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Sustainable Entrepreneurship Project (SEP)

Barriers and Drivers to Establishing Waste Management Enterprises in Developing Countries: A Case Study of Indonesia

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ABSTRACT

Indonesia faces a mounting waste management crisis, intensified by rapid urbanization, limited infrastructure, and low public awareness. While private-sector involvement is increasingly viewed as a critical component in addressing this issue, waste management enterprises in Indonesia continue to face considerable challenges. This research explores the barriers and drivers to establishing waste management enterprises in Indonesia through a qualitative, Grounded Theory approach. Semi-structured interviews were conducted with eight stakeholders representing different roles across the waste management value chain, including collection, processing, and venture development. The data was analyzed using open, axial, and theoretical coding to inductively identify and categorize key themes. The findings reveal five key domains influencing enterprise development: financial, legal, market, technical, and supply chain. Key barriers include high capital requirements, regulatory gaps, limited market demand, technological complexity, and fragmented supply chains. Conversely, drivers such as accessible funding opportunities, growing government support, eco-conscious consumer segments, operational innovations, and cross-sector collaboration offer pathways for enterprise growth. The study concludes by providing practical recommendations to foster a more enabling ecosystem for waste management enterprises and highlights areas for future research to support sustainable entrepreneurship in the sector.

Keywords: Waste Management, Sustainable Entrepreneurship, Indonesia, Barriers, Drivers, Private Sector, Grounded Theory, Qualitative Research.

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1. INTRODUCTION

Indonesia, the fourth most populous country in the world, generates an estimated 105,000 tons of solid waste daily, amounting to over 38 million tons annually. This figure is projected to rise to nearly 55 million tons per year by 2025 (World Bank, 2021). Compounding the issue, Indonesia ranked as the second-largest contributor to marine plastic pollution in 2015 (Jambeck et al., 2015). Approximately 346,500 tons of plastic waste are discharged annually into the marine environment from land-based sources in Indonesia (World Bank, 2021).

The immense volume of waste generated in Indonesia impacts various aspects of daily life. For example, landfills contribute significantly to greenhouse gas emissions, while both land and oceans suffer from pollution caused by toxic chemical components in waste. In severe cases, waste mismanagement can even lead to disasters. One such tragedy occurred in 2005 at the Leuwigajah landfill in Bandung, Indonesia, where heavy rainfall triggered a massive waste slide. The disaster buried 71 houses, claimed 143 lives, and became the second deadliest waste slide in history (Lavigne et al., 2014).

Although having serious issues in waste management, studies reveal that current waste management activities address only 0.004% to 2.9% of the country's total waste (Aprilia, 2021). This strikingly low figure highlights a major gap in the sector, particularly the limited involvement of key actors, including the private sector. Furthermore, research emphasizes that the private sector plays a crucial role in strengthening waste management systems, especially in areas such as waste segregation and reduction (Sharma & Malik, 2022). This underrepresentation suggests a missed opportunity to leverage private innovation and capacity in addressing the country's growing waste crisis.

Improving the waste management industry in Indonesia requires active participation from all stakeholders to establish and support waste management enterprises. Despite its importance, the sector remains underdeveloped, with limited understanding of the barriers and drivers involved in starting and scaling waste management companies. This knowledge gap significantly hinders efforts to foster entrepreneurship and innovation within the industry. As a response to this challenge, the research question for this study is: *"What are the barriers and drivers to establishing waste management enterprises in Indonesia?"*

The primary aim of this research is to analyze the challenges and obstacles entrepreneurs face when attempting to establish waste management companies in Indonesia. Additionally, it seeks to identify the key drivers that can accelerate the growth and expansion of the sector. By addressing these critical aspects, the study aims to provide actionable insights for both stakeholders and policymakers, enabling them to create a more supportive environment for waste management enterprises.

The findings of this research are anticipated to inspire Indonesian entrepreneurs to take a more active role in the waste management industry. By fostering growth and innovation in this sector, the study hopes to contribute to making Indonesia more sustainable, particularly in tackling its pressing waste management challenges.

2. THEORY

In line with Grounded Theory methodology, this chapter does not aim to apply a predefined theoretical framework but instead provides a contextual overview of the waste management sector in Indonesia. The goal is to situate the research within the broader environmental, economic, and entrepreneurial landscape relevant to the study.

2.1 Overview of Waste Management in Indonesia

Indonesia faces a growing waste crisis driven by rapid urbanization, rising consumption, and underdeveloped infrastructure. A significant amount of waste in Indonesia ends up in landfills, which is largely attributable to the country's low recycling rates. For instance, only 10% of plastic waste in Indonesia is recycled (Zahrah et al., 2024). One of the primary factors behind this low recycling rate is the inadequacy of infrastructure and resource capacity to accommodate the substantial demand for waste recycling (Zahrah et al., 2024). This lack of facilities severely limits the country's ability to process and recycle waste efficiently, further exacerbating the reliance on landfills as the primary waste management solution.

Many landfills in Indonesia are operating beyond their capacity, further exacerbating the waste management crisis. For instance, the Cipayung landfill, located in one of Indonesia's metropolitan areas, is nearly 100% over its intended capacity. Designed to accommodate 1.3 million cubic meters of waste, it is currently handling 2.5 million cubic meters (Tempo, 2022).

The national waste management system remains highly conventional and fragmented. Modernization efforts are hindered by a substantial funding gap. According to a World Bank article in 2022, the country's budget allocation for addressing environmental issues is far below what is needed. Data from Climate Budget Tagging indicates that achieving Indonesia's Nationally Determined Contributions (NDC) target, a climate action plan to reduce emissions and adapt to climate impacts, requires an average annual funding of IDR 266.3 trillion until 2030. In contrast, during the 2020-2022 period, Indonesia allocated only IDR 37.9 trillion annually for environmental development, leaving a substantial funding gap (Direktorat Jenderal Anggaran, 2022). Research has also highlighted that limited local budgets allocated for waste management in several Indonesian cities result in significant resource constraints for

infrastructure development, including waste banks. This lack of funding reduces the capacity for effective plastic waste recovery, further exacerbating the challenges faced by cities in managing their waste (Zahrah et al., 2024). This financial shortfall significantly hampers progress in modernizing the waste management system.

2.2 Current Waste Management Business Landscape

Amidst the growing waste crisis in Indonesia, the role of sustainable entrepreneurship is becoming increasingly relevant. Establishing businesses in the waste management sector presents not only a pathway to address urgent environmental challenges but also an opportunity to revitalize the industry through innovation and private-sector leadership. Private sector involvement not only supports operational improvements but also serves as a critical source of funding for waste management initiatives (Sharma & Malik, 2022). By fostering partnerships and investments, the private sector can play an integral role in enhancing the efficiency and sustainability of waste management practices across Indonesia.

Indonesia's substantial population of over 275 million people offers a promising market for waste management companies. Research highlights that the COVID-19 pandemic spurred the emergence of waste management startups in the country, signaling positive growth prospects for the industry (Kurniawan et al., 2022). Yet, despite this positive signals, market participation in Indonesia remains low, particularly among citizens. A survey by Siringo et al., (2020) revealed that only 60% of respondents in Jakarta were aware of existing regulations and collection practices related to electronic waste, highlighting limited public engagement. This low level of awareness and participation significantly affects the viability of private-sector initiatives. Furthermore, formal waste management enterprises often face stiff competition from informal actors, such as local scavengers who dominate the collection and recycling of various waste streams. According to Rochman et al., (2017), a single scavenger in Yogyakarta can collect an average of 20.3 kg of waste per day, demonstrating the scale and entrenchment of the informal system. This dynamic presents a substantial challenge for formal businesses attempting to establish efficient and profitable operations within an already saturated and informally structured market.

Given Indonesia's underdeveloped infrastructure and limited market readiness, it's no surprise that waste management enterprises continue to face significant struggles. According to a news article from Voice of America (VoA) for Indonesia, waste management initiatives, particularly waste banks, are facing significant challenges and are on the brink of closing down. This is largely due to a perceived lack of support from both the society and the government (VoA, 2022). Additionally, other media outlets have reported that one of Indonesia's waste management startups is facing bankruptcy. The company’s inability to pay salaries to its workers, combined with its inactivity on social media, highlights its financial instability and operational struggles (Tech in Asia, 2024)

2.3 Barriers and Drivers Overview

The pursuit of sustainable practices in Indonesia is influenced by a complex interplay of drivers and barriers across different sectors. Several studies have highlighted institutional and administrative limitations as key barriers to sustainability. For instance, Rosyadi et al. (2022) observed that local policymakers often exhibit routine-minded and inflexible administrative behavior, which hinders the development of innovative and competitive sustainable initiatives, particularly in the creative economy. Similarly, Fitriani & Ajayi (2023) identified three major barriers to sustainable practices: lack of knowledge and standards, poor design implementation, and significant financial constraints, challenges that are especially critical for emerging enterprises and SMEs.

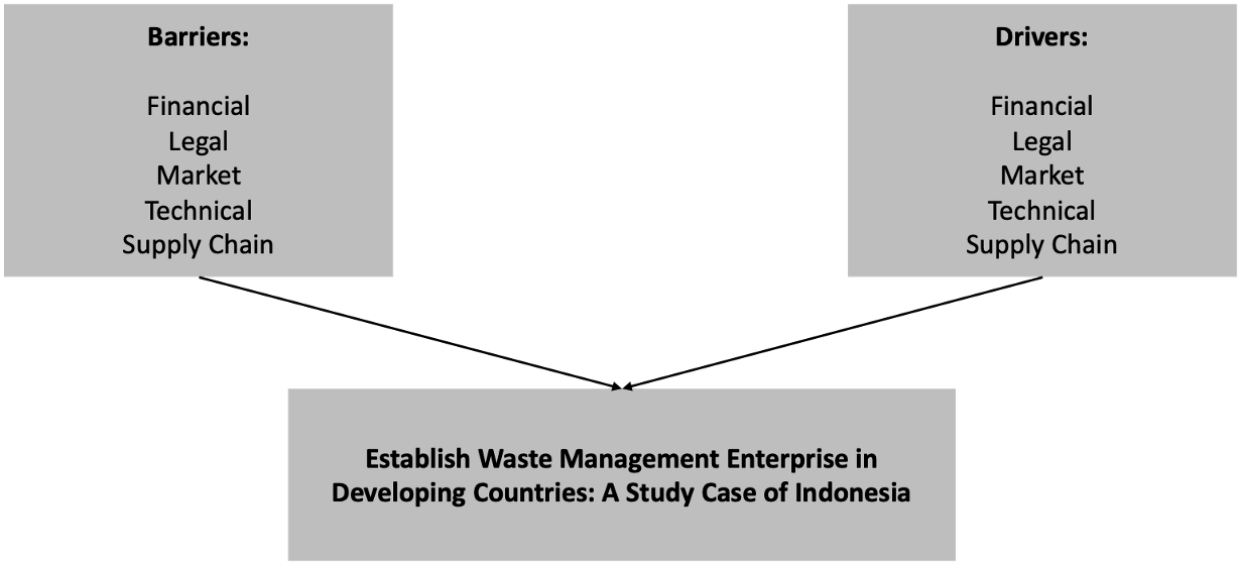
On the other hand, various motivating factors have been identified as drivers of sustainability in Indonesia. Hasan et al. (2021) found that regulatory enforcement, employee motivation, competitive advantage, customer demand for green products, and access to environmentally friendly technologies are among the most influential factors encouraging sustainable management practices. These drivers are further supported by internal values and leadership attitudes. Johansson et al. (2019) emphasized the importance of company management and employee mindsets, stating that sustainability efforts are often rooted in personal values, long-term relationships with partners, and proactive collaboration with external stakeholders. Together, these studies illustrate how both external systemic conditions and internal organizational culture shape the landscape of sustainability in Indonesia, where progress often

requires overcoming institutional rigidity while leveraging values-driven leadership and stakeholder collaboration.

2.4 Conceptual Framework

This research focused specifically on waste management enterprises, with the aim of exploring the challenges and opportunities within this sector. To achieve this, the study adopted a circular business model innovation approach, which is particularly relevant for industries such as waste management that are working towards sustainability and resource efficiency. The research drew on existing literature that examined both the barriers and drivers associated with the adoption of circular business models proposed by Geissdoerfer et al., (2023) with adjustments informed by the researcher's judgment and contextual considerations.

Figure 1. Conceptual Framework



To provide a structured and comprehensive analysis, the study categorized these barriers and drivers into specific frameworks. The barriers and drivers were classified into five main categories: Financial, Market, Legal, Technical, and Supply Chain (Geissdoerfer et al., 2023). These categories helped identify the primary obstacles and opportunities that waste management companies face as they attempt to implement circular business practices in waste management.

This framework was carefully selected for its relevance to the waste management industry, as it captured the multifaceted challenges and incentives involved in the sector. By utilizing this

comprehensive structure, the research provided valuable insights into the key elements that influence waste management enterprises and their ability to adopt circular business models. It ensured that all relevant factors were considered and thoroughly explored, ultimately providing a deeper understanding of the dynamics within the industry and offering practical recommendations for overcoming barriers and enhancing drivers of change.

3. METHODS

This research seeks to explore the perspectives of waste management stakeholders on the barriers and drivers to establishing waste management enterprises. Due to the diverse and complex nature of these perspectives, a qualitative approach is adopted, with semi-structured interviews as the primary method of data collection. This research used a Grounded Theory approach, which does not rely on predefined hypotheses but instead aims to generate new theoretical insights based on the data collected from participants.

3.1 Data Collection

The interviews were conducted online between 28 February and 11 April 2025 using a semi-structured format guided by ten core questions (see Appendix A). All questions primarily focused on identifying the barriers and drivers to establishing waste management companies in Indonesia, categorized into five key aspects: Financial, Legal, Market, Technical, and Supply Chain. This study gathered insights from eight professionals across various segments of Indonesia's waste management and sustainability sector. The duration of the interviews ranged from 28 minutes for the shortest to 59 minutes for the longest session (see Appendix D).

The participants represented different types of organizations, including three operating in the waste collection stage, used cooking oil and household waste collectors (I1, I2, I4), and four in the processing stage, focusing on plastic and textile recycling (I5, I6, I7, I8). Additionally, one participant (I3) was from an environmental-focused venture builder, offering a broader industry perspective from a startup development and investment angle. This spread of roles across the value chain provided a balanced understanding of both upstream and downstream waste management challenges and opportunities.

This study applied a multi-stakeholder approach which involved various positions of interviewees, including CEOs, COOs, sustainability managers, engineers, and venture specialists, allowing the study to reflect both strategic and operational viewpoints. The participant group was also diverse in terms of gender and age, with an equal representation of 4 male and 4 female interviewees. The age range of participants spanned from individuals in their 20s to their 40s, ensuring that the insights gathered reflected a broad spectrum of perspectives.

This diversity helped to capture a more comprehensive understanding of the barriers and drivers in Indonesia's waste management sector.

All interviews were recorded with consent and securely stored in the University of Groningen's Google Drive. Transcription and translation (Indonesia-English) were completed using AI-assisted tools to ensure efficiency and accuracy in processing the qualitative data. The transcription outputs were relistened and manually checked for completeness and correctness, while the translated texts were reread and reviewed to ensure the accuracy and clarity of meaning across both languages.

3.2 Data Analysis

The data was analyzed in three phases: open coding, axial coding, and theoretical coding. In the first phase, open coding was used to identify emerging drivers and barriers directly from the interview transcripts. Although the researcher was already familiar with the concepts of drivers and barriers from the literature, open coding allowed for an unbiased exploration of the data and the discovery of unexpected insights. Given the open-ended nature of the questions, it is acknowledged that some factors may not have surfaced in every case. In the second phase, axial coding was conducted to group related codes and streamline the list of identified factors. Lastly, theoretical coding was used to categorize the drivers and barriers into broader themes, drawing on frameworks and categorizations established in previous studies.

3.3 Ethical Considerations

This research involved individual participants and adhered to the University of Groningen's Research Ethics guidelines. Prior to the interviews, participants received a detailed consent form outlining the ethical principles governing the study. The researcher collected signed consent forms from participants before the interviews commenced.

To ensure confidentiality, all recordings were deleted after transcription, and participants' identities were anonymized in the transcripts. Transcription documents were securely stored in the researcher's student account on Google Drive, accessible only to the researcher. These measures were taken to protect participants' privacy and maintain the highest standards of ethical research practice.

4. RESULTS

Based on semi-structured interviews with eight stakeholders from various roles and areas of expertise within Indonesia's waste management industry, key barriers and drivers to establishing waste management companies were identified. The findings were categorized into five main aspects: financial, legal, market, technical, and supply chain factors.

4.1 Barriers

The waste management industry in Indonesia faces significant limitations and challenges, as the concept of sustainability is still evolving in the country. Understanding these barriers is crucial to gaining a realistic view of the current practices and conditions, and to identifying the obstacles that must be addressed to successfully establish waste management enterprises in Indonesia.

4.1.1 Financial Barriers

Financial challenges are one of the most critical obstacles faced by waste management enterprises in Indonesia. Based on the interviews, several key financial barriers were identified, including high capital and operational costs and limited revenue potential. These barriers reflect the broader financial constraints within the industry and significantly impact the ability of companies to establish and grow sustainably.

High Capital and Operational Costs

The most frequently highlighted financial barrier is the high capital and operational cost associated with waste management enterprises. This issue was mentioned by five out of eight interviewees (I1, I3, I6, I7, I8). In the waste management industry, operations are often linked to the use of machinery for both processing and collection activities.

Supporting this point, I1 explained, *"What we're currently developing is machines spread out across multiple cities in Indonesia that function to collect used cooking oil, so developing the machines and the app takes up the biggest chunk of cost,"* reflecting the significant cost in the collection stage. Similarly, I8 emphasized the high capital requirements in the processing stage, stating, *"Because the machinery and technology used in recycling facilities are designed for massive capacities……so setting up a full end-to-end textile recycling facility requires significant*

investment." Additionally, I6 mentioned the high operational capital needed to purchase raw materials, sharing, *"if there's a big project, we can't handle it. Like if someone offers to sell us a large tonnage of plastic—we don't have the capital to buy it."*

Limited Revenue Potential

Another significant financial barrier is the limited revenue potential, particularly for companies operating in the waste collection stage. This issue was highlighted by I1, I2, and I3. Businesses in this segment often struggle to generate substantial profit margins.

I1 and I2 pointed out that selling waste raw materials does not yield large profits. I2 mentioned, *"The prices for those aren't competitive yet, so from an operational standpoint, it's not worth it for us to store those kinds of waste."* This is echoed by I1, who stated, *"The biggest financial challenge now is finding profit….. the gap between buying and selling prices is narrow."*. This problem also relates to I3's observation about market willingness, *"the financial barriers—first of all—is the willingness to pay. So whether the waste management clients are B2C or B2B, it's rare that they are willing to pay the actual cost required to handle waste responsibly."*

However, a different situation is found among businesses focused on the processing stage. I6 and I7 noted that they do not face major difficulties in creating profit margins, this because of their ability to add value to the products. As I7 mentioned, *"Honestly, we haven't found any issues there. The margin is pretty good. So the challenge isn't in the margin…. That's where we get our good profit margin — by adding value to the materials."*

4.1.2 Legal Barriers

The legal environment in Indonesia presents significant challenges for waste management enterprises. Based on the interviews, several key legal barriers were identified, including regulatory gaps and misalignment, weak law enforcement, and bureaucratic complexity. These issues highlight the difficulties businesses face in navigating regulations that are often unclear, inconsistently applied, or administratively burdensome.

Regulatory Gaps and Misalignment

The most frequently mentioned legal barrier is regulatory gaps and misalignment, highlighted by five out of eight interviewees (I1, I2, I5, I7, I8). This reflects the lack of clear, supportive, and

targeted regulations for circular economy initiatives, green businesses, and waste management enterprises in Indonesia.

I1 and I2 emphasized how current permitting regulations are not supportive for businesses. I1 stated, *"Like with business permits (NIB), in Indonesia, there's no specific licensing category for green companies. So we're not registered as an environmental company,"* illustrating how waste management has not yet been prioritized in regulatory structures. This was further explained by I2, who said, *"the problem is that waste management is still seen as something 'additional,' not as an obligation. So we end up without laws that really protect or support us."*

As a company operating at the collection stage, I2 also highlighted how the lack of basic household waste management regulations hinders business growth: *"The thing is, there's no strong regulation that requires all Indonesian households to manage their waste."* From another perspective, I8 pointed out the lack of incentives for green companies, stating, *"One thing we recyclers really need is fair incentives. Right now, the government doesn't see recycling as a major environmental contributor."*

Weak Law Enforcement and Ineffective Implementation

Another important theme discussed in the interviews is weak law enforcement and ineffective implementation, mentioned by five out of eight interviewees (I2, I3, I5, I6, I7). This theme reflects how existing regulations fail to achieve their intended impact due to poor enforcement.

I3 clearly highlighted that although regulations for waste management already exist at both national and local levels, they are not properly enforced. As stated by I3, *"the rules regarding waste management actually already exist at national and local levels. But the implementation still needs to be tightened."*

Similarly, I6 shared that while official regulations are in place, there is no actual enforcement of the law, stating, *"They know the practice in Indonesia, but there's no law enforcement…there's actually a regulation…But in practice, zero implementation."*

Bureaucratic Complexity

The third key barrier identified in the interviews is bureaucratic complexity, as highlighted by I1,

I2, and I6. This factor emphasizes that legal compliance is made difficult due to confusing, time-consuming, and multi-layered permit procedures.

I1 shared the challenges faced in managing the required procedures, mentioning, *"To process waste, from the Ministry of Environment (KLH), there are so many, like a lot of letters or permits that have to be applied for."*

I2 and I6 also expressed similar concerns. I2 said, *"Like, for example, licenses—getting permits is super hard. Even something like a license to release a report, that kind of thing doesn't exist in Indonesia,"* while I6 explained, *"but I admit that's wrong, because we're not yet able to build an IPAL (wastewater treatment installation). Getting a permit for an IPAL is pretty complicated."*

However, not all businesses face the same bureaucratic hurdles. I4 stated that their company has not experienced difficulties, mentioning, *"maybe other companies struggle with bureaucracy, but thankfully we don't — again, due to privilege."* I4 further explained that strong relationships with government officials have helped their business operations, saying, *"One of the founders has a government background, so we got a lot of privileges. They know many people in business and government, so it helped us move swiftly."*

4.1.3 Market Barriers

The waste management industry in Indonesia also faces significant market-related challenges. Based on the interviews, the main barriers identified include low public awareness and participation, market saturation by existing actors, and the centralized structure of the waste management market. These issues highlight how market conditions can limit business growth and hinder the development of sustainable waste management practices across the country.

Low Public Awareness and Participation

The most commonly highlighted market barrier is low public awareness and participation, mentioned by six out of eight interviewees (I1, I2, I3, I5, I7, I8). This reflects the low level of sustainability awareness in Indonesian society, where waste management is often seen as optional rather than a responsibility.

Several interviewees explicitly described the lack of public awareness, especially in household waste sorting practices. I1 stated, *"But that's hard—getting people to even separate trash at*

home is difficult. That's the core issue." This was further emphasized by I6, who described the everyday reality of waste management behavior in Indonesia: *"Here, people just dump everything into a bin and wait for someone to collect it.".* Additionally, I2 highlighted how waste management is not perceived as an obligation, stating, *"Indonesians' willingness and awareness about waste management is still just 'if you do it, good; if you don't, it's okay.' It's not seen as a responsibility."*

Beyond waste behavior, I8 noted that low sustainability awareness affects market demand for sustainable products, impacting business growth: *"Public interest in sustainable or eco-friendly materials is still developing and not yet massive…considering the macro situation in Indonesia's textile industry, it's still hard to confidently approach investors.".* I7, working at the same company as I8, shared a similar view: *"...It would be overkill to invest in that kind of advanced tech when the market isn't significant yet."*

Market Saturation by Existing Actors

Another significant barrier is market saturation by existing players, particularly informal and conventional waste collectors, which makes market entry and competition difficult. This was mentioned by five out of eight interviewees (I1, I2, I5, I6, I8).

I1 and I2, who operate in the waste collection segment, pointed out the dominance of long-established collectors. I1 explained, *"our competitors are these collectors who've been in the game for years, undisturbed by startups like us."* Similarly, I2 highlighted, *"competition with collectors and such. So it becomes a race—like, every time a new restaurant opens, we have to approach them first."*

In the recycling sector, I5 and I6 noted the intense competition among recyclers. I6 stated, *"...it's actually harder to find raw material supply than off-takers. Lots of off-takers want the material…Too many recyclers competing."* This was supported by I5, who said, *"The plastic market is very fluctuating. Like right now, PET is in high demand from factories, but at the collector level, there's intense competition."*

From a different perspective, I8, who produces end products, mentioned that competition also comes from imported goods, stating, *"Another challenge is the flood of imported products in*

Indonesia. If we compare our recycled materials to imports from China, the price gap is enormous." I8 further explained the difficulty of competing with virgin products: *"Also, recycled materials can't be directly compared to virgin ones. They differ in treatment, composition, texture, durability, and comfort."*

However, not all businesses face intense competition. I4 shared a different experience, indicating that their niche market in eastern Indonesia shields them from major competition: *"(Any competitive challenges among other startups?) Not really, because we operate in pretty remote areas."* Additionally, I4 emphasized the importance of collaboration with existing players rather than competition: *"So far, it's fine. We deal directly with the big players — we sell straight to the off-takers, not through collectors again."*

Centralized Market Structure

The third major barrier discussed is the centralized nature of Indonesia's waste management market, mentioned by I3, I4, and I8. This situation highlights how waste management services and market opportunities are concentrated in certain regions, particularly Java, limiting access and reach for businesses in more remote areas.

I3 described this situation, explaining, *"Maybe now it's still very Java-centric, but there are already big waste management players in Makassar, for example.....even though the waste is collected and processed in Makassar, the recycled products are usually sold in Jakarta."*. This challenge was further supported by I4, whose business operates in rural areas: *"(Oh, the off-takers are in Java?) Yes, Java. (There are no off-takers in the east?) Not yet."*

I8 also emphasized that centralized market dynamics limit sustainability efforts in less developed regions, stating, *"because textile waste exists not only in Jakarta or Surabaya. What's the condition like in NTT? Is there awareness? Are there infrastructures? That's our goal at [COMPANY NAME]."*

4.1.4 Technical Barriers

Technical challenges present significant barriers for waste management enterprises in Indonesia. Based on the interviews, the most prominent issues include high technological costs and complexity, limited accessibility and adaptability of technology, and inadequate supporting

infrastructure. These challenges not only increase the difficulty of starting and scaling operations but also limit innovation and efficiency within the sector.

High Technological Costs and Complexity

The most frequently mentioned technical barrier is the high cost and complexity of technology in the waste management sector. This issue was highlighted by seven out of eight interviewees (I1, I2, I3, I4, I5, I7, I8), reflecting how both initial investment and operational technical demands pose significant challenges for companies.

Interviewees widely agreed that the machinery used in the sector requires substantial capital. I1, speaking from the perspective of a waste collection company, emphasized the investment needed for technology development: *"What we're currently developing is machines spread out across multiple cities in Indonesia that function to collect used cooking oil, so developing the machines and the app takes up the biggest chunk of cost."*. I4 echoed this challenge, highlighting the importance of seeking external support: *"Our strategy is to seek outside investors for tech development, because that obviously requires significant funding."*

From a recycling perspective, I8 explained the scale and complexity of the technology needed in the processing stage: *"Because the machinery and technology used in recycling facilities are designed for massive capacities. That's a major challenge for anyone starting in this industry—especially in textiles. Textile is more complex; we're dealing with a very diverse range of fabric materials, so setting up a full end-to-end textile recycling facility requires significant investment."*. I8 further noted the complexity of recycling processes, particularly in textiles: *"In textile recycling and disposal, there are many variables—not just 'cotton can be recycled.' Thickness, texture, and fiber structure all affect recyclability. Unlike plastic, where categories are clear (bottle, cap, label), textile is more complex."*

Accessibility and Adaptability Issues

Another prominent technical barrier is related to accessibility and adaptability of technology. This includes both user limitations and the mismatch between available technologies and Indonesia's geographic and socio-economic conditions. This theme was discussed by I1, I2, I3, and I8.

I1, whose company operates a digital-based collection system, highlighted a challenge in reaching their target users: *"But the largest producers of used oil are people in lower socioeconomic groups, and many are not tech-savvy."*. I2 supported this view, noting difficulties among less digitally literate users: *"Since we're app-based—like, we use an application—not everyone in Indonesia is willing to use an app, especially older people or those who aren't tech-savvy."*.

I8 offered a different angle, noting the lack of scalable, compact technology that fits Indonesia's dispersed geography: *"We saw many technologies and massive capacity at ITMA (Textile Fair), but what we really needed were compact, end-to-end machines—lab-sized ones. Not many of those exist yet."*. This view is reinforced by I3, who stressed the need for modular and localized solutions: *"For us, it's finding innovations that fit the Indonesian market. Like, how can we create waste processing facilities that don't have to be as big as the current ones?...can we make it more modular, cheaper, and more spread out?"*

Infrastructure Limitations

The final technical barrier identified relates to infrastructure limitations, particularly the lack of adequate facilities to support sustainable waste management operations. This was mentioned by I1, I2, and I3.

I1 described the basic infrastructural challenges at the disposal stage: *"The simplest one—TPA (landfills) in every city or region are mostly over capacity. That's the most basic problem. The landfills are damaged, leaking, unmanaged."*. This was echoed by I3, who noted, *"Landfills in Indonesia are already full, so the final disposal stage is still an issue."*

I2 added that while initiatives such as waste banks are promising in theory, the lack of execution limits their effectiveness: *"The Waste Bank is cool because the idea is good…But in execution, it's not happening. Most waste banks are dead—didn't survive."*

4.1.5 Supply Chain Barriers

Supply chain challenges play a critical role in hindering the growth of waste management enterprises in Indonesia. Based on the interviews, the main barriers identified include limited local processing facilities, supply shortages and collection barriers, and complex, costly logistics.

These supply chain issues create significant operational difficulties and highlight the need for more efficient and decentralized waste management systems.

Limited Local Processing Facilities

The most frequently mentioned supply chain barrier is the shortage of local processing facilities, as highlighted by seven out of eight interviewees (I1, I2, I4, I5, I6, I7, I8). This shortage creates dependence and bottlenecks across the waste management supply chain, making it difficult for businesses to efficiently manage collected waste.

Several interviewees agreed that there are limited options for recycling or processing raw materials in Indonesia. For instance, I2 mentioned, *"And even if we wanted to store them, the number of processors willing to accept them is low."*Similarly, I1 pointed out, *"Yes, that's the issue—lack of local processors."*. I5 further highlighted difficulties with specific materials, noting, *"Some materials, like multilayer plastic, are difficult—we hear that factories in East Java can process them, but we've never had direct contact. So it's hard to manage those materials even if they're abundant."*

Supply Shortages and Collection Barriers

Another major supply chain challenge is related to supply shortages and collection barriers, as discussed by I1, I5, and I6. These issues reflect the difficulties in maintaining a steady flow of waste materials and dealing with user behavior that complicates collection logistics.

I1, working in waste collection, described how societal habits increase logistical challenges and costs: *"So again, the challenge is that Indonesians don't want to carry their waste—we have to pay someone to pick it up."*. In the recycling sector, I6 explained the difficulty in securing a consistent supply of raw materials, stating, *"the biggest issue is the supply of raw materials—we're still lacking."*. This was supported by I5, who noted the irregularity in material collection: *"Oh yes, very much so. Sometimes we have to wait a week for materials….. It's not always consistent, except maybe during Eid when everything slows down."*

However, I8 shared a different experience, highlighting how collaboration helped maintain a stable supply: *"We get both pre-consumer and post-consumer waste. Pre-consumer waste comes from households to large-scale industries—anywhere from 500kg to hundreds of tons per month.*

Post-consumer sources include the Uniform Disposal Program (from corporates, institutions, and schools) and the Portable dropboxes we run with collaborators."

Logistic Complexity and Costs

The third major barrier identified is the logistical complexity and high costs associated with transporting waste across Indonesia. This issue was mentioned by I1, I3, and I7.

I1 illustrated the financial burden caused by transporting waste to centralized processing locations, stating, *"Once we've collected the oil, it's sent to processors who turn it into avtur. That's also expensive—especially considering our oil comes from many cities. If their processing plant is in Cilacap, for example, and we're collecting from Jakarta, Tangerang, Bali, Bandung—that's huge logistics cost. So even if we buy at 6,000 and sell at 12,000, that's before subtracting shipping costs."*

Similarly, I7 emphasized the complexity of the multi-actor logistics process within the recycling ecosystem: *"We have to plan how to move that waste to us, then from us to the location of the processing machines. Once it becomes yarn, we send it to the fabric makers. Then we think about whether it's directly delivered to customers or goes through vendors."*

However, I5 has different perspective due to its location privilege *"we're lucky because we're close to the landfills, so the flow of materials is localized and doesn't require high logistics costs."*

4.2 Drivers

While various barriers hinder the development of waste management enterprises in Indonesia, several positive drivers were also identified during the interviews. These drivers highlight the opportunities, enablers, and strengths that can support the growth of the sector.

4.2.1 Financial Drivers

Despite the financial challenges faced by waste management enterprises in Indonesia, many stakeholders also highlighted the increasing availability and accessibility of funding as a key driver for business growth. Various financial channels, including venture capital, institutional

investors, and grant programs, are supporting the development and scaling of green and waste-related enterprises across the country.

Availability and Accessibility of Funding

The most frequently mentioned financial driver is the availability and accessibility of funding, highlighted by six out of eight interviewees (I1, I2, I3, I5, I7, I8). This finding indicates that there are various financial support channels in Indonesia that can facilitate the establishment and scaling of waste management enterprises.

Several interviewees agreed that funding opportunities for green and sustainable businesses are increasingly accessible, particularly in the waste management sector. For example, I1 shared that investor interest in green tech companies is high: *"Many venture companies or investors looking for green companies—we're actually being sought out. Personally, I get contacted a lot by venture companies. They're quite attracted to us, so there's always someone willing to invest."*. I2 also emphasized this trend, stating, *"So if you ask me, there are a lot of investors and institutions that want to fund waste management. Last year, for example, the founders were super focused on pitching—like, they were constantly pitching everywhere."*

In addition to private investment, some interviewees highlighted the availability of grants as another source of financial support. I3 explained, *"And there are still a lot of grants available, from ministries in the UK, Denmark—I forget exactly which—but there are foreign investments that provide grants."* This point was reinforced by I8, who shared a recent success story: *"We recently received a grant from an NGO, which we used to conduct a pre-feasibility study in collaboration with PwC India."*

While access to funding was identified as a key driver by several interviewees, five out of eight participants also highlighted contrasting concerns that complicate the funding landscape in Indonesia., I1 and I8 discussed how a recent startup scandal has negatively affected the investment climate for green tech in Indonesia. I1 stated, *".....threatened because of eFishery—you know that case? It's the biggest scam in Southeast Asia, and since then, the investment climate in Indonesia has dropped."*

Meanwhile, I2, I6, and I7 shared a different concern, hesitation to pursue external investment due to fear of investor pressure. I7 expressed this by saying, *"Maybe that's why we haven't caught investors' attention. And if we did get investment through 'made-up' stories, that would be mentally burdensome. It wouldn't be fun anymore."* A similar sentiment was echoed by I6, *"it's hesitation. Like I said, I've seen friends get big investments, hire a ton of people, burn money like crazy, end up in the red, and get kicked out by investors. I'd rather avoid that."*

4.2.2 Legal Drivers

Despite the legal challenges in Indonesia's waste management sector, several interviewees highlighted recent improvements in government commitment and regulatory support. These developments include stronger collaboration between policymakers and industry practitioners, as well as the introduction of new policies aimed at supporting green businesses. Such efforts indicate a positive shift toward creating a more enabling legal environment for sustainable waste management enterprises.

Strengthening Government Commitment and Support

A key legal driver identified by several interviewees is the growing commitment and support from the Indonesian government in fostering a more enabling regulatory environment for waste management enterprises. This was mentioned by six out of eight interviewees (I1, I3, I4, I6, I7, I8). These developments show that the government is not only engaging more actively with private sector practitioners but also initiating policies that support sustainable business operations.

I3, I4, and I7 described stronger collaboration between the private sector and the government. For example, I3 explained the value of having industry professionals involved in policymaking: *"Having professionals in government helps inform policymakers about the real situation….the founder of that waste management company is now part of the advisory team in a ministry."*. From another company, I7 noted the importance of collaboration with BAPPENAS (Ministry of National Development Planning of Indonesia), stating, *"We currently have a good relationship with BAPPENAS in Indonesia. BAPPENAS's job is to design government work plans. They propose ideas to the government. From our side, this is a significant move."*

Additionally, I1, I6, and I8 pointed to emerging government regulations that directly support green businesses. I1 described how a new school-level environmental policy has helped their operations: *"The Ministry of Environment, they have a new policy program called P5. It mandates all schools in Indonesia to run green programs—green campus, green school. That helps our company a lot. One of the ways [COMPANY NAME] collects used oil is through schools and universities. The goal is to build habits, like parents and kids getting used to collecting used oil."*. I8 also highlighted a promising regulatory shift in the textile sector, explaining, *"Bappenas' RPJPN 2045 has listed textile as one of the five priority sectors…we've seen three policy directions—two I remember are the recycling input rate and the circular input rate…which is a good start."*

4.2.3 Market Drivers

Amidst the challenges in Indonesia's waste management sector, market-related drivers are beginning to create new opportunities for growth. One of the most significant drivers identified by interviewees is the increasing demand from eco-conscious consumers and businesses. This shift, influenced by global sustainability trends and ESG commitments, is expanding the market potential for waste management enterprises across the country.

Growing Demand from Eco-conscious Market Segments

The most frequently mentioned market driver is the growing demand from environmentally aware market segments. This was highlighted by six out of eight interviewees (I1, I2, I3, I6, I7, I8). This trend reflects a rising market potential driven by eco-conscious consumers, global sustainability trends, and increasing corporate commitments to ESG (Environmental, Social, and Governance) principles in Indonesia.

I7 shared that their company is experiencing a positive market response, as seen in growing sales and regional expansion: *"...Sales are rising, and we're seeing broader regional reach — not just Jakarta, Jogja, Bali anymore. Now Makassar, Solo, Semarang, and other second cities like Bandung are responding."*. From the same company, I8 emphasized the influence of global trends in shaping local market behavior: *"Globally, the recycling material trend is already strong. There are recyclers in the US, Europe, and Asia—Thailand, Cambodia, India…The fashion industry is being pushed by its consumers to adopt more sustainable materials."*

A similar pattern was described by I1, who noted that the demand for their collected raw materials is increasing significantly, and the company is receiving numerous requests for waste collection boxes: *"But demand is huge, so we don't worry about who will buy our used oil. Companies like [COMPANY NAME] are already starting to process it into bioavtur. We also have many export buyers. From social media alone, the demand is huge—people are asking for collection boxes in their cities. Right now we're overwhelmed."*

4.2.4 Technical Drivers

Technology is playing an increasingly important role in improving operational efficiency within Indonesia's waste management sector. Several interviewees highlighted how the adoption of digital tools and automation has enhanced real-time monitoring, waste traceability, and system transparency. These innovations are helping businesses streamline processes and improve decision-making.

Technology-Driven Operations

A key technical driver identified in the interviews is the role of technology in improving operational efficiency, particularly in real-time monitoring and waste traceability. This theme was mentioned by three out of eight interviewees (I1, I2, I4), highlighting how digital tools and innovations can strengthen the control and transparency of waste management processes.

I1 shared how their company uses technology to monitor collection activities across multiple locations: *"We've developed a dashboard that allows us to monitor all boxes—we can see how many liters have been collected in each box, in real time."*. This was supported by I2, who emphasized how technology enhances their ability to track waste throughout the system: *"So that really helps us in tracking everything. Because with our tech, we can really trace where our waste is—what stage it's at, and so on."*

Although still in development, I4 mentioned their ongoing efforts to implement automation to further streamline their operations: *"We're working on a technology for direct recognition — plastic waste can be scanned and it instantly calculates how much the user earns. So we're developing that kind of automatic tech."*

4.2.5 Supply Chain Drivers

In contrast to the logistical and infrastructural challenges in Indonesia's waste management sector, several interviewees highlighted the emergence of a collaborative ecosystem as a key supply chain driver. Increased cooperation among waste collectors, recyclers, manufacturers, and supporting institutions is helping to build a more connected and efficient supply chain, supporting the growth of sustainable waste management practices.

Collaborative Ecosystem Development

The most frequently mentioned supply chain driver is the development of a collaborative ecosystem, noted by four out of eight interviewees (I2, I3, I4, I8). This reflects the growing engagement and cooperation among stakeholders, such as entrepreneurs, companies, artisans, and institutions, in building an integrated and supportive waste management network.

I8 highlighted their initiative to work with local partners to produce sustainable end products: *"Other than that, we've also built an ecosystem involving collaborators—partners that help us turn recycled fabric into products. We collaborate from village-level artisans to large manufacturers."*. Similarly, I2 shared how collaboration extends to private sector research and development efforts: *"We collaborate with a brand that produces baby diapers. And when researchers hand over trust to waste management companies, it means those companies can directly handle the waste."*.

I4 described operational collaboration that helps streamline their recycling process, stating, *"We also collaborate with a company that provides databases of plastic volume and off-taker locations. We connect with that company and execute."*. This collaborative spirit was also acknowledged by I3, who observed the openness within the sector for sharing knowledge and experience: *"Knowledge transfer already exists…the players in this sector are still few, and the people are pretty much the same, everyone knows each other."*

5. DISCUSSIONS

This section summarizes the key findings of the study, followed by practical recommendations to support the growth of waste management enterprises in Indonesia. It also outlines the study's limitations and proposes directions for future research to build on these insights and broaden their applicability.

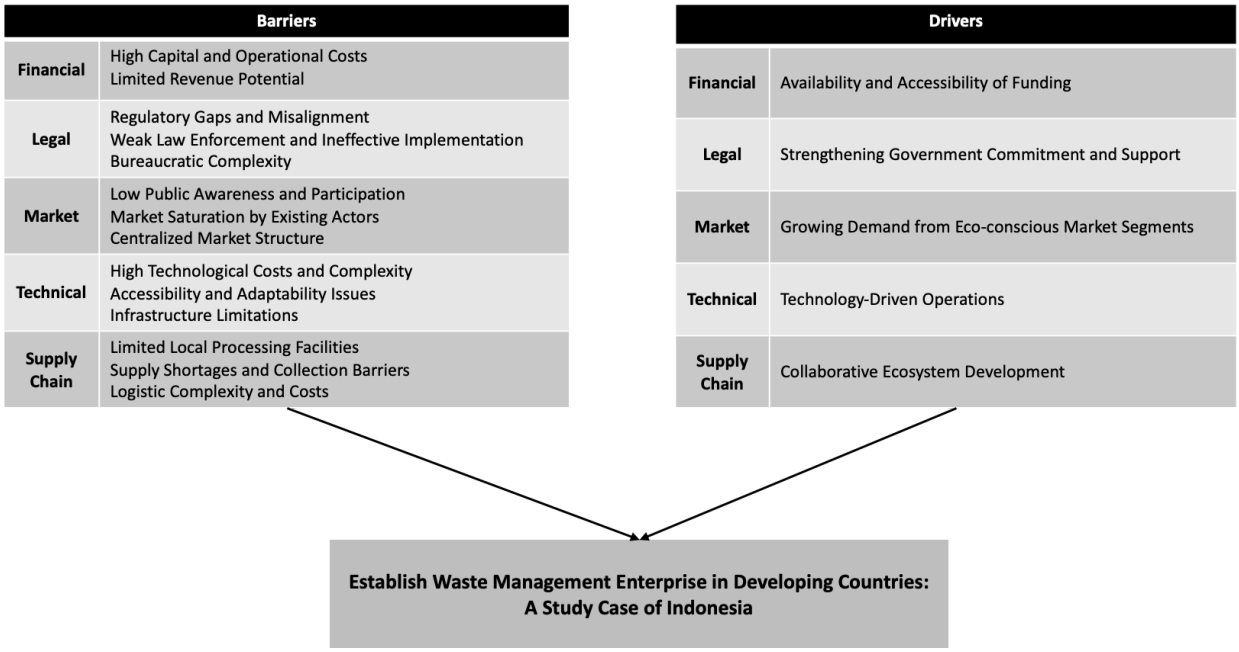
5.1 Summary

This research has explored the key barriers and drivers to establishing waste management enterprises in Indonesia across five major dimensions: financial, legal, market, technical, and supply chain. In the financial aspect, the high capital and operational costs, as well as limited revenue potential, remain critical challenges, particularly for emerging enterprises, mirroring the financial constraints noted by Fitriani and Ajayi (2023). However, the availability of funding through grants, venture capital, and institutional support presents a key enabling factor that supports business entry and scalability. This supports Hasan et al. (2021), who highlight accessible financing and institutional mechanisms as crucial drivers of green business practices. In the legal domain, the research found substantial hurdles including regulatory gaps, weak enforcement, and burdensome bureaucratic procedures. These findings resonate with Rosyadi et al. (2022), who argue that normative and inflexible policymaking often stifles local innovation. Nevertheless, participants in this study also recognized growing government commitment and regulatory support for green initiatives, in line with Hasan et al.'s (2021) emphasis on regulation and policy enforcement as a motivating force behind sustainable practices.

Market-related barriers such as low public awareness, dominance of informal actors, and centralized service availability reflect persistent structural limitations, yet the rise in eco-conscious consumer segments points to an emerging demand-driven opportunity. This supports Johansson et al. (2019), who note that customer demand and stakeholder engagement are crucial in advancing sustainability. Similarly, while technical challenges such as costly and incompatible technology persist, innovations in real-time waste tracking and digital monitoring are enabling more efficient operations, echoing Hasan et al. (2021) finding that access to appropriate technology can drive sustainable behavior.

Lastly, the supply chain dimension highlights inefficiencies due to limited local processing options, inconsistent supply, and logistical complexity. However, growing cross-sector collaboration among recyclers, producers, and local communities, demonstrates the kind of stakeholder partnership that Johansson et al. (2019) argue is essential for embedding sustainability across value chains.

Figure 2. Barriers and Drivers to Establishing Waste Management Enterprises in Developing Countries: A Case Study of Indonesia



Transdisciplinary Dimension

Throughout this research, I encountered many transdisciplinary dimensions that enriched the overall understanding of the topic. Although the central theme "sustainable business in the waste management sector" remained consistent, it became clear that it involves a wide range of actors, including government bodies, customers, and various industry stakeholders. Each brought unique roles, highlighting the complex and interconnected nature of sustainability challenges. This diversity of perspectives reflects the comprehensive and multi-layered reality of the field.

Additionally, I observed that some opinions were even contradictory across different stakeholder groups. Rather than being a limitation, these contradictions underscored the contextual nature of knowledge and emphasized the importance of diving deeper to interpret insights within their

specific social, economic, or organizational settings. Navigating these differing views has strengthened my ability to engage with both academic and practical understandings, and has reinforced the value of integrating multiple viewpoints in addressing sustainability challenges.

5.2 Recommendations

Based on the findings of this research, two key recommendations are proposed to support the development of waste management enterprises in Indonesia.

Implement Green Incentives for Producers and Consumers

One of the most consistent themes identified in the interviews was the low level of public awareness and participation in sustainability initiatives, particularly in waste management. Many interviewees noted that Indonesian society tends to adopt egoistic values, participating in sustainable practices only when there is a clear financial benefit. Therefore, introducing green incentives at both the consumer and producer levels could be an effective strategy to encourage behavior change and engagement in the early stages. Incentives such as tax breaks, subsidies, or discounts for consumers who sort waste properly, as well as financial or logistical support for businesses adopting sustainable practices, can help normalize sustainability in everyday life. These incentives would not only motivate existing businesses to transition toward greener models but also attract new entrepreneurs to explore circular and sustainable business opportunities, particularly in the waste management sector.

Establish a Collaborative Forum for Sustainable Business Stakeholders

Another important insight from the study is the role of cross-sector collaboration as a driver for business development, although this driver was only evident among a few interviewees. Notably, collaborations involving the government were limited, despite their potential to catalyze sector-wide impact. To address this, the creation of an official collaborative forum for stakeholders in the sustainable business ecosystem, especially in the waste management industry, is strongly recommended. This forum could serve as a platform for businesses, government agencies, NGOs, researchers, and local communities to share insights, challenges, innovations, and policy updates. Such a platform would facilitate knowledge transfer, enhance partnerships, and provide a space for policy feedback and alignment. Involving government actors in this space is particularly crucial to ensure that the regulatory environment evolves alongside industry

needs and innovations. Ultimately, fostering stronger multi-stakeholder engagement through such a forum would accelerate the development of a more inclusive, resilient, and efficient waste management sector in Indonesia.

5.3 Limitations

This research has two primary limitations that should be considered when interpreting the findings. First, the total number of interviewees is relatively limited. While the study includes insights from eight stakeholders in the waste management sector, Indonesia is a vast country with a highly diverse and dynamic market. As such, the number of participants may not be sufficient to fully capture the complexity and variety of experiences across the national landscape.

Second, the geographical distribution of the interviewees presents another limitation. Most participants in this study are based in Jakarta and Surabaya, both located on Java Island, the most developed and economically dominant region in Indonesia. Given that Indonesia is an archipelagic country with thousands of islands, this concentration may lead to a Java-centric perspective. As a result, the findings may not fully represent the challenges and opportunities faced by waste management enterprises in other regions, particularly in more remote or underdeveloped areas.

5.4 Future Research

There are several directions for future research that can build on the findings of this study and contribute to a more comprehensive understanding of the waste management sector in developing countries, particularly Indonesia.

First, future studies should involve a larger and more diverse group of stakeholders. Given Indonesia’s large population and complex market landscape, increasing the number of interviewees is essential to better capture the full range of perspectives within the industry. Including stakeholders from various backgrounds, such as policymakers, community leaders, informal sector workers, and technology providers, can enrich the analysis and provide a more holistic view of the barriers and drivers impacting waste management enterprises.

Second, future research should focus on including participants from both remote and underdeveloped regions, as well as more developed urban centers. Since this study primarily involved interviewees based in Java, particularly Jakarta and Surabaya, there is a need to explore conditions in other islands to ensure regional representation. Involving stakeholders from across Indonesia will provide a fairer and more accurate national perspective, while also highlighting the specific needs and challenges of less-developed regions. This can contribute valuable insights for inclusive and equitable waste management development across the country.

Third, comparative research involving other developing countries could offer broader insights into whether similar barriers and drivers exist in different national contexts. Conducting cross-country case studies would not only test the generalizability of the findings but also help identify region-specific or global patterns in waste management challenges. Such research could be particularly useful for countries that are still struggling to build efficient and sustainable waste management systems.

5.5 Conclusion

In sum, while the waste management sector in Indonesia continues to face significant structural and contextual challenges, there is clear momentum driven by innovation, collaboration, and shifting market values. With the right combination of supportive policies, financial mechanisms, and cross-sector partnerships, Indonesia has strong potential to accelerate the development of sustainable waste management enterprises that contribute to both environmental and economic resilience.

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APPENDICES

Appendix A: Interview Main Questions

Financial

1. What financial challenges did you or others face when trying to start a waste management business in Indonesia?
2. Were there any financial support systems, such as grants, investors, or incentives, that helped you move forward?

Legal

3. What legal or regulatory hurdles did you encounter during the establishment or operation of your business?
4. Are there any regulations or government policies that have helped or encouraged your business development?

Market

5. What market challenges have you observed, such as customer behavior, pricing issues, or competition?
6. Have you noticed any positive trends or growing interest from customers or companies in sustainable waste solutions?

Technical

7. What technical or technological difficulties have you faced in managing waste or scaling your operations?
8. Do you think the available infrastructure and digital literacy in Indonesia support tech-based waste solutions?

Supply Chain

9. Can you describe the waste collection and processing supply chain in your area? What are the main challenges? Are there any logistical or material flow issues that make waste management difficult or inefficient?
10. Have you experienced collaboration or support from other actors (e.g., collectors, processors, transporters) that helped improve the system?

Appendix B: Interview Consent Form

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INFORMED CONSENT FORM

Title study: *The Barriers and Drivers to Establishing Waste Management Enterprises in Developing Countries: A Study Case of Indonesia*

Name Participant:.....

Assessment

- I have read the information sheet and was able to ask any additional question to the researcher.
- I understand I may ask questions about the study at any time.
- I understand I have the right to withdraw from the study at any time without giving a reason.
- I understand that at any time I can refuse to answer any question without any consequences.
- I understand that I will not benefit directly from participating in this research.

Confidentiality and Data Use

- I understand that none of my individual information will be disclosed to anyone outside the study team and my name will not be published.
- I understand that the information provided will be used only for this research and publications directly related to this research project.
- I understand that data (consent forms, recordings, interview transcripts) will be retained on the Y-drive of the University of Groningen server for 5 years, in correspondence with the university GDPR legislation.

Future involvement

- I wish to receive a copy of the scientific output of the project.
- I consent to be re-contacted for participating in future studies.

Having read and understood all the above, I agree to participate in the research study: yes / no

Date.....

Signature.....

To be filled in by the researcher

- I declare that I have thoroughly informed the research participant about the research study and answered any remaining questions to the best of my knowledge.
- I agree that this person participates in the research study.

Date.....

Signature.....

Appendix C: Interview Information Sheet

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INFORMATION SHEET

TITLE OF THE STUDY:
The Barriers and Drivers to Establishing Waste Management Enterprises in Developing Countries: A Study Case of Indonesia

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Dear Participant,

Thank you for your interest in participating in this research study. This information sheet explains what the study involves and how it will be conducted. Please read the following information carefully, and if you have any questions, feel free to contact me using the details provided at the end.

WHAT THIS STUDY IS ABOUT?

- **Rationale:**
  This research investigates the key barriers and drivers influencing the establishment of waste management enterprises in developing countries, focusing specifically on Indonesia. It examines factors across financial, legal, market, technical, and supply chain dimensions.
- **Participants:**
  Approximately 6 to 12 participants will be interviewed individually to provide diverse insights into the waste management sector.
- **Why You Are Invited:**
  You have been selected because of your experience and/or decision-making role in the waste management sector. Your perspective is essential for understanding the challenges and opportunities in this field.
- **Funding:**
  This study is part of my Master's research at the University of Groningen and is not externally sponsored.

WHAT DOES PARTICIPATION INVOLVE?

- You will take part in a one-on-one interview conducted virtually (via platforms such as Zoom).
- The interview will last approximately 45 to 60 minutes.
- With your consent, the interview will be audio and/or video recorded to accurately capture your responses. The recordings will be used solely for transcription and analysis.

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DO YOU HAVE TO PARTICIPATE?

- Your participation is completely voluntary.
- You are free to withdraw from the study at any time without any consequences or the need to provide an explanation.
- You may choose not to answer any question that you feel uncomfortable with.

ARE THERE ANY RISKS IN PARTICIPATING?

- The risks associated with this study are minimal. Some questions may require you to reflect on professional experiences, which could potentially cause minor discomfort.
- If you experience any discomfort, you may skip questions or withdraw from the study at any time.

ARE THERE ANY BENEFITS IN PARTICIPATING?

- There are no direct personal benefits for you. However, your participation will contribute to a deeper understanding of the waste management sector in Indonesia.
- The findings may help inform future policies and practices in waste management.

HOW WILL THE INFORMATION YOU PROVIDE BE RECORDED, STORED, AND PROTECTED?

- **Recording:**
  The interview will be recorded (audio) with your consent.
- **Storage and Confidentiality:**
  All recordings and data will be securely stored on encrypted University of Groningen servers.
  Personal identifiers will be removed or replaced with codes to ensure anonymity.
  Access to the data will be restricted to myself and my supervisor.
- **Compliance:**
  Data management will adhere to GDPR guidelines as established by the University of Groningen.
- **Future Use:**
  Data will be kept securely for five years after the study's completion, after which it will be permanently deleted.

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WHAT WILL HAPPEN TO THE RESULTS OF THE STUDY?

- The study results will be used in my Master's thesis and may be presented at academic conferences.
- All findings will be reported in a manner that preserves participant anonymity and confidentiality.

ETHICAL APPROVAL

- This research study has received ethical approval from the Campus Fryslân Ethics Committee / University College Groningen.
- I am committed to upholding all ethical standards and ensuring your rights are protected throughout the study.

INFORMED CONSENT FORM

- Please review and sign the attached informed consent form. Signing the form indicates that you understand the purpose of the study, your role, and your rights, including the right to withdraw at any time without penalty.

WHO SHOULD YOU CONTACT FOR FURTHER INFORMATION?

If you have any questions or require further details about this study, please feel free to contact:

Penggawa Pietra Pramananda
Master's Student, Sustainable Entrepreneurship
University of Groningen
Email: p.p.pramananda@student.rug.nl
Phone: +31657081577

Appendix D: List of Interviewees

Tabel D1. List of Interviewees

Interview	Company Profile	Job Position	Location	Date	Duration
Interview 1	Waste Management (Used Cooking Oil Collector)	Sustainability Manager	Online	28/02/2025	40:46
Interview 2	Waste Management (Household Waste Collector)	Strategic Partnership and Enterprise Associate	Online	02/03/2025	44:27
Interview 3	Enviromental Focused Venture Builder	Venture Development Specialist	Online	08/03/2025	35:28
Interview 4	Waste Management (Household Waste Collector)	VP Engineering and Tech Development	Online	11/04/2025	28:24
Interview 5	Plastic Waste Recycler	Deputy Sales and Marketing Manager	Online	03/03/2025	38:19
Interview 6	Plastic Waste Recycler	Chief Executive Officer	Online	03/03/2025	37:10
Interview 7	Textile Waste Recycler	Chief Operating Officer	Online	25/03/2025	57:06
Interview 8	Textile Waste Recycler	Chief Executive Officer	Online	25/03/2025	59:28

Appendix E: Coding Quotation Samples

Table E1. Codes quotation samples

Sub-Theme	Code	Code Definition	Quotation Example	Interview
Limited Revenue Potential	Thin profit margins	Thin or negative profit margins	"I also can't afford to pay you collector-level prices. Because then the business margin won't work for us, right? So even though B2C is already pretty big for [COMPANY NAME]—with lots of repeat users and such."	Interview 2
	Low willingness to pay	Limited willingness to pay by customers	"the financial barriers—first of all—is the willingness to pay. So whether the waste management clients are B2C or B2B, it's rare that they are willing to pay the actual cost required to handle waste responsibly"	Interview 3
Weak Enforcement and IneffectiveImplementation	Weak law enforcement	Poor enforcement of existing laws	"It's wrong, yes—but the government's kind of stuck too. They know the practice in Indonesia, but there's no law enforcement."	Interview 6
	Ineffective waste bank policy	Ineffective implementation of waste bank policies	"The Waste Bank is cool because the idea is good. It's supposed to create a small waste business unit at the grassroots level—in communities, in households, in neighborhoods or villages. But in execution, it's not happening. Most waste banks are dead—didn't survive."	Interview 2
Availability and Accessibility of Funding	Funding alternatives	Having alternate funding either investor or grants	"many venture companies or investors looking for green companies—we're actually being sought out. Personally, I get contacted a lot by venture companies. They're quite attracted to us, so there's always someone willing to invest."	Interview 1
	Easy access to funding	Easy access to funding opportunities	"From what I know, the application process wasn't too difficult. I think it was still using the name of a parent as the guarantor, so the collateral was in the parent's name—it was still safe that way."	Interview 5
Collaborative Ecosystem Development	Cross-sector collaboration	Cross sector collaboration in the industry starts emerging.	"Post-consumer sources include the Uniform Disposal Program (from corporates, institutions, and schools) and the Portable dropboxes we run with collaborators."	Interview 8
	Engagement in ecosystem	Entrepreneurs sharing knowledge each others	"For off-takers, you can find them on Google — plastic factories. We contact and visit them directly. We also collaborate with a company that provides databases of plastic volume and off-taker locations. We connect with that company and execute."	Interview 4

Appendix F: Codes and Themes Categorization

Table F1. Codes and Themes Categorization

Theme	Sub Theme	Code
Financial Barriers	**High Operational and Capital Costs**	High capital needs
		Underpaid staff
		Hiring human resources challenges
		Cash flow issues
	Limited Revenue Potential	Low waste value
		Low customer willingness to pay
		Thin profit margins
	Difficult Access to Funding	Early-stage funding difficulty
		Challenges accessing funding
		Foreign investor leaving
		Investor pressure aversion
Legal Barriers	**Regulatory Gaps and Misalignment**	Lack of waste management/circularity regulation
		Lack of green company regulation
		Misaligned regulations
		Lack of green incentives
	Bureaucratic Complexity	Permit complexity
		Permit difficulty
		Vendor legal permits
	Weak Law Enforcement and Ineffective Implementation	Weak law enforcement
		Ineffective waste bank policy
Market Barriers	**Low Public Awareness and Participation**	Low awareness
		Waste as optional
		Immature market
	Market Saturation by Existing Actors	Collector/processor competition
		Competition with conventional product
		Imported commodities
	Centralized Market Structure	Centralized current market
Technical Barriers	**High Technological Costs and Risks**	High tech cost
		Operation risk in recycling
		Complex processing mechanism
	Accessibility & Adaptability Issues	Low digital literacy
		Machine malfunction
		Limited technology in modular option
	Vulnerability in Public Spaces	Tech vandalism
	Infrastructure Limitations	Lack of waste management infrastructure

Supply Chain Barriers	**Limited Local Processing Facilities**	Lack of processors
		Limited recycling options
		Processor bottlenecks
		Processor dependence
		Export dependency
	Logistic Complexity and Cost	High logistics cost
		Complex supply chain flow
	Supply Shortages & Collection Barriers	Low supply materials
		Drop-off resistance
Financial Drivers	**Availability and Accessibility of Funding**	Funding alternatives
		Easy access to funding
	Favorable Cost Structures and Profitability	Decent profit margin
		Low logistic cost
Legal Drivers	**Strengthening Government Commitment and Support**	Government engagement
		Emerging regulation
Market Drivers	**Growing Demand from Eco-conscious Market Segments**	Potential and emerging market
		Emerging eco-conscious customer
		ESG-conscious demand
		High demand of end product
		Global trend drives local interest
Technical Drivers	**Technology-Driven Operations**	App-based tracking
		Real-time monitoring dashboard
		Waste traceability
		Automated waste recognition
Supply Chain Drivers	**Collaborative Ecosystem Development**	Cross-sector collaboration
		Engagement in ecosystem

Appendix G: Link to consent forms and interview transcripts

Interview Transcript

Interview Consent Form