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## **A Systematic Review for Advancing Inclusive and Sustainable Waste Management in Thailand**

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### **Abstract**

China's 2018 waste import ban caused Thailand to receive excess waste without proper waste management, causing pollution, overflowing landfills, and exploitation of waste pickers. Using mobile platforms to transform Thailand's recycling industry can improve waste pickers' income and well-being, reduce middlemen and transportation costs, and increase government tax revenue. This can contribute to achieving SDGs 1, 8, and 12, reducing poverty, promoting economic growth and decent work, and promoting sustainable consumption and production.

Keywords: Recycling Platform; Fair price; Backhaul logistics; Sustainable Development Goals

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### **1.0 Introduction**

China has prohibited 24 materials from entering the country since 2018, including eight types of post-consumer plastic scrap, one type of unsorted paper, a dozen types of used textiles, and four metal slags containing vanadium. As a result, these waste products redirect to alternative destinations, such as India and many countries in Southeast Asia. Privately-owned facilities can process certain materials.

However, unprocessed residual waste has contributed to exacerbating the existing pollution issue in Thailand. Like many countries, household waste separation for recycling is crucial for urban sustainability and a circular economy. However, mixed waste remains a challenge for municipal governments, as it often leads to landfill disposal. Due to the urgent situation arising from the limitation of landfill space and the negative impact of incineration on air pollution, waste recycling has emerged as a better solution to address this waste problem. (Chen et al., 2018).

In Thailand, the private sector manages almost 100 percent of waste sorting facilities, which often perform sorting at a minimal level and sell the materials to recycling factories (Nguyen et al. 2019). Waste management is a pressing issue, and Thailand has been facing an influx of waste from developed countries, particularly plastics, and paper. Laws and regulations surrounding the dumping or selling of foreign debris in Thailand are currently under review to address this problem.

Creating a reasonable and fair price for waste materials requires a collaborative effort between the government, the private sector, and the waste pickers. By working together and taking a holistic approach, we can create a more sustainable and equitable waste management system for Thailand.



Fig. 1: Amount of waste generated in Thailand  
(Source: [www.btlbangkok.com](http://www.btlbangkok.com))



Fig. 2: Hierarchy of Recycling Chain and Values  
(Source: Authors, 2023)

This situation perpetuates poverty and exploitation and hinders the development of a sustainable recycling industry in Thailand. (Menikpura et al., 2013) Waste picking is, and will be, an essential means of survival for people experiencing poverty (Barford et al., 2021). Waste pickers are a vital part of the informal recycling sector. Still, their exploitation by middlemen means they often need more resources to invest in better equipment or facilities and need help negotiating better prices for their materials. This, in turn, can lead to lower-quality recycled materials, which are less valuable and less useful in downstream manufacturing processes.

Recycling plants in Thailand typically buy various recyclable materials from households, businesses, and industrial facilities. The specific types of waste that they purchase and produce vary depending on the type of recycling plant and the materials they specialize in. Some of Thailand's most commonly recycled materials include plastic, paper, Metal, Glass, Rubber, and Used cooking oil. They play an essential role in reducing waste and conserving natural resources. In addition, they help to divert recyclable materials from landfills and promote a more sustainable approach to waste management.

There are four major categories of waste: municipal solid waste, industrial waste, agricultural waste, and hazardous waste, which manage through different processes. We focus on municipal solid waste (Households, Stores, hotels, restaurants, markets, Schools, hospitals, government centers, office buildings, new construction sites, renovation sites, demolition of buildings, etcetera). This research focuses on identifying an economically feasible solution to address the waste problem and alleviate unfair pricing practices. An online application with offline management and backward logistics could transform the recycling business ecosystem and improve the income and well-being of impoverished and small recycling shops. This solution would reduce the number of middlemen involved in the process, resulting in lower transportation costs. Additionally, as all transactions involving the buying and selling of recycled products would record on a digital platform (Bonino et al., 2016), the government could collect more vat tax. The research goal would be to create a more sustainable and equitable recycling industry that benefits both the environment and the livelihoods of those who collect and recycle waste materials. (De Bercegol et al., 2017)

## 2.0 Literature Review

### 2.1 Inclusive waste management

Inclusive waste management refers to a system that includes and benefits all stakeholders, particularly the informal waste sector and considers social, economic, and environmental factors to create sustainable and cost-effective solutions. (Rutkowski et al., 2015)

### 2.2 Thailand recycling market

The research center of Krungthai Bank has evaluated that Thailand's recycling market will grow by an average of 5.7% annually, from a value of 170 billion baht in 2019 to 224 billion baht in 2024, or 1.2% of the country's GDP. Recycling platforms (Wang et al., 2022) will play a significant role in stimulating waste separation at the source, reducing the cost of collecting and transporting the non-systemic waste (Kulsuwan et al., (2018), and accelerating the return of quality recycled waste to the recycling process, so call "Closed-loop Supply Chain" (Shaharudin, et al., 2022). In addition, people involved will use big data to support the sustainability of businesses. Sponsored by the Bio-Circular-Green Economy (BCG Model) policy, which emphasizes the efficient use of resources, Thailand's government has set a target to eliminate plastic waste by 2027. These policies have raised environmental awareness and stimulated demand for recycled materials in the manufacturing process. However, the main challenge lies in inefficient waste separation at the source. In this regard, circular economy platforms are crucial in creating a network between waste sellers and buyers, leading to a circular flow of recycled materials.

### 2.3 Digital technology related to waste management

Unlike developed countries, where the government carries out municipal waste management systems through digital technology systems using blockchain, IoT, and online platforms (De Wildt et al., 2023), developing countries still manage waste through offline collection by the private sector and rely on labor to separate recyclable waste from organic waste. The popularity of mobile digital platforms (Luthra et al., 2023) and reverse logistic platforms (Matsui, K. 2023) from startup companies has increased as the platform economy continues to evolve daily.

### 2.4 Research gap

The need for studies that have explored the potential of mobile platforms to transform the recycling business ecosystem in Thailand, particularly in terms of creating fair and sustainable pricing practices and improving the well-being of waste pickers and small recycling shops, has to be focused on. The research gap could also relate to the need for more research on the effectiveness of backhaul logistics in reducing the carbon footprint of the recycling industry in Thailand.

## 3.0 Methodology

This research utilizes a systematic review and realist review method (Schenck et al., 2016), a practical approach for exploring complex social interventions such as digital platforms to achieve fair recycling pricing. The realist review approach (Rycroft-Malone et al., 2012) focuses on identifying the underlying theories and mechanisms that drive interventions and exploring how they interact with contextual factors to produce outcomes. This model is used to examine complex interventions and understand how they work in different contexts. It is advantageous when looking at digital platforms' impact on fair recycling pricing.

## 4.0 Findings

### 4.1 Problems and obstacles of small recycling shop

The traditional model of the Thailand recycling business, which is based on real-world trial and error, has faced challenges. When we look at small shops that buy waste materials from waste pickers, they need stability in their business because most of them do business on a rental basis on land and invest minimally in the shop's infrastructure and lack powerful machinery to improve the condition of the products, making them clean and meet the factory's requirements which lead to the oppression from the upper level of the hierarchy. (Fig.2) While many have succeeded, others have incurred losses and had to shut down due to a lack of understanding of the market for recycled goods and the volatility of market prices. At times, certain types of products accumulate in large quantities at high prices, and when prices drop significantly, there needs to be more working capital to purchase new types of products. The issues of labor costs and transportation expenses are also significant obstacles to doing business. Furthermore, some shops buy items without paying taxes, which increases the risk of being audited and facing retroactive penalties. Additionally, the management of these shops is often disorganized and needs a systematic approach. They use illegal workforce from nearby countries. Finally, purchasing items from various categories carries a price volatility risk, which can lead to losses and revolving cash flow.

### 4.2 Problems and Obstacles of waste pickers

Waste pickers in Thailand often face exploitation and unfair pricing practices from recycling middlemen or shops. These middlemen take advantage of the fact that many waste pickers are impoverished and lack social security or employment, which makes them vulnerable to exploitation. Recycling middlemen or shops always exploit and take advantage of these individuals by offering them low prices for the

solid waste they collect or purchase from households for various reasons or justifications. Although recycling factories typically pay two to three times more than what waste pickers get, they are forced to sell their materials to the middleman at a low price due to their vulnerable socioeconomic status. (Schenck et al., 2011)

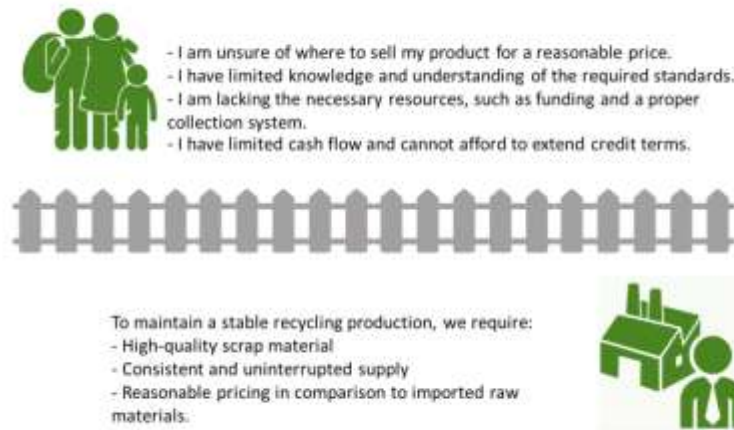


Fig. 3: Recycling Supply Chain Gap  
(Source:) Authors,2023

Creating a reasonable or fair price for waste materials is a complex issue, but there are a few ways to approach it. One method is establishing a pricing system based on the quality and quantity of the collected materials. In addition, this pricing system should consider factors such as the market demand for certain types of waste, the cost of processing the materials, and the profit margin required by the recycling companies. Another approach involves waste pickers and other informal sector members in pricing by giving them a voice in setting prices. This can help to ensure that the prices are fair and transparent.

Another essential step in creating a reasonable price is educating waste pickers on identifying and sorting high-value materials. This can help them to improve the quality of the materials they collect and increase their earning potential. Recycling companies can also help by offering technical assistance and providing access to equipment and processing facilities.

Addressing these issues requires a multi-faceted approach involving government and private sector action. On the one hand, the government can play a role in promoting fair pricing practices and providing support for the development of local recycling industries. On the other hand, private sector companies can create more transparent supply chains and build relationships with waste pickers and other informal sector actors. This can reduce the number of middlemen involved and ensure that waste pickers receive fair material prices. Additionally, technological innovations, such as the online application mentioned earlier, could give waste pickers greater bargaining power and enable them to access more reasonable prices for their materials.

#### 4.3 Suggestions for Using Online and Offline Strategies

By integrating online applications with offline management, waste-buying hubs (buyback centers) can be established in every province, which operates like collection hub. Consumers and waste pickers in nearby areas can sell their waste products to designated hubs, reducing the need for long-distance waste transportation. Backhaul logistics platforms can play a support mechanism to minimize carbon emissions by utilizing empty cargo space on return trips. Combining online and offline strategies can improve waste management and reduce environmental impact. This approach is helpful in digital platforms for fair pricing in recycling, making waste management more efficient and sustainable while ensuring fair prices for consumers. (Truong, 2022)

## 5.0 Discussion

### 5.1 Resistance to innovation (Tang et al., 2023)

It is common when individuals or organizations refuse to adopt innovation or technologies. Regarding digital device recycling platforms, sellers may resist for various reasons, including waste pickers who face difficulties using the platform. Common factors contributing to seller and waste picker resistance include lack of awareness, uncertainty about benefits, concerns about costs and risks, and perceived incompatibility with existing systems and practices. A significant factor contributing to seller and waste picker resistance is a need for more awareness regarding the benefits of digital device recycling platforms. Sellers and waste pickers may need to comprehend the potential environmental and economic advantages of recycling their devices through these platforms or be skeptical about the recycling process's effectiveness.

Additionally, uncertainty about the costs and risks of using a digital device recycling platform can discourage sellers and waste pickers. For instance, sellers and waste pickers may be apprehensive about the security of their data or the likelihood of fraud, or they may not be sure about the expenses of shipping their devices to a recycling facility. Perceived incompatibility with existing systems and

practices can also be a substantial obstacle to adoption for sellers and waste pickers. Sellers and waste pickers may feel the platform is too complicated or time-consuming to use or believe it must align with their existing workflows and processes. Waste pickers, often marginalized and with limited access to digital tools, may need help to adopt and use these platforms effectively. Providing clear and compelling information about the benefits of the digital device recycling platform is crucial in overcoming resistance from sellers and waste pickers which includes highlighting the environmental and economic benefits of device recycling, addressing concerns about costs and risks, and providing training and support to assist sellers and waste pickers in integrating the platform into their existing systems and practices. It is crucial to provide training and support that specifically addresses the needs of waste pickers, including access to digital tools and resources. By addressing these concerns and providing appropriate support, digital device recycling platforms can help to promote more equitable and inclusive waste management practices that benefit everyone.

### *5.2 Challenges and Criticisms Faced by Platform Economy Companies: Regulatory Scrutiny and Calls for Fairness and Innovation*

Platform economy companies have also faced criticism and regulatory scrutiny. For example, some critics argue that these companies have created new forms of inequality, such as exploitative labor practices, unfair competition, and the concentration of wealth and power in the hands of a few large companies. As a result, policymakers and regulators are increasingly looking to regulate these platforms to ensure that they operate fairly and equitably while promoting innovation and growth in the digital economy.

## **6.0 Conclusion and Recommendation**

A platform economy is an economic system where businesses rely on digital platforms to connect buyers and sellers, service providers and customers, or producers and consumers. These platforms typically use digital technologies to create an online marketplace where users can buy, sell, or exchange goods, services, or information.

Examples of platform economy companies include ride-sharing platforms like Uber and Lyft, online marketplaces like Amazon and eBay, and gig economy platforms like TaskRabbit and Upwork. These companies have disrupted traditional business models by leveraging digital platforms to create new marketplaces, connecting buyers and sellers in real-time, and enabling transactions to occur faster and more efficiently.

One of the key advantages of platform economy companies is their ability to leverage network effects. By bringing together large numbers of buyers and sellers, these platforms can create powerful network effects that help increase the platform's value for all users. For example, more buyers on an online marketplace led to more sellers, which in turn attracted even more buyers. This positive feedback loop creates a virtuous cycle that can lead to rapid growth and success.

A recycling platform within the platform economy could benefit the recycling industry and the environment. One key advantage of such a platform is that it could help increase recycling processes' efficiency and effectiveness. In addition, by connecting buyers and sellers of recyclable materials directly, the platform could reduce the amount of waste in landfills and increase the number of recycled and reused materials.

Additionally, a recycling platform operating within the platform economy could address some of the challenges traditional recycling systems face. For example, many recycling programs struggle with low participation rates, as individuals often need clarification about what materials can be recycled, where to recycle them, and how to prepare them for recycling properly. A recycling platform could address these issues by providing individuals with clear and easy-to-use tools for recycling, such as searchable databases of recyclable materials, maps of nearby recycling centers, and step-by-step guides for preparing recycling materials.

Furthermore, a recycling platform within the platform economy could also use digital technologies to provide greater transparency and traceability throughout the recycling process. For example, it could use blockchain technology to create a secure and tamper-proof record of the movement of recyclable materials from collection to processing to end users. This could help ensure that materials are processed responsibly and sustainably and are not disposed of or dumped improperly. Moreover, using a reverse logistics platform with the recycling platform can further reduce transportation costs, increasing profits. Additionally, it promotes a reduction in Carbon dioxide emissions and improves transportation systems' utilization since recycled goods are distributed throughout every province in Thailand. This enables the opportunity to fill transportation vehicles with recycled goods for the return journey, creating a closed-loop system in logistics.

Overall, a recycling platform operating within the platform economy has the potential to help promote a more circular and sustainable economy. By leveraging digital technologies to connect stakeholders, create new marketplaces for recyclable materials, and provide greater transparency and traceability throughout the recycling process, such a platform could reduce waste, increase recycling rates, and promote a more sustainable future.

A recycling platform operating within the platform economy could also support waste pickers and small recycling shops while contributing to achieving Sustainable Development Goals 1, 8, and 12. (Fig. 5)

SDG 1 aims to eradicate poverty and reduce inequality. Connecting waste pickers and small recycling shops to new marketplaces and increasing the demand for recycled materials, a recycling platform within the platform economy could create new economic opportunities and income streams for these groups. This could lift them out of poverty and reduce inequality while supporting the broader goal of promoting sustainable economic growth.

SDG 8 promotes sustainable economic growth, full and productive employment, and decent work. By creating new marketplaces for recycled materials, a recycling platform within the platform economy could promote sustainable economic growth and support the creation of employment in the recycling industry. This could be particularly beneficial for waste pickers and small recycling shops, which often operate in the informal economy and may need more access to formal employment opportunities.



Fig. 4: Integrated platform for achieving SDG goals  
(Source:) Authors,2023



Fig. 5: Model for improving the system  
(Source:) Authors,2023

SDG 12 aims to promote sustainable consumption and production patterns. Increasing the efficiency and effectiveness of recycling processes, a recycling platform within the platform economy could encourage more sustainable consumption and production patterns. In addition, by diverting materials away from landfills and back into the economy, the platform could reduce waste and promote more sustainable use of natural resources.

In summary, a recycling platform operating within the platform economy has the potential to support waste pickers and small recycling shops, promote sustainable economic growth, and contribute to achieving sdg 1, 8, and 12. Creating new marketplaces for recycled materials, increasing the efficiency and transparency of recycling processes, and promoting more sustainable consumption and production patterns, such a platform could help to create a more sustainable and equitable future for all.

However, using just a recycling platform may hinder access to waste pickers due to the need for appropriate equipment. Therefore, establishing multiple hubs or buyback centers in every province could serve as a change agent in purchasing and managing various waste management processes, including providing training and knowledge, which could help address these challenges. (Fig. 5)

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### Paper Contribution to Related Field of Study

This paper contributes to Environmental Design and Sustainable Development.

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