste generation. The regency has two final disposal sites (TPA), Cihara and Dengung, and two TPS3R facilities (Barangbang and Parungsari) that apply the 3R concept (Reduce, Reuse, Recycle) [42]. In 2024, Cihara TPA received 21,900 tons of waste, of which 21,535 tons were landfilled. Dengung TPA received 23,360 tons, with 22,995 tons landfilled [43]. Barangbang TPS3R processed 1,460 tons, managing 1,314 tons, while Parungsari TPS3R processed 730 tons, managing 693.5 tons [44]. Overall, the waste processed at TPAs and TPS3Rs still fell short of total waste generation in the same year. Poorly managed waste poses a risk of environmental pollution and negative impacts on public health. Moreover, both TPAs still rely on outdated landfilling methods.

Another major challenge is the low level of public awareness in addressing waste issues. Repeated practices shape community culture, and in Lebak Regency, it is still common to dispose of waste into rivers or on roadsides, or to burn it without sorting [42]. At the simplest level, sorting waste by type would facilitate processing, both by individuals and by businesses in the waste sector. As noted earlier, organic waste constitutes the largest share and could be converted into valuable products such as fertilizer, biogas, and animal feed if properly managed. Sorting would also simplify raw material collection for these industries and increase the volume of waste managed. Despite the existence of community movements promoting environmental conservation, overall public awareness and behavior regarding waste management in Lebak Regency remain low.

Addressing waste management challenges requires policies that provide a strong legal basis. Constitutionally, Article 28H paragraph (1) of the 1945 Constitution serves as the foundation for waste management. This was reinforced by Law No. 18/2008 on Waste Management, which provides the national legal framework. At the local level, Lebak Regency has enacted Regional Regulation No. 4/2018 on Waste Management as its primary policy



instrument. These legal frameworks represent key assets that the Lebak Regency Government, particularly the DLH, can utilize to achieve waste-management goals.

Another opportunity for the DLH lies in the funding allocated by the regional government through the Regional Revenue and Expenditure Budget (APBD) for the waste-management sector. According to Regional Regulation No. 5/2019 on the Lebak Regency Medium-Term Development Plan for 2019–2024, the budget allocated for waste management amounts to IDR 36,924,503,800, or approximately IDR 7.3 billion per year [45]. However, funding optimization, whether through contributions from business actors or by converting waste into products of economic value, has not yet been maximized.

Therefore, considering the existing problems, assets, and opportunities, waste management in Lebak Regency should prioritize the development of modern final waste-processing facilities such as Integrated Waste Processing Sites (TPST), Composting Houses, and Waste Banks, distributed evenly across villages. Community education programs on waste sorting and collection are also essential as the first step in managing waste at the source. In addition, sustainable optimization through levies or partnerships, using collaborative and circular economy approaches, could generate regional revenue that can be reinvested into local waste-management programs.

## 4.2 Input Evaluation

The primary purpose of input evaluation is to determine which programs, projects, or interventions can best improve services for the intended beneficiaries. It also assesses proposed strategies, work plans, and budgets, while critically examining relevant approaches, including those already in use. Input evaluation thus serves as a precursor to the success, failure, or efficiency of change efforts. Initial resource-allocation decisions may limit improvement opportunities, as even potentially effective solutions cannot have an impact if planners fail to identify and evaluate their benefits [39].

In Lebak Regency, waste management efforts are guided by a predetermined work plan aimed at achieving specific policy targets and objectives. Addressing waste generation requires two key activities: waste reduction and waste handling. According to Attachment II of Regent Regulation No. 30/2018, the waste-reduction and waste-management targets for 2020–2024 are outlined as follows.

**Table 3.** Waste reduction and management targets in Lebak Regency 2020–2024 [46]

Indicator	Year				
	2020	2021	2022	2023	2024
Waste reduction target	20%	30%	35%	40%	43%
Waste management target	15.5%	17%	18%	19.5%	20%

To meet the targets shown in Table 3, specific policy objectives are required, particularly in relation to the provision of adequate facilities and infrastructure to support program success. Based on Attachment III of Regent Regulation No. 30/2018, the policy objectives for achieving waste-management goals in Lebak Regency for 2018–2025 are as follows: Establishment of 2 Main Waste Banks (BSI); Establishment of 414 Waste Bank Units (BSU); Construction of 13 units of Waste Processing Facilities (TPS) with the 3R concept (Reduce, Reuse, Rycyle) or TPS3R; Leadership capacity building; Institutional capacity building; Increasing the capacity of human resources for handling household waste in 483 villages; and The budget allocated for waste management is Rp. 32 billion, or Rp. 4 billion per year [46].

However, as of 2024, the actual facilities and infrastructure available for waste management in Lebak Regency are as follows: 2 landfill facilities (TPA) including TPA Cihara and TPA Dengung [42, 43]; 2 TPS3R facilities including TPS3R Barangbang and TPS3R Parungsari [45]; 1 Banjarsari Recycling Center (PDU) facility [42]; 1 BSI [42, 47]; 9 BSU according to the studies [48] or 66 BSU according to [42]; 10 informal sectors [49] or 67 informal sectors according to [42]; and 13 fleet of garbage trucks [50].

Based on the currently available facilities, Lebak Regency lacks sufficient resources to achieve its predetermined targets. Additional basic facilities are needed to ensure that managed waste can meet the goals outlined in the work plan. Existing infrastructure remains inadequate: of the 13 garbage trucks owned, only 11 are operational, and the fleet is generally outdated [50]. Moreover, facilities such as landfills (TPA), TPS3R, and the PDU still fall short of matching waste-processing capacity with the volume of incoming waste. Waste Banks (BSI and BSU) and active community groups are also unevenly distributed, being concentrated mainly in Rangkasbitung District, the administrative center of the regency. Further explanation is provided in the process evaluation section.

## 4.3 Process Evaluation

Process evaluation is essentially a continuous review of the implementation of a plan, including documentation of any modifications, omissions, or poor execution of specific procedures. Its purposes include providing feedback to staff and managers on whether activities are carried out on schedule, as intended, and efficiently; identifying

problems in implementation; and suggesting improvements. Since not all aspects of a plan can be determined at the project's outset, adjustments are often required when initial decisions prove inappropriate or invalid. Process evaluation also periodically assesses the extent to which participants accept and perform their roles. It should compare actual activities with planned activities, identify challenges, evaluate responses to those challenges, and analyze the costs of implementation [39].

In Lebak Regency, continuous review of waste-management policy implementation can be assessed through performance outcomes. As previously discussed, the context evaluation highlighted that population growth alters consumption patterns, thereby increasing waste production. The input evaluation outlined the waste-management targets for 2020–2024. The question now is: to what extent has implementation aligned with these planned targets? Performance achievements provide an evidence base for evaluating the work of the DLH, as follows.

**Table 4.** Waste management performance achievements in Lebak Regency 2020–2024

Year	Waste Generation (Tons/Year)	Managed Waste (Tons/Year)			Recycling (Tons/Year)	Unmanaged (Tons/Year)
		Subtraction	Handling	Total		
2020	187,706.21	31,307.69	33,580.00	64,887.69	7,094.57	115,723.95
2021	-	-	-	-	-	-
2022	215,885.24	8,686.89	40,880.00	49,748.89	7,426.24	158,710.11
2023	218,266.50	8,033.39	43,435.00	51,468.39	7,515.83	159,282.28
2024	219,931.19	6,920.43	47,450.00	54,370.43	6,464.86	165,560.76
Percentage (%)						
2020	100	16.68	17.89	34.57	3.78	61.65
2021	-	-	-	-	-	-
2022	100	4.11	18.94	23.04	3.44	73.52
2023	100	3.68	19.90	23.58	3.44	72.98
2024	100	3.15	21.57	24.72	2.94	75.34

Table 4 shows that from 2020 to 2024, the percentage of waste reduction in Lebak Regency steadily declined, while waste management increased. In 2024, waste reduction was only 3.15%, whereas waste management reached 21.57%. Compared to the 2024 targets, 43% for waste reduction and 20% for waste management [46], these figures indicate that the waste-reduction goal was not achieved, even though the waste-management goal was slightly surpassed.

Further analysis is required to evaluate waste-management performance in relation to the available infrastructure facilities in Lebak Regency. As noted in the input evaluation, these facilities include landfills (TPA), TPS3R (Reduce, Reuse, Recycle facilities), BSI (Main Waste Banks), and BSU (Waste Bank Units). However, no data were found on the volume of waste managed at the Banjarsari PDU. The performance of existing facilities in 2024 is presented in Table 5.

**Table 5.** Waste management facilities in Lebak Regency in 2024 [41, 43, 47, 48]

No.	Facility Name	Waste Intake (Ton/Year)
1	TPA Cihara	21.900,00
2	TPA Dengung	23.360,00
3	TPS3R Barangbang	1.460,00
4	TPS3R Parungsari	730,00
5	BSI Rangkasbitung	547,50
6	BSU Cipta Resik	13.200,00
7	BSU Anjaya	12.000,00
8	BSU Cimangeunteung	15.600,00
9	BSU Purnama	12.000,00
10	BSU Peduli Lingkungan	10.800,00
11	BSU Ciladaeun	4.800,00
12	BSU Maja Baru	9.600,00
13	BSU Pamumbulan	6.600,00
14	BSU Wanasari	7.200,00

Table 5 shows that the total volume of incoming waste reached 139,797.5 tons. Compared with the 2024 waste generation of 219,931.19 tons, there remains a gap of 80,133.69 tons that did not enter any processing facilities. Of

the total, only 54,370.43 tons were actually managed, leaving 85,427.07 tons unprocessed. Although Lebak Regency also has 67 informal facilities, their collective capacity is minimal, only about 115 kg per month each. This amounts to 92.46 tons per year, which is far below the unprocessed waste volume.

The waste gap is closely linked to the limited number of garbage trucks. Of the 13 trucks owned by Lebak Regency, only 11 are operational. Each truck can transport 4–5 tons per trip and complete 2–3 trips per day [50]. In total, this provides a transport capacity of about 139.60 tons per day, or 50,954 tons per year, with a maximum capacity of 165 tons per day or 62,225 tons per year. These figures demonstrate that the existing fleet is insufficient to transport the waste generated.

Another key element of the work plan is building human resource capacity for household waste management across 483 villages. This is especially relevant because organic waste, dominated by food waste, accounts for 30 percent of total waste. Training and mentoring programs on waste-sorting procedures at the household, Neighborhood Association (RT), and Citizens' Association (RW) levels are intended to ensure that waste is separated at the source. Proper sorting facilitates transportation to processing facilities and enables organic waste, particularly food waste, to be converted into valuable products such as fertilizer, biogas, and animal feed.

Were these activities implemented effectively? Field observations in several villages and discussions with residents revealed that the Lebak Regency Environmental Agency had not conducted such programs. Instead, similar initiatives were often found to be carried out by educational institutions as part of community service, for example, converting organic waste into compost and animal feed through the Black Soldier Fly (BSF) method in Citorek and Bayah Villages. Community groups specializing in environmental issues also reported that small-scale initiatives existed independently in several villages, without official involvement from the Environmental Agency. However, since these initiatives are not documented in official reports, they are not considered valid for the purposes of this study.

The role of communities at the household, neighborhood, and citizen levels remains suboptimal. Official documents contain no evidence of activities by the DLH aimed at strengthening community participation in waste sorting, collection, or processing, nor in optimizing infrastructure such as village-level temporary storage facilities. As a result, key capacity-building measures, such as public outreach, provision of segregated bins, training on sorting, and enforcement of sanctions against violators, have not been carried out.

With regard to funding, the process begins with the submission of the annual Work Plan and Budget (RKA) by the DLH to the local government. The RKA includes all operational expenses as well as allocations for infrastructure and facilities, including those related to waste management. The DLH's RKA for 2021–2023 is shown in Table 6.

**Table 6.** Work plan and budget of the Lebak Regency environmental service for 2021–2023 [51]

Year	Income	Expenditure		Total
		Operation	Capital	
2021	890,564,338	14,388,594,721	623,607,950	(14,121,638,333)
2022	1,058,381,338	15,336,381,337	7,721,721,500	(21,999,721,499)
2023	1,674,754,602	16,673,006,432	5,221,412,500	(20,219,664,330)

Revenue represents the income of the DLH from managing all environmental sectors, while expenditure covers operational costs required to ensure program implementation. The total reflects the funds requested by the DLH from the Lebak Regency Government to carry out planned activities. Nearly half of operational expenditures are allocated to employee salaries, for example, in 2023 personnel expenses amounted to Rp. 7,317,575,485. The remainder is used for goods and services. Meanwhile, capital expenditure funds are allocated for field operations such as land acquisition, equipment and machinery, as well as infrastructure including roads, networks, and irrigation [51].

From the budget proposal, the realization of the budget allocated to the Lebak Regency DLH, after the budget change process and specific funding for the waste sector, is as follows.

Table 7 indicates that the waste budget accounts for an average of only 1% of Lebak Regency's PAD, while the share of the DLH budget ranges between 20–30%. According to the Ministry of Environment and Forestry, however, waste-management funding should ideally amount to 3% of PAD to achieve optimal waste reduction and handling. Although the average allocation for 2021–2024, roughly IDR 4–5 billion per year, aligns with the targets set in the 2018–2025 waste-management work plan (IDR 32 billion total, or IDR 4 billion annually) [46], challenges remain. In particular, sustainable optimization requires leveraging levies and partnerships with the private sector and civil society.

Optimizing waste management through levies and partnerships is a practical strategy. The establishment of waste banks not only benefits communities economically but can also generate levy revenues for the Environmental Agency, which can be reinvested into waste-management programs. On average, waste banks earn around Rp. 1,555,000 per month, with maximum revenues reaching Rp. 4–5 million [42]. If the target of establishing 414 waste banks were met and evenly distributed, the potential benefits would extend beyond reducing waste generation to strengthening the



local economy. However, it is important to note that waste banks registered with SIPSN or DIKPLHD are limited to processing inorganic waste. For this reason, the establishment of additional infrastructure, such as Organic Processing Centers, Compost Houses, and other composting facilities, is strongly recommended to convert organic waste into valuable products. Given that organic waste accounts for 57% of total waste, with food waste alone making up 30%, there is a clear link between building such facilities and providing community training in waste sorting and collection to enhance the processing of organic waste by individuals, businesses, and community groups.

**Table 7.** Budget of the Lebak Regency environmental service for 2021–2024 [52]

Year	Local Own-Source Revenue (PAD)	DLH Budget	Waste Budget	Percentage (%)		
(A)	(B)	(C)	(D)	(C/B)	(D/B)	(D/C)
2021	385,144,019,220	15,255,988,529	4,045,461,000	3.96	1.05	26.52
2022	421,548,555,369	21,704,902,436	6,966,033,600	5.15	1.65	32.09
2023	434,292,734,733	17,438,852,798	1,962,091,000	4.02	0.45	11.25
2024	403,582,198,479	22,275,826,920	7,064,451,100	5.52	1.75	31.71

#### 4.4 Product Evaluation

Product evaluation seeks to measure, interpret, and assess achievements, determining the extent to which they meet the needs of intended beneficiaries [46]. Feedback on outcomes is essential throughout the activity cycle and at its conclusion, encompassing both expected and unexpected results, whether positive or negative. Such evaluations should analyze and compare findings to determine whether results justify the investment. Evaluators must also discern whether shortcomings stem from poor implementation or from flaws in the initial plan itself. Importantly, product evaluations should be grounded in the findings of context, input, and process evaluations [39]. Accordingly, evaluating waste management in Lebak Regency requires examining results from multiple perspectives, aggregate, subgroup, and, where relevant, individual.

The need for waste management in Lebak Regency arises from population growth, which alters consumption patterns and increases waste production. By 2024, total waste generation reached 219,931.19 tons. Regent Regulation No. 30/2018 set a target of 63% managed waste, 43% reduction and 20% handling. In practice, however, only 54,370.43 tons (24.72%) were managed: 6,920.43 tons (3.15%) through reduction and 47,450 tons (21.57%) through handling.

Waste reduction remains a major challenge for the Lebak Regency Environmental Agency. Article 3(2) of Regent Regulation No. 30/2018 stipulates that reduction efforts should include limiting generation, recycling, and reuse. Success in reduction depends on effective waste management, as the two are closely interrelated [46]. Article 3(3) of the regulation outlines that management encompasses sorting, collection, transportation, processing, and final disposal [46]. While the 2024 management target of 20% was met (actual achievement: 21.57%), this suggests that the current capacity of Lebak Regency's facilities is only sufficient to achieve the minimum goal and not to drive significant progress in waste reduction.

Targets for facility development included two BSI, 414 BSU, and 13 TPS3R units. In reality, by 2024 only one BSI, nine BSU, and two TPS3R had been established, alongside existing infrastructure such as two landfills (TPA), one PDU, a fleet of 13 garbage trucks (of which only 11 are active), and 10 informal sectors. Together, these facilities could receive 139,797.5 tons of waste. Their processing capacity, however, was much lower: 54,370.43 tons through TPA, TPS3R, and waste banks; 6,464.86 tons through the PDU; and only 92.46 tons through informal sectors. The 11 active garbage trucks had a transport capacity of 50,954 tons per year, with a maximum of 62,225 tons.

The gap between generated waste and the amount entering facilities totals 80,133.69 tons, meaning that this volume remains unmanaged in the community. The shortfall is largely due to the limited capacity of waste-collection facilities, which can transport a maximum of only 62,225 tons annually. To address this, Lebak Regency urgently needs to expand its infrastructure, particularly modern final-processing facilities such as Integrated Waste Processing Sites (TPST), additional TPS3R units, and evenly distributed waste banks in every village. Procuring more garbage trucks is also critical, as the current fleet is inadequate. Equally important is the establishment of Organic Processing Centers and Composting Houses, since existing waste banks handle only inorganic waste. At present, no facilities, whether run by government, communities, or businesses, are dedicated to processing organic waste.

A key policy target is to build human resource capacity for household waste management in 483 villages. This is critical because organic waste dominates overall waste composition at 57%, with food waste alone contributing 30%, followed by inorganic waste (38%) and other waste (5%). These figures show that households are the largest source of waste, particularly food waste. To achieve the goals of waste management, residents not only have rights but also obligations. Article 3 of Regional Regulation No. 4/2018 requires individuals at the household, neighborhood, and

village levels, along with local apparatus, to maintain environmental cleanliness by reducing and managing waste, for example, by providing containers or using materials that are reusable, recyclable, or biodegradable.

Capacity-building in waste management should include community training and mentoring to promote waste sorting and collection, as well as reduction activities at the household, neighborhood, and citizen levels. Article 5 of Regional Regulation No. 4/2018 emphasizes raising awareness, encouraging active participation, sorting and processing waste, and promoting waste reduction. However, field observations in several villages revealed that such activities were absent. This is problematic because community involvement is central to addressing waste issues, which largely originate at the source. Strengthening public awareness and active participation is therefore essential. Article 6 of the same regulation highlights the community's role in enhancing capability, independence, empowerment, and partnerships to pioneer waste reduction and management efforts at local levels.

The DLH's failure to educate the public on waste reduction and handling, such as sorting, collection, and processing, highlights the need for private-sector involvement. Educational institutions and business actors can play important roles. Article 7 of Regional Regulation No. 4/2018 assigns educational institutions the responsibility to provide knowledge and understanding to the public and students on environmentally sound waste management, conduct studies and research, and support government programs in the sector. Article 8 further outlines the role of business actors in sorting and processing waste, reducing waste, developing and providing technology, supplying infrastructure, innovating waste-processing methods, and supporting community-level waste initiatives.

To address these gaps, the DLH can adopt a collaborative approach for sustainable optimization by fostering partnerships among the public sector (DLH), private sector (educational institutions, business actors, community groups), and civil sector (citizens). This interconnected network system reflects the principles of collaborative governance, with DLH serving as a network broker linking stakeholders, facilitating communication with decision-makers, and coordinating inter-agency and cross-sector cooperation. Establishing dedicated forums focused on waste issues would further strengthen this system. If effectively implemented, such collaboration could address waste problems at their source while enabling private and civil actors to support the public sector with innovations in waste management.

Waste management in Lebak Regency is supported by a budget of Rp. 32 billion for the 2018–2025 work plan, equivalent to Rp. 4 billion per year. Between 2021 and 2024, funding from PAD sources averaged Rp. 5 billion annually, with 2024 recording the highest allocation at Rp. 7,064,451,100. This represents 1.75% of PAD, well below the Ministry of Environment and Forestry's recommended 3%. Although the allocations align with the work plan, service delivery, infrastructure development, and public-awareness programs remain suboptimal. The DLH must therefore formulate new strategies, such as sustainable optimization through levies on circular economy activities that transform waste into economically valuable products and generate regional revenue to reinvest in waste management.

Circular economy initiatives must go hand in hand with collaborative governance. A network-based system for waste management not only fosters collective awareness but also strengthens the role of business actors in the sector. Funding cannot rely solely on the Regional Budget (APBD); Article 41 of Regional Regulation No. 4/2018 authorizes local governments to collect levies for waste-management services. However, public awareness is critical to the success of this approach, particularly regarding household-level sorting and collection. Mixed waste is difficult to process, limiting opportunities for business actors. Consequently, most business participation in Lebak Regency, through waste banks and informal sectors, focuses exclusively on inorganic waste. Organic waste, which remains largely untapped, represents a significant opportunity to develop levy-based revenue streams for the local government.

## 5 Conclusion

Based on the results and discussion, waste management in Lebak Regency remains suboptimal. Population growth has been directly proportional to the increase in waste generation, but the volume of waste successfully managed continues to face serious implementation challenges. Managed waste, at 24.72%, is relatively low compared to unmanaged waste. Within this figure, waste reduction accounts for only 3.15%, far below the target of 43%, while waste handling reached 21.57%, slightly exceeding the 20% target but still low relative to capacity.

The suboptimal performance is largely due to inadequate services and infrastructure, such as waste banks and TPS3R facilities that fall short of work-plan targets, along with insufficient training and community outreach to raise awareness and participation. In addition, financial resources have not been fully optimized, particularly through levies and other mechanisms within the circular economy. Together, these limitations hinder the effective implementation of waste management in Lebak Regency.

The Lebak Regency Government, particularly the DLH, needs to formulate policies tailored to waste management needs. The following recommendations can be made: a) The establishment of modern waste processing facilities, such as TPSTs, is a priority, along with the provision of a fleet of garbage trucks, which is currently in urgent need. Furthermore, the provision of facilities that have not yet reached their targets, such as waste banks and TPS3R (Recycling Waste Management) needs to be thoroughly reviewed. If adequate, the DLH should establish a PDU (Public Work Unit), an organic processing center, and a composting/composting house. b) The network system was

established using a collaborative approach between the public, private, and civil society sectors. The DLH serves as a network broker for stakeholders, communicating with decision-makers, collaborating with other agencies, businesses, and the community. The establishment of a forum focused on waste management is a continuation of the network system. This is an effort to continuously educate and educate the public about waste sorting and collection at the household level. With the established network system and the formation of a waste forum, the Lebak Regency DLH can collaborate with youth groups and environmental NGOs to carry out these activities. c) In addition to raising public awareness of waste management, collaborative governance can be used to optimize financial resources. A potential untapped by the DLH is the utilization of organic waste. Organic waste can be converted into economically valuable products such as biogas, fertilizer, and animal feed.

### Author Contributions

Conceptualization, H.H.W.; methodology, H.H.W.; validation, H.H.W. and H.T.; formal analysis, H.T.; investigation, H.H.W. and U.S.R.; resources, H.H.W. and M.A.A.; data curation, U.S.R.; writing—original draft preparation, H.H.W. and H.T.; writing—review and editing, H.T., U.S.R., and M.A.A.; visualization, H.T.; supervision, H.H.W.; project administration, U.S.R. and M.A.A.; funding acquisition, H.H.W. All authors have read and agreed to the published version of the manuscript.

### Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

### Conflicts of Interest

The authors declare that they have no conflicts of interest.

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