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A Waste As An Economic Resource: The Potential Of Plastic Waste Management In Supporting A Circular Economy

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Abstract

Plastic waste is commonly viewed as an environmental burden, yet at the household level, it has a marketable value when sorted and distributed to the recycling market. This study aims to examine how waste banks generate the economic value of plastic waste, the factors that determine their sustainability, and whether the practice can be considered a circular economy, with an emphasis on the Riau context. The study employed a qualitative literature study approach. Data, consisting of eleven purposively selected journal articles and proceedings published between 2020 and 2026, were analyzed using thematic analysis, and discussed using the circular economy framework and Arnstein's ladder of participation. The study yielded four themes. First, the economic value of plastic waste is largely determined by the cleanliness and tidiness of sorting, while prices are determined by collectors, leaving households as price beneficiaries. Second, knowledge, socialization, and easily understood incentives determine participation, which in some cases only reaches the consultation stage. Third, hierarchical institutions and inter-level communication influence the flow of goods and information. Fourth, limitations in facilities, logistics, funding, and data recording hinder the contribution of waste banks. Evidence from Pekanbaru shows a similar pattern, but relies on three studies, two of which examined the same waste banks. Waste banks are better understood as community-based recycling nodes rather than evidence of a fully fledged circular economy. Strengthening efforts need to be directed at sorting quality. Certainty of incentives, partnerships with collectors, and integrated data recording.

Keywords: plastic waste; waste bank; circular economy; community participation; Riau

INTRODUCTION

The waste problem in Indonesia is an increasingly pressing environmental issue due to population growth, urbanization, and changes in consumption patterns. The increase in waste generation is not always matched by adequate management capacity,

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resulting in most waste ending up in landfills (TPA) without any sorting or processing. This situation has the potential to cause soil, water, and air pollution, as well as harm public health. Based on data from the National Waste Management Information System (SIPSN) in 2025, national waste generation will reach approximately 24.8 million tons per year. Of this total, only approximately 34.55%, or 8.5 million tons, is managed properly (Kompas.com, 2026). This situation is also evident in Riau Province. Waste generation in Riau is recorded at 3,818 tons per day, but only approximately 16% is optimally managed, while approximately 75% of TPA still use the open dumping system (kemenlh.go.id). At the city level, Pekanbaru faces similar challenges. Antin et al. (2025) reported that, based on data from the National Waste Management Information System (SIPSN), the proportion of managed waste in Pekanbaru City was 74.57% in 2022 and 2023, then decreased to 66.49% in 2024.

In Riau, plastic waste has become a center of attention. An advocacy staff member from WALHI Riau, quoted by Antin et al. (2025), considers plastic to be the type of waste that contributes most to environmental problems because it is difficult to decompose naturally, even though if sorted and recycled it has high economic value. From an economic perspective, plastic waste has two sides: if it is disposed of without sorting, it can cause environmental impacts that must be borne by others (negative externalities), while if sorted and cleaned, it can become a raw material that has economic value in the market. Meanwhile, management in Pekanbaru still relies on a collection, transportation, and disposal pattern. Based on information from the Environment and Sanitation Agency (DLHK) mentioned in Antin et al. (2025), approximately 1,000 tons of waste is produced by the city every day, with approximately 800 tons sent to the Muara Fajar landfill. This pattern causes the landfill to fill up quickly and requires new land, while ignoring materials that can actually still be utilized for economic value.

It is in this context that waste banks were established to bridge these two conditions. Minister of Environment and Forestry Regulation No. 14 of 2021 stated that waste banks are waste management facilities that adhere to the 3R principles aimed at education, behavioral change, and the implementation of a circular economy, as proposed by Yandri et al. (2024). Budiyarto et al. (2025) noted that by the end of 2022, there were 4,341 waste banks spread across 34 of 38 provinces, although their contribution to the management of recyclable waste was only around 7%. This large number with a relatively small contribution raises questions about the economic value and sustainability of waste banks, which require further research.

The literature on waste banks is growing rapidly, but it largely consists of case studies of single waste banks, such as those conducted by Afifa and Asteriani (2024) in Pekanbaru or Alfitri et al. (2026) in Padang, or national-level overviews such as those by Budiyarto et al. (2025). Yandri et al. (2024) even mention that empirical research

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examining sustainability indicators for waste banks is still very limited. This situation presents two shortcomings. First, the economic value of plastic waste is rarely discussed in depth; it usually appears only as context or as an argument that customers earn additional income. Second, three interrelated factors—economic value, household participation, and waste bank institutions—are often discussed separately. For Riau province, as far as the author has researched, there has been no synthesis linking the three.

It's important to note from the outset that only a small number of studies specifically address plastic, such as that conducted by Alfitri et al. (2026), while other studies address waste banks in general. Therefore, this study utilizes plastic as a lens to examine evidence regarding waste banks, and the evidence that is truly plastic-specific, namely the price list at one waste bank, is treated as an example, not as a comprehensive overview.

Based on these shortcomings, this study aims to (1) examine how the economic value of plastic waste is formed in waste banks in the context of a circular economy, (2) describe how it is managed in Indonesia and Riau based on previous research, (3) identify supporting and inhibiting factors and their consequences for the improvement of waste banks in Riau, and (4) evaluate whether the practice of waste banks has met the criteria of a circular economy. The contribution to be made is a theme-based synthesis that links the economic value of plastic, participation, and institutions in one analytical framework.

LITERATURE REVIEW

1.1 Circular Economy and Waste as a Resource

The concept of a circular economy shifts the perspective on waste, from the endpoint of one process to the input for the next. However, this concept lacks a single, clear definition. Kirchherr et al. (2017) analyzed 114 definitions and found that the circular economy was most often described as a combination of reduce, reuse, and recycle activities, while the need for systemic change was rarely highlighted.

1.2 Waste Banks in the Regulatory Framework and Literature

Antin et al. (2025) stated that community waste management still focuses on the collect-transport-dispose pattern, even though Law Number 18 of 2008 emphasizes the importance of the 3Rs (reduce, reuse, and recycle) with community participation. According to Yandri et al. (2024), this law, along with Government Regulation Number 81 of 2012, encourages community-based waste management, of which waste banks are one example. This hierarchical structure demonstrates that waste banks do not exist in isolation. Kubota et al. (2020) show that the primary intervention of the local government

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in Makassar was the establishment of a central waste bank, which aims to facilitate transactions between community waste banks and parties involved in recycling. The success of waste banks thus depends on downstream purchasing networks, and the local government has a role to play in developing these networks.

1.3 Community Participation

In many discussions, participation is considered a determinant of waste bank success, although its levels are rarely elaborated. Arnstein (1969) formulated a ladder of citizen participation, dividing it into three groups: non-participation, tokenism, and citizen power. The information and consultation stage includes tokenism, meaning that citizens are heard but their voices do not necessarily influence decisions. This framework was used by Antriyandarti et al. (2025), and it helps distinguish residents who simply deposit waste from those who participate in determining waste bank management. This study uses it to assess the quality of participation, not just the number of customers.

1.4 Previous Research

Previous research can be divided into three streams. The first stream focuses on economic impacts and participation. Antriyandarti et al. (2025) surveyed 118 village decision-makers from various regions and found that regular waste bank operations accompanied by training or outreach increased economic benefits at the 1% significance level. 70.3% of respondents assessed that the village's economic conditions had improved. However, the respondents were officials and managers, not customers, so the findings reflect the perceptions of decisionmakers.

RESEARCH METHODS

Research Design

This research uses a qualitative approach with a library research design. This design was chosen because the goal was to synthesize published findings, not directly measure customer behavior. This should be stated openly: the findings presented are the result of a synthesis and interpretation of the research of others, and therefore their strength depends on the quality and diversity of the sources reviewed.

Data Sources and Search Strategy

The data were sourced from journal articles and proceedings on waste banks, community-based waste management, and the circular economy in the Indonesian context. The search took place in November 2026 using web search engines and open journal portals. The keywords were “waste bank,” “circular economy,” “community participation,” “plastic waste,” “Pekanbaru,” “Riau,” “waste bank Indonesia,” and “circular

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economy plastic waste," in Indonesian and English. Sources were selected purposively based on four inclusion criteria: (1) discussing waste banks or community-based waste management in Indonesia; (2) containing empirical findings, reviews, or policy analyses whose methods could be traced; (3) published between 2020 and 2026; and (4) having verifiable bibliographic identity (author, journal, volume, year). Community service activity reports that did not contain analytical data, as well as sources with unclear bibliographic identity, were excluded. This process resulted in eleven articles (Table 1), supplemented by four theoretical and methodological sources: Kirchherr et al. (2017), Geissdoerfer et al. (2017), Arnstein (1969), and Braun and Clarke (2006).

Data Analysis Techniques

Data analysis used a six-stage thematic analysis according to Braun and Clarke (2006). In the first stage, the authors read each article to understand its context and findings. In the second stage, key information such as location, design, data, findings, and limitations was recorded in an extraction matrix and given initial codes. In the third stage, similar codes were grouped into potential themes. In the fourth stage, potential themes were analyzed. All articles were reviewed to ensure that no findings were forced. In the fifth stage, each theme was named and defined. In the sixth stage, the themes were reported and discussed using the circular economy framework and Arnstein's (1969) ladder of participation. All figures in the results section are sourced from the reviewed articles, and derived calculations by the authors are clearly marked.

RESULTS AND DISCUSSION

Overview of the Studies Reviewed

Eleven studies were analyzed across Sumatra, Java, Sulawesi, and the national scale, plus one global bibliometric study (Table 1). Three were located in Riau, all in Pekanbaru City, and two examined the same waste bank, the Mutiara Waste Bank. In terms of design, seven studies used a quantitative or mixed-method approach, while four used a qualitative or review approach. This distribution means that conclusions about Riau rely on a narrow evidence base, and this limitation is carried throughout the following discussion.

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Table 1. Summary of analyzed studies

No	Author (year)	Location	Design and data	Main findings
1	Afifa & Asterian i (2024)	Pekanbaru, Riau	Qualitative descriptive; observation, secondary data; 72 customers	Facilities are not yet sufficient; transportation is waiting for half to one car; data not entered SIPSN
2	Alfitri et al. (2026)	Padang	Mixed methods; structuration theory Giddens	High participation due to awareness and incentives; garbage collection service
3	Antin et al. (2025)	Pekanbaru, Riau	AHP; 17 respondents; interviews, FGD, observations	Persuasive communication is prioritized (46.8%); communication process is the biggest criterion (36%)
4	Antriyan dartiet al. (2025)	Rural areas, various regions of Indonesia	Online survey of 118 village decision makers; logit regression	Routine operations and training increase economic benefits; participation at the consultation stage
5	Budiyart o et al. (2025)	Regency in Indonesia	Review of literature and government documents	4,341 waste banks (end of 2022); contribution of around 7%; need infrastructure and

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No	Author (year)	Location	Design and data	Main findings
				management capacity
6	Kubota et al. (2020)	Makassar	Document review; semi-structured interviews	Central waste bank facilitate transactions with recyclers
7	Rachman et al. (2021)	Mauk, Tangerang	8-day survey; 96 household interviews ladder	94.4% want to be members; village level economic potential
8	Saffanah et al. (2025)	Pekanbaru, Riau	Qualitative case study; interviews, observations	Awareness is increasing; gold savings schemes are poorly understood; funding constraints and HR
9	Sari et al. (2025)	Sukoharjo	Binary logistic regression (50 samples); causal loop diagram	Knowledge and socialization influence participation
10	Yandri et al. (2024)	Tangerang South, Yogyakarta	Literature study; SEM; 143 members	24 valid indicators in five dimensions
11	Yusuf et al. (2026)	Global; Jakarta case	Bibliometrics; 1,604 Scopus articles	It requires institutional synergy, participation, and technical aspects.

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The Economic Value of Plastic Waste and Household Bargaining Position

The first theme answers the most fundamental question: where does the economic value of plastic waste come from? This value is not uniform. The Mutiara Waste Bank price list reported by Afifa and Asteriani (2024) clearly demonstrates this (Table 2). A clean mineral water glass is priced at IDR 4,000 per kilogram, four times the price of a dirty glass (IDR 1,000). A clean mineral water bottle is priced at IDR 1,500 per kilogram, while a dirty bottle is IDR 1,000. Clean plastic packaging is priced at IDR 1,000 per kilogram, while plastic packaging for oil and fragrance is only IDR 300 and plastic bags are IDR 200.

Table 2. Prices of selected plastic waste at Mutiara Waste Bank, Pekanbaru

Types of plastic waste	Code	Price per kilogram (Rp)
Clean mineral glass	G1	4,000
Dirty mineral water glass	G2	1,000
Clean mineral water bottle	G3	1,500
Dirty mineral water bottle	G4	1,000
Gallon	P15	2,000
Clean plastic packaging	P18	1,000
Paralon	P11	1,000
Plastic packaging (oil, perfume, etc.)	P7	300
plastic bags	P5	200
Mica	P13	200

Source: Afifa and Asteriani (2024).

The source article does not mention the effective date of the price list and references the 2018 Mutiara Waste Bank document as one of its data sources, so the prices may be from a longer period. The figures are read as a single point in time.

This pricing pattern has two implications. First, the economic value of plastic is essentially generated by household labor: washing, separating, and depositing it intact. Ministerial Regulation No. 14 of 2021, as cited by Afifa and Asteriani (2024), requires waste to be sorted intact and clean due to its higher economic value. As an illustration, using the author's calculations from Table 2, a deposit of 100 kilograms of mineral water

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bottles is worth IDR 400,000 if clean and IDR 100,000 if dirty. Second, waste banks and their customers act as price takers. Quality standards are determined by downstream collectors, and this is evident in the practice of re-sorting bottles into caps, mouths, and bodies to ensure they are acceptable to collectors (Afifa & Asteriani, 2024). In other words, Economically, households bear the costs of preparation in the form of time and water but have no bargaining power over prices.

To see whether price alone is enough to motivate households, consider the findings of Saffanah et al. (2025) at the same waste bank. Some residents chose to pay a monthly fee of Rp 15,000 to the Waste Management Agency because their waste was collected from their front door without sorting. Using the price list in Table 2, the equivalent of this fee would be approximately 10 kilograms of clean bottles or approximately 3.75 kilograms of clean glasses per month, not including washing and sorting time. These calculations are based on two separate articles, not a direct comparison, and are presented as analytical illustrations rather than field findings. Nevertheless, they help explain why price incentives alone are rarely enough to overcome the convenience of collection services.

Community Participation, between Depositing and Determining

While the first theme suggests that economic value depends on household labor, the second theme asks what motivates households to engage in it. The studies reviewed agree that participation is influenced by knowledge and socialization. Sari et al. (2025) found a significant influence of both in Sukoharjo, and Yandri et al. (2024) included customer knowledge as a valid social indicator. Evidence from Pekanbaru is in the same direction. Antin et al. (2025) explain that the establishment of waste banks at the neighborhood unit (RT) and community unit (RW) levels begins with an approach to the neighborhood unit (RT) and community unit (RW) heads, village heads, and prospective administrators such as women from the Family Welfare Movement (PKK) and Family Planning Villages (KB) before socialization to prospective members.

Knowledge alone is insufficient if the incentives are difficult to grasp. Alfitri et al. (2026) demonstrate that in Padang, high levels of participation stem from a combination of awareness and economic incentives. In Pekanbaru, however, Saffanah et al. (2025) observe a different reality. While a gold-savings scheme—implemented in collaboration with the state-owned pawnshop, Pegadaian—has successfully shifted how residents perceive the economic value of waste, interviews reveal that participants lack clear information on how the system functions. Residents are often unaware of the amount of waste required to earn a gram of gold; they perceive the accumulation process as too slow, and some prefer the more straightforward approach of paying a flat fee to a waste management organization. Furthermore, awareness is uneven, particularly among

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transient populations such as university students. From an economic perspective, this is a matter of certainty: incentives with an unquantifiable value are less effective than clear, cash-based rewards. The quality of participation presents another challenge.

Data quality is a weakness that is rarely highlighted. Antin et al. (2025) reported that SIPSN data for the Induk Hijau Lestari Terus Waste Bank showed that 730.00 tons of waste entered in 2019 and 2020, 2,011.52 tons in 2021, and 907.28 tons in 2022. The 730.00 tons recorded in two consecutive years equates to exactly two tons per day for 365 days, so it is reasonable to assume that these figures are estimates, not the result of weighing.

Operational and Sustainability Barriers

The most concrete obstacles were identified at the Mutiara Waste Bank. Afifa and Asteriani (2024) noted that storage facilities lacked partitions and unlabeled containers, while collection was only carried out when a single type of waste had reached half or one carload, as required by the company-level collectors. As a result, waste piled up, and according to the authors, this risked attracting cockroaches and rats.

From a funding perspective, Saffanah et al. (2025) revealed that limited funding due to the social nature of the program was a major challenge to maintaining operations, coupled with a lack of human resource capacity. Afifa and Asteriani (2024) reported that the waste bank was launched as part of a corporate social responsibility (CSR) program managed by Pegadaian. Reliance on CSR needs to be considered as a potential risk to sustainability. Although the articles analyzed did not discuss the financial aspects of waste banks, this situation is important to note, as Yandri et al. (2024) confirmed that profitability, reinvestment, and efficiency are economic indicators of a sustainable waste bank. Budiyarto et al. (2025) also emphasized the importance of adequate infrastructure and capacity building for managers. In other words, literature sources demand business sustainability, while financial data from waste banks in Riau is almost unavailable.

Synthesis: Have Waste Banks Achieved a Circular Economy?

When viewed together, the four themes in Table 3 appear to form a chain. Downstream parties who set plastic prices make it difficult for household incomes to increase. Low incomes make incentives for waste banks less attractive than easier and more practical waste collection services. Consequently, residents are reluctant to participate, resulting in less waste collection, and this low volume makes it difficult for waste banks to meet collector requirements. However, this causal sequence is the author's interpretation based on findings from several separate studies,not the results of statistical tests.

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Table 3. Summary of themes and their implications for Riau

Theme	Main findings	Implications for Riau
Economic value and bargaining position	Clean plastic is priced far above dirty plastic (mineral glass Rp. 4,000 versus Rp. 1,000 per kg), and it is the collectors who set the standards (Afifa & Asteriani, 2024)	Customers are trained to sort and wash plastic and are informed of the price differences; volumes are combined to strengthen bargaining position
Participation	Understanding and socialization influence participation (Sari et al., 2025); the gold savings scheme is still confusing for customers (Saffanah et al., 2025); community involvement has only reached the consultation stage (Antriyandarti et al., 2025)	The method of calculating incentives is made clear (kilograms per unit value); customers are involved in determining prices and shipping schedules.
Institutionaland data	Pekanbaru has a central waste bank with its units (Antin et al., 2025); Makassar has a central waste bank (Kubota et al., 2020); SIPSN data does not consistent	The main waste bank plays a role in connecting units with plastic buyers; reports are compiled from weighing results. and entered into SIPSN
Barriers and sustainability	Minimal facilities, new transportation only started after sufficient volume, and there was no income when operations stopped in 2020 (Afifa & Asteriani, 2024); funds and Limited human resources (Saffanah et al., 2025)	Funding sources are not only CSR; reinvestment and efficiency improvement plans are prepared

This raises a theoretical question: is all of this sufficient to constitute a circular economy? The reviewed literature is not unanimous. Yandri et al. (2024) view waste banks as a concrete example of a circular economy within the community, while Rachman et al. (2021), Sari et al. (2025), and Alfitri et al. (2026) also link the two. This research does not deny that waste banks fall into this category. The issue lies in the evidence: does the available data truly demonstrate a closed cycle? This difference of

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opinion stems primarily from definition. If a circular economy is defined as the 3Rs, waste banks partially fulfill them through recycling. If it is defined as a comprehensive system change, as criticized by Kirchherr et al. (2017) and described by Geissdoerfer et al. (2017), the available evidence is insufficient.

The results of the Arnstein ladder analysis add one important point. Residents derive economic benefits from waste banks at a low level of participation, as they simply deposit their waste and rarely participate in decision-making. However, if a circular economy is expected to generate equitable benefits, as Kirchherr et al. (2017) criticized regarding its weak social dimension, customer involvement in management should be included in the design from the outset. Furthermore, the studies reviewed do not address producer responsibility for plastic packaging. This highlights the limitations of a community-based approach and opens up opportunities for further research.

Based on all of this, there are five possible directions in Riau, each based on the evidence above. First, plastic sorting and washing training should include an explanation of the price difference so customers understand why clean plastic is more expensive. Second, incentive calculations should be understandable to customers, for example, by stating how many kilograms of plastic are equivalent to one gram of gold in a gold savings scheme. Third, the central waste bank in Pekanbaru could act like the central waste bank in Makassar by connecting with plastic buyers, so that small units do not have to wait for half a carload to be picked up. Fourth, consistent recording based on weighing and reporting to the SIPSN is needed so that waste bank contributions can be measured. Fifth, funding sources should go beyond CSR and should be supplemented by reinvestment and efficiency plans, similar to the economic indicators in Yandri et al. (2024). These five directions are proposals compiled from the literature, so their feasibility at each waste bank still needs to be proven through field research.

CONCLUSION

This research has addressed four main objectives. First, plastic waste has economic value through waste bank management, but this value is conditional on the level of cleanliness and the quality of sorting. Prices are generally determined by collectors downstream in the waste management chain, leaving households as price takers. For example, at the Mutiara Waste Bank, the price of a clean mineral water glass can be four times higher than a dirty one.

Second, the development of waste banks in Indonesia and Riau shows a similar trend. Although waste banks have expanded significantly, their contribution to national waste management with potential for recycling remains at around 7%. In Pekanbaru, waste bank operations also face several obstacles, particularly limited facilities, transportation logistics issues, and data recording systems.

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Third, the success of waste bank management is supported by several important factors, such as public knowledge, outreach activities, a clear incentive system, and a hierarchical institution that connects waste bank units with buyers. Conversely, several inhibiting factors include an incentive system that is difficult to understand, community participation that stops at the consultation stage, inconsistent data, and dependence on funding.

Fourth, waste banks are more accurately viewed as one node in a community-based recycling system that supports a circular economy. Therefore, the existence of waste banks cannot directly be used as evidence that the circular economy has been fully and comprehensively implemented.

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