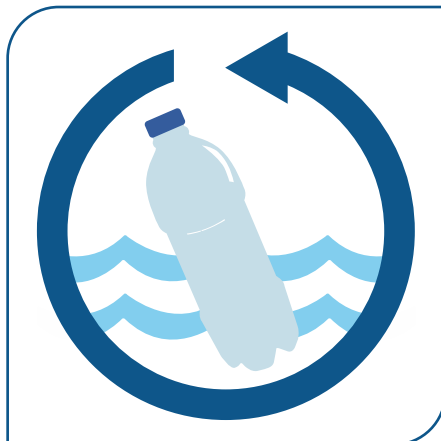


CLOSING THE LOOP

Innovative partnerships with informal workers to recover plastic waste, in an inclusive circular economy approach



SAI MAI DISTRICT, BANGKOK CASE STUDY



Acknowledgements

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Abbreviations

BMA	Bangkok Metropolitan Administration
CO₂	carbon dioxide
HDPE	high-density polyethylene
LDPE	low-density polyethylene
PET	polyethylene terephthalate
PP	polypropylene
PS	polystyrene

1. Introduction

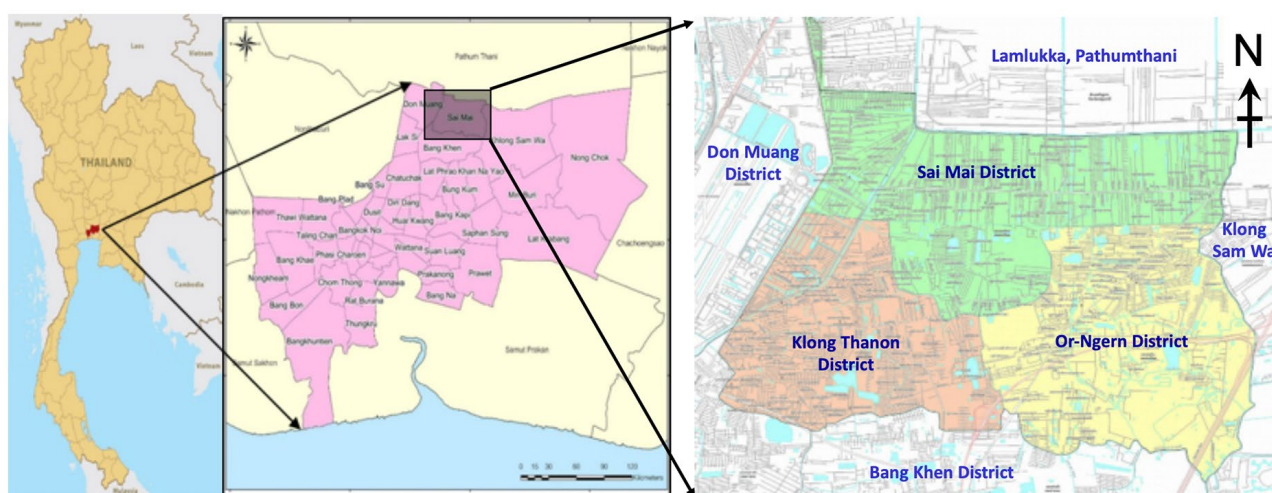
Thailand is one of the five countries globally contributing the most plastic waste pollution into the oceans.¹ Thailand has critical problems with improper waste management infrastructure, poor waste management practices and low public awareness of how or why individuals should be responsible waste generators. In the country's large and growing capital, Bangkok, the situation is becoming increasingly acute.

This case study explores the plastic waste value chain in Bangkok to better understand the contributions of – and links between – formal and informal actors in plastic waste management. The insights from this study hopefully will help determine a range of policy measures that work to enhance the contributions of all level of waste collectors and thus the environmental and economic benefits of an integrated plastic waste management system.

The study centred on plastic waste management in the Bangkok metropolitan area, and specifically in Sai Mai District for more in-depth research. Sai Mai District is one of three waste collection and transportation systems run by the Bangkok Metropolitan Administration (BMA), with waste composition and waste stream flows comparable to many of the city's 50 other districts.

Sai Mai District's population of 203,000 people are located within an area of 44,615 sq km and divided into three districts: Saimai, Or-Ngern and Klong Thanon (see figure 1). The data used for this study were collected by the Stockholm Environment Institute during August and September 2018 and were presented and validated at a city-level workshop in Bangkok (October 2018). Because this case study focuses on one part of the value chain, at the Sai Mai transfer station, and uses limited data due to access issues, it is only a glimpse of the issues of informal waste management in Bangkok. Where presented, the quantitative analysis contains limitations due to the reliance on rough estimates based on secondary data. Deeper research is required to better understand the scale of operations of informal waste workers across the whole of Bangkok and accurately quantify plastic waste flows within the city.

Figure 1: Sai Mai District



Source: Remote Sensing and Geographic Information System, AIT 2016; Sai Mai District Office, 2018.

KEY MESSAGES

- Along with the formal waste management system provided by the Bangkok Metropolitan Administration, the informal sector in Bangkok also has an important role in plastic waste collection and recycling.
- Conservative estimates calculated using secondary data on the number of informal waste actors in Bangkok indicate that they are helping to ensure that large quantities of plastic waste are recycled rather than incinerated or going to landfill. The estimated total amount of plastic waste collected from all sources in Sai Mai District (including the sorting within the Sai Mai transfer station) amounts to around 39.6 tonnes per day, or 14,454 tonnes per year. This activity contributes to significant reductions in greenhouse gas emissions, with more than 21,681 tonnes of CO₂ equivalent avoided in Sai Mai District.
- Conservative estimates indicate that the informal collection, processing and recycling of plastic waste in Sai Mai District enables the Bangkok Metropolitan Administration to avoid an estimated 10 million baht (\$316,000) per year in waste management costs. Across Bangkok's 50 districts, this could amount to 500 million baht (\$15.8 million) per year, which is greater than the average of 437 million baht per year spent for waste collection between 2011 and 2013.
- Informal actors work in unhealthy conditions without any protective gear, are socially marginalized and their contributions are under-recognized by local government.
- To better recognize the positive role of informal actors and better link them with the formal waste management system, local authorities should formally recognize waste picking as a legitimate activity and support the establishment of cooperatives or associations for informal actors, through which they can access training and health and safety equipment and negotiate contracts with formal actors.
- To improve the separation of waste at source, which could significantly improve recycling rates, local authorities should undertake public awareness campaigns to educate and encourage citizens to contribute to recycling efforts.
- Better data on the contribution of informal actors to plastic waste management in Bangkok are still required and are vital to enable evidence-based decision-making and to support the recognition of their contributions and thus scale up plastic recycling in the city.

2. Policy context

Bangkok at a glance²

- Bangkok is situated within the Chao Phraya river delta in the Gulf of Thailand.
- The city has a population of 9.4 million inhabitants and a population density of approximately 3,626 people per kilometre.
- The city's climate is tropical, with a mean annual rainfall of 1,498 mm, with September typically the wettest month (220 mm) of the year.
- Due to the city's proximity to the sea, the river and network of manmade canals that criss-cross the city are critical in draining the city during heavy and intense downpours.
- Management and disposal of municipal solid waste in Bangkok's 50 districts is the responsibility of the Bangkok Metropolitan Administration.
- There are approximately 1,774 informal settlements in Bangkok, housing around 1.8 million people.
- Literacy rates of men and women in Thailand in 2015 were approximately 95 per cent for men and 91 per cent for women.
- Per capita income in Thailand in 2017 was the equivalent of \$6,593.
- In 2016, 11,269 tonnes of municipal solid waste were generated daily.

Solid waste management in Thailand is formally governed by policies, regulations and standards set by the central Government and implemented by local authorities, such as the BMA. At the central level, the Ministry of Natural Resources and Environment has major responsibilities: Its Pollution Control Department provides recommendations on the technical preparation of solid waste management policy and develops relevant guidance, guidelines and processes; its Department of Environmental Quality Promotion disseminates information pertaining to municipal solid waste management; and its Office of Natural Resources and Environmental Policy and Planning prepares policies and prospective plans and administers the Government's Environmental Fund.

In addition, the Ministry of Interior's Department of Local Administration administers the finances of Local Government Organizations and provides support for the preparation of local development plans. The Thai Ministry of Industry's Department of Industrial Works manages waste landfill sites around the country.

These government institutions carry out their activities under the auspices of several national regulations governing municipal solid waste management in Thailand, including the 1992 Public Health Act, the 1992 Enhancement and Conservation of National Environmental Quality Act and the 1999 Decentralization to Local Administrative Organizations Act. In addition, the Government has promoted a National Policy on Waste Management as well as a 3Rs strategy to reduce, reuse and recycle waste.

Within the BMA, the overall environmental management and improvement in the performance of solid waste management is the responsibility of the Department of Environment and the Environment and Sanitation section within each of the 50 BMA district offices. This responsibility includes promoting waste reduction strategies, collecting and sorting waste and applying appropriate technologies that increase the efficiency of solid waste management processes (DOE, 2015).³ The Department of Environment has several units whose work directly relates to solid waste management in Bangkok:

- **Policy and Planning Division**, which is responsible for preparing master plans and occasional plans, solid waste statistics, planning and promoting campaigns on waste separation and minimization and research into waste collection and disposal improvement.
- **Solid Waste, Hazardous Waste and Night Soil Management**, which is responsible for solid waste, hazardous waste, night soil collection, receiving problems from operational unit-collection, handling solid waste, hazardous waste and night soil collection in the event of an emergency, setting up drinking water and garbage containers for special occasions, cleaning roads with machines and coordination with the district offices.
- **Solid Waste Disposal Division**, which is responsible for the management and supervision of solid waste disposal as well as contracting out the activities to ensure highest efficiency and least impact to the environment.
- **Public Park Office**, which is responsible for making Bangkok a “metropolis of the environment” by increasing public parks and miniature parks.

The BMA Department of Public Cleansing, together with the 50 districts, is responsible for cleaning the city and reporting the amount of waste collected from all districts.

In addition to the formal governance arrangement between the central Government and local authorities, there is also significant informal activity around solid waste management, which is often overlooked and under-recognized. This study contributes to making the important contribution of informal actors to solid waste management in Bangkok more visible.

3. Municipal solid waste management in Bangkok

Population growth, economic development and lifestyle changes are the major causes of the increasing waste generation in Bangkok. According to the Pollution Control Department (2017),⁴ around 4.2 million tonnes (or 11,534 tonnes per day) of solid waste was generated in Bangkok in 2016. But only 10,130 tonnes per day was collected.⁵ In comparison, the generation of municipal solid waste in Jakarta and Manila in 2017 was around 3.2 million and 3.17 million tonnes per year, respectively.⁶

The BMA Department of Environment has primary responsibility for the city's waste management and works closely with its 50 district offices. There are about 1,894 waste collection trucks, ranging in size for waste collection services.⁷ Waste is collected directly from accessible households, institutions and businesses by municipal garbage collection crews. Currently, the BMA employs 2,587 collection drivers, 7,591 collection staff and 9,042 street sweepers.⁸ After it is collected, municipal solid waste is transported to three large disposal centres in Bangkok: Sai Mai, On Nut and Nong Khaem (see table 1).

Table 1. Waste transfer stations in Bangkok

Transfer centre	Sai Mai	On Nut	Nong Khaem
Sources	18 districts 14 organizations (government agencies, universities, military)	25 districts 35 organizations	25 districts
Waste transfer contractor	Wasaduphan Thurakit Ltd (private)	Phairot Sompong Phanit Co. Ltd (private)	Klum 79 Ltd (private)
Solid waste transferred (tonnes/day)	2,000–2,300	2,600	3,600
Landfill site location	Kamphaeng Saen District, Nakhon Pathom Province	Phanom Sarakham District, Chachoengsao Province (sanitary landfill)	Kamphaeng Saen District, Nakhon Pathom Province
Other waste disposal measures		Euro West Engineering Ltd. Contracted by BMA to renovate On Nut transfer station and establish a waste composting processor to compost 1,200 tonnes/day	BMA contracted a private company to build and operate an incinerator at Nong Khaem, incinerating 300 tonnes/day and generating 5 MW of electricity.
Principal districts covered	Bangkhen, Bangsue, Bungkhum, Donmuang, Dusit, Jatujak, Khannayao, Khlongsamwa, Ladphrao, Laksi, Phyathai, Rajathewi, Saimai and Wangthonglang	Nong Chok, Min Buri, Lat Krabang, Prawet, Saphan Sung, Bang Kapi, Suan Luang, Phra Khanong, Bang Na, Khlong Toei, Watthana, Huai Khuang, Din Daeng, Pom Prap Sattru Phai and Samphanthawong	Thawi Wattana, Bang Khae, Nong Khaem, Bang Bon, Bang Khuntien, Thung Kru, Chom Thong, Phasi Charoen, Taling Chan, Bang Phlat, Bangkok Noi, Bangkok Yai, Thon Buri, Bang Kho Laem, Yan Nawa, Sathon, Bang Rak, Khlong San, Pra Nakhon, Rat Burana, Pathum Wan, Ratchathewi and Dusit

Note: Some of Bangkok's 50 districts send their waste to more than one waste transfer centre, taking advantage of geographical proximity to reduce the cost of transportation. As a result, the district sources of waste across all transfer centres is greater than 50.

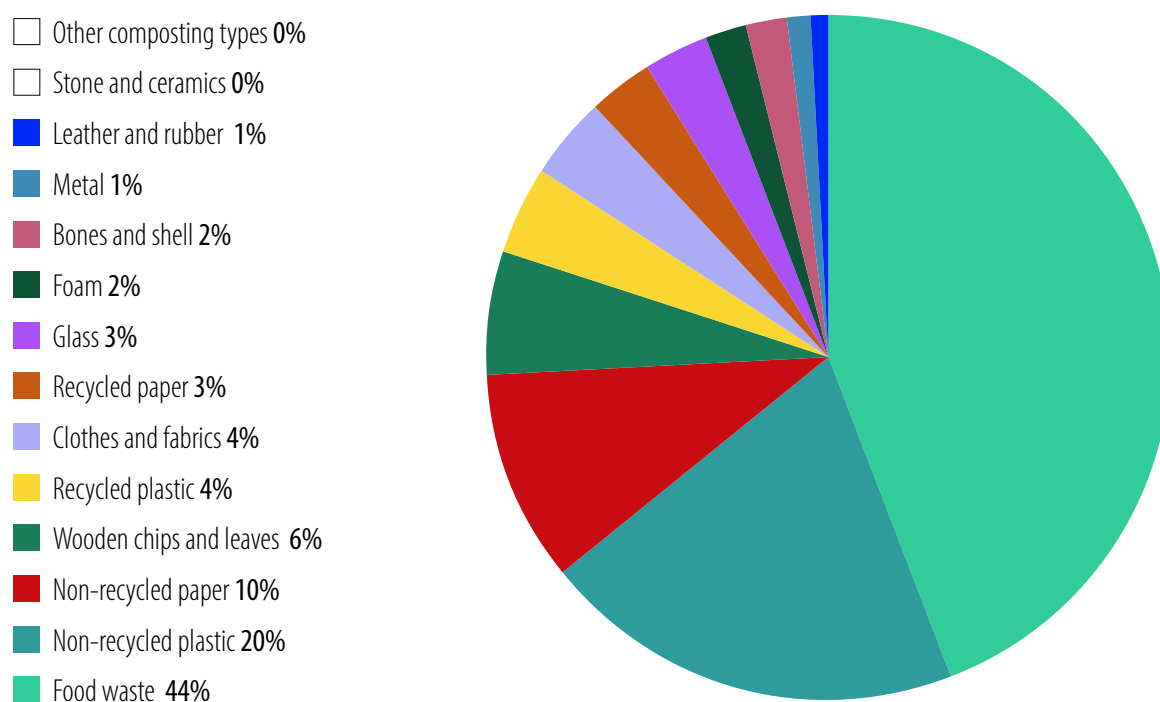
Source: DOE, 2015; Jungrungrueng, 2014.

The remaining solid waste is disposed at landfill sites located outside of the Bangkok metropolitan area. Waste from Sai Mai and Nong Khaem transfer stations is taken to a landfill site in Kamphaeng Saen District, Nakhon Pathom Province; waste from On Nut transfer station is taken to a landfill site in Phanom Sarakham District, Chachoengsao Province.

To minimize waste generation and waste to landfills as well as promoting waste separation, the BMA launched reduce, reuse and recycle (3R) campaigns in several domains that target households, communities, schools, and institutions. Specifically, the BMA highlighted the importance of recycling as a core mechanism in waste minimization and initiated pilot activities as a model for community-based waste management. Although there have been a number of campaigns encouraging residents to reduce waste generation and conduct waste separation before disposing⁹ only 8 per cent of the total population separates their waste.¹⁰ This is important because source separation is a key factor in the economic value of recyclable waste.

The composition of the BMA solid waste is 49.9 per cent organic, which could be diverted to produce compost, biogas or animal feed. On average, 12.7 per cent is recyclable waste and 37.4 per cent is non-recyclable, or non-utilized solid waste. Of the latter, 20 per cent is non-recycled plastic that could be either reduced if appropriate policies were introduced to stop it entering the waste stream or recycled if appropriate technologies were introduced (see figure 2). Either way, there are significant opportunities for increasing recycling rates in Bangkok.

Figure 2: Municipal solid waste composition in Bangkok (% weight)

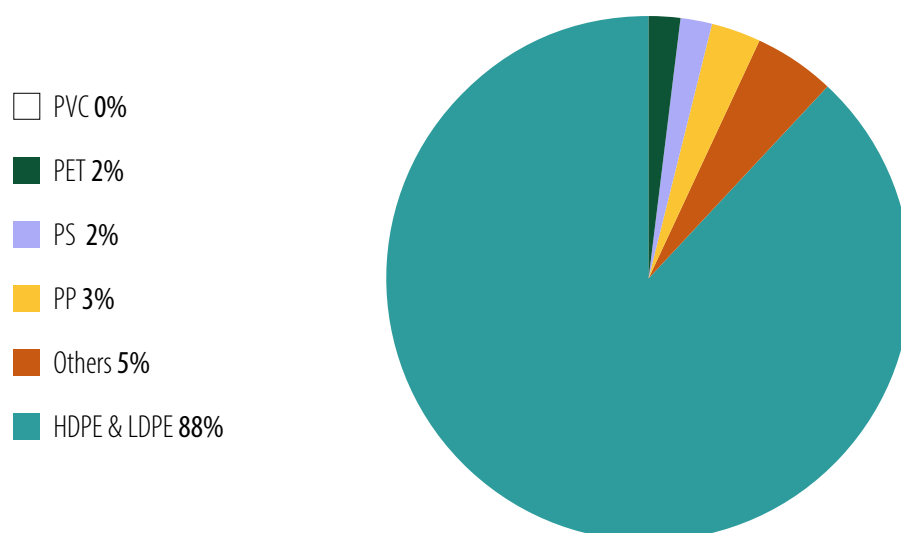


Source: DOE, 2017.

4. Plastic waste value chain

In Bangkok, there are five main types of recyclable plastic (figure 3) that enter the solid municipal waste stream: high-density polyethylene (HDPE), low-density polyethylene (LDPE), polyethylene terephthalate (PET), polypropylene (PP) and polystyrene (PS).

Figure 3: Composition of different types of plastic waste in Bangkok

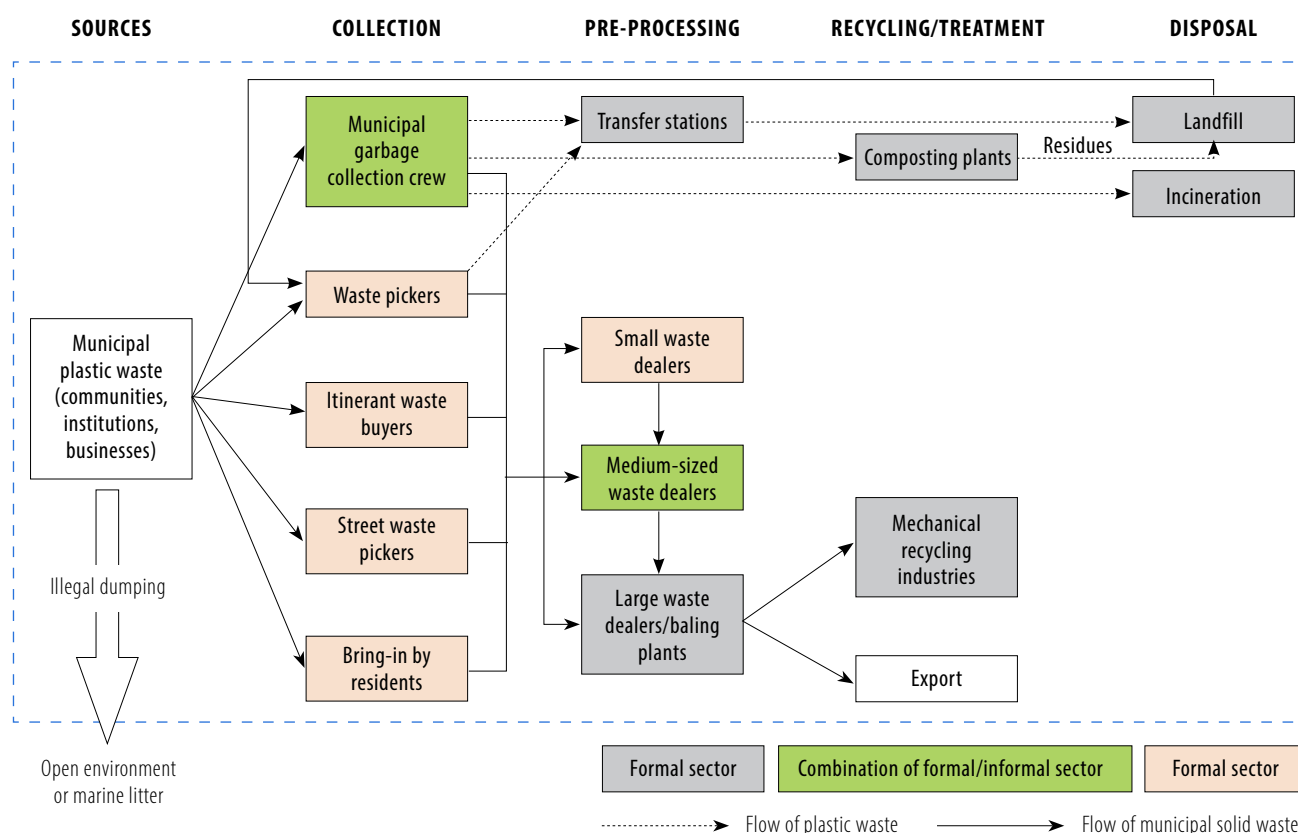


Source: Kamala, 2013.

As shown in figure 4, plastic waste flows through Bangkok in a number of ways.¹¹ Plastic waste is generated alongside solid waste from several sources, such as communities, institutions and businesses. Plastic waste in mixed solid waste is first collected by the formal municipal solid waste management process, which involves collection by municipal garbage collection crews, processing at transfer stations and disposal at landfill sites, composting plants and incineration plants. There are several stages in which plastic separation takes place. For example, at composting plants run by private companies contracted by the BMA, plastic items in mixed solid waste are separated out by informal workers before the composting process. High-value plastics with a resale market, such as plastic bottles, plastic food containers and plastic cups, are separated out to be sold. The remaining plastic waste, with low value and no market, such as plastic bags and plastic straws, are taken to landfill. At the transfer stations and landfill sites, there are also groups of waste pickers separating valuable plastic waste to sell.

Alongside the formal waste management system, the informal waste sector has a major role in collecting and separating plastic waste for recycling at source. They are itinerant waste buyers (known as *salengs*) and street waste pickers. After collecting and sorting plastic waste from households and/or bins at public spaces, they sell to the small waste dealers or junkshop owners who operate without the permission from the local government. Some buyers and pickers sell to medium-sized waste dealers, some of which are registered with the local government. Small and medium-sized waste dealers are the middlemen in the plastic waste value chain, connecting informal actors with formal recycling plants.

Figure 4: Actors involved in plastic waste management in Bangkok



Source: Authors, adapted from The Bangkok Post, 2012 and Sukholthaman, P. and Shirahada, K. (2015). Technology in society technological challenges for effective development towards sustainable waste management in developing countries: Case study of Bangkok, Thailand. *Technology in Society*, vol. 43, pp. 231–239.

4.1 Collecting and sorting plastic waste

Plastic waste materials are collected, sorted, processed and traded by four groups of actors working informally: BMA garbage collection crews, itinerant waste pickers known as *salengs*, street waste pickers and waste pickers at transfer stations. Each informal group collects and separates waste at different locations and using different methods (see figure 5).

Figure 5: Waste collection activities in Bangkok



(a) BMA garbage collection crews

(b) *Salengs*

(c) Street waste pickers



(d) Waste pickers at transfer station

Source: Nguyen, 2017.

(a) BMA garbage collection crews

During collection of solid waste from waste bins, formalized BMA garbage collection crews also separate out recyclable plastics for selling (see figure 5). Any recyclable plastic that is found is put into large bags or containers and loaded onto the back or top of a truck before the crew moves onto the next collection point. In Sai Mai District, garbage collection crews reported collecting around 100 kg of potentially recyclable plastic waste per truck per trip. At the end of their shift, they sell the plastic waste informally to fixed waste dealers situated near the transfer station and with whom they have an established relationship. The owner of the waste dealers might provide promotions to attract BMA garbage collection crews to sell the recyclable plastics they collect. For example, they may offer a higher price than other nearby shops or they might add 10 per cent onto the total price when the crews sell plastic waste to their shops. The plastic waste is typically sold for around 6–7 baht per kg and the money is divided equally among the crew. Each crew member could earn additional income of up to 150–200 baht per day on top of their BMA wage.

(b) Salengs

Rather than discarding plastic waste into collection bins, many households, institutions and businesses sort their plastic and sell it to *salengs*, who travel around on small motorcycles or tricycles collecting potentially recyclable waste, including plastic (see figure 5). Most *salengs* have taken on the role because it has been a family tradition, and they usually work in an area no more than 5 km from their home. *Salengs* buy recyclable plastic waste at 5 baht per kg and sell it to waste dealers with whom they have a relationship and are located near to where they reside, for 9 baht per kg. Most *salengs* earn around 700–800 baht per day after expenses, of which around 400 baht per day might come from the purchase and sale of recyclable plastic. Depending on the season, *salengs* may make three to four daily trips to collect waste and might expect to buy and sell up to 100 kg of recyclable plastic per day.

Salengs typically sell the plastic they collect on a daily basis for two reasons: first, to generate revenues that go to supporting the purchase of recyclable items the following day; second, because they have no storage space. As a result, *salengs* are not always in a strong position to negotiate prices because they are under daily pressure to sell what they have collected. There is no data on the number of *salengs* in Bangkok, but their presence likely will continue to increase because there are few barriers to entering the work, making it an attractive option to poor low-skilled migrants to the city.

(c) Street waste pickers

Street waste pickers make a living collecting potentially recyclable plastic from waste bins in public and residential areas (see figure 5c). They mostly collect plastic PET bottles because of the higher price it attracts, and they typically travel on foot, by bicycle or with a cart, which limits the amount of waste they can collect and the area within which they work. Some street waste pickers carry large bags and walk along the sidewalks of streets collecting recyclable plastic. Others have small two-wheel carts and collect the waste along the way until the cart is full. When their bags or cart is full, they take the plastic waste to a nearby waste dealer, usually one with whom they have an established relationship. A street waste picker might expect to collect around 40–50 kg of plastic per day and earn about 300–400 baht a day.

(d) Waste pickers at transfer station

Waste pickers who operate within the three waste transfer stations in Bangkok earn their income by sorting, separating and selling recyclable plastic from the municipal solid waste before the waste is transferred to landfill sites (see figure 5d). Transfer stations do not have any system for sorting waste into recyclable and non-recyclable materials. In Sai Mai, the private company running the transfer station subcontracts a large waste dealer to collect and separate recyclable material within the premises. According to Nguyen (2017), this waste dealer organizes 40–60 waste pickers to do the collecting and separating work. Most of the waste pickers come from north-east Thailand (70 per cent) and Cambodia (30 per cent), attracted by an invitation to join friends or family already working at the transfer station.¹² The waste dealer provides them with free accommodation nearby and free water, but they have to pay for electricity use. In return, the waste pickers must register with the waste dealer to get permission to go inside the transfer station, and they have to sell all recyclable material they collect to the waste dealer. Each waste picker has a private storage area in the station where they store the recyclable plastic they collect and use as a rest area during breaks. After finishing their working day, they spend time separating the different types of recyclable plastic they have collected before selling to the waste dealer.

4.2 Trade and pre-processing

After sorting by informal waste collectors, recyclable materials are sold to waste dealer shops – also referred to as junk shops or scrap shops, including both licensed and unlicensed dealers. These waste dealers often trade among themselves, with the largest dealers among them selling plastic in bulk to recycling centres after limited pre-processing. Almost all recyclable plastic that is bought and sold in the plastic waste value chain goes through these waste dealerships, and they are considered a vital link between informal waste collectors and formal recycling plants.

Waste dealers usually have permanent storage yards where waste is separated and pre-processed. According to the BMA Department of Environment, an average of 3,125 tonnes per day of recyclable material were separated and sold to waste dealers in 2014.¹³ And a survey by the Pollution Control Department in 2009 led to an estimate of 10,200 waste buyer shops in the recycling sector across Thailand, 30 per cent of which were located in and around Bangkok and most of which were small and medium in size.¹⁴

Before plastic waste is sent to recycling plants for processing into fully recycled plastic, it goes through pre-processing, such as sorting into different types of plastics, cleaning and compressing to reduce the size (all of which is done either by waste dealers or by informal waste collectors). This increases the value of waste before it is sold. Waste dealers are looking to sell to each other or to recycling plants for the highest price. Many have transportation vehicles, which they may use to transport plastic to bigger waste dealers or recycling plants. Informal waste collectors are also looking to sell to waste dealers for the highest price, although they typically have much less negotiating power, for reasons mentioned earlier.

Most informal waste pickers separate different types of plastic waste before selling to get a higher price, but some sell mixed plastic, even though they know they will be paid a lower price. Some of the waste dealers interviewed said they often refuse plastic waste from street waste pickers and municipal garbage collectors because it is contaminated by wet organic waste that was put in the garbage bin; it is then smelly and hard to separate.

A few waste dealers also claimed that informal waste collectors sometimes do not provide accurate information on the amount of plastic they have brought or how contaminated it is, although many waste dealers have scales to weigh the waste. But many waste dealers gain more profit by separating the waste themselves before sending to the larger waste dealers or recycling plants. Many of them remove the labels of the plastic bottles to increase their value. Table 2 presents the buying prices of plastic waste at waste dealers and recycling plants.

Table 2: Buying prices of plastic waste

Plastic category	Subcategory	Buying price (baht/kg)		
		Waste dealer	Recycling plant	Manufacturing industry
HDPE	HDPE with plastic and foil paper	5–9	16	26–27
	HDPE without plastic and foil paper		25	
	Milk bottle separated according to its category (label, cover and foil removed)		18	
	Gallon with label and foil		16	
	Gallon		20	
	Gallon (fully separated – label, cover, foil)		22	
	Betagen bottle – milk bottle (with label and foil)		15	
	Betagen bottle – milk bottle		16	
PET (clear)	PET bottle	6–9	13	
	PET bottle (colour separated and label separated)		16.5	
	PET bottle (If the colour of the cover is already separated)		18	
PET (green)	No separation		9	
	Fully separated		10	
PET (colour)	Mixed	1–2	4	
	Mixed coloured PET but separate label, foil and cover		6	
PP	With label, sticker, foil	8	14	
	Fully separated		18	
Cover (except black cover)	Cover (except black cover)		11	
PVC	Transparent (no separation (no label, foil, cover)	6–7	12	
	Transparent (fully separated		14	
	Transparent and yellow		6	
Black plastic bag		1–2		
LDPE		5		
Food and beverage packaging		2–3		
Mixed plastic		2–3		

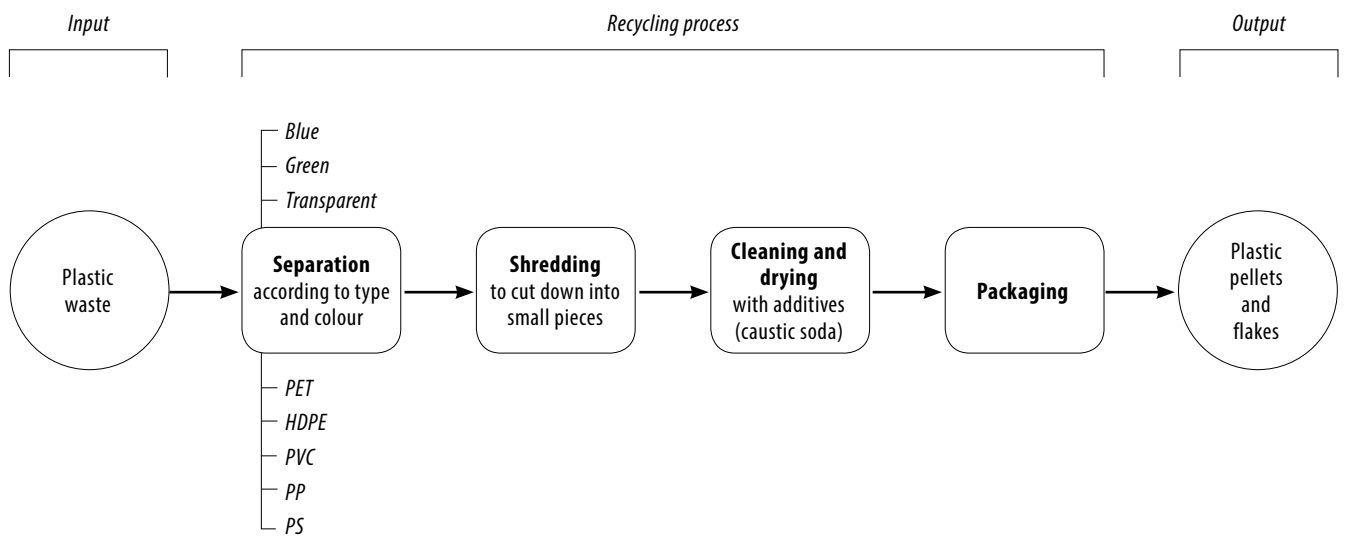
Source: Authors' case study interviews.

4.3 Recycling

Recycling companies separate, shred, clean, dry and package plastic waste to be sold to plastic manufacturers as raw material for production of clothes and new plastic products (see figure 6). Plastic is first separated according to its colour (blue, green, coloured, transparent) and type (PET, HDPE, PVC, PP and PS). Transparent plastic has the highest value because it can be remade and converted into any other colour.

After separation by informal workers at recycling plants, the plastic waste is sent to a shredding machine that cuts it into small pieces. These pieces are then cleaned with caustic soda flakes to wash away any dirt and then dried and packaged. The final products are plastic pellet and plastic flakes, which are sold to plastic manufacturers at a price of 26–27 baht per kg. They are packaged and sent to plastic manufacturers. A typical recycling plant might produce about 30 tonnes per day of plastic pellet and plastic flakes. Prior to shredding, plastic residue that has not yet been removed and that is of no value due to its low quality for recycling, such as the label of plastic bottles, builds up. It is usually separated and compressed before being sent to the INSEE company in Saraburi Province for use as fuel in their cement production plant. Approximately 20 tonnes of plastic labels are sent up to three times per month.

Figure 6: Recycling process



Source: Authors.

Table 3 highlights the types of products that use this plastic material. We were unable to find any data on how much of Bangkok's plastic waste is not recyclable at all and how much is technically recyclable but not actually recycled for other reasons, such as lack of technology, economic infeasibility or limited demand.

Table 3: Recycled plastics in the solid municipal waste stream in Bangkok

Type		Use	Recycled products
High-density polyethylene (HDPE)		Piping Automotive fuel tanks Bottles Toys	Pipes, household appliances, flower vases, bins, furniture, bottles (not for food)
Low-density polyethylene (LDPE)		Plastic bags Cling film Flexible containers	Waste bags, carrier bags, furniture, plastic slabs, agricultural plastic sheets
Polyethylene terephthalate (PET)		Bottles Carpets Food packaging	Carpet, textile industry, jackets, bedding, packaging, and bottles or containers
Polypropylene (PP)		Food containers Battery cases Bottle crates Automotive parts Fibre	Plastic brooms, Brushes, buffers and battery cases
Polystyrene (PS)		Dairy product containers Tape cassettes Cups and plates	Rulers, panel power switches, thermal insulation, thermometer bulbs, egg trays
Polyvinyl chloride (PVC)		Window frames Flooring Bottles Packaging film Cable insulation Credit cards Medical products	Trough for agriculture, water supply pipes, traffic cones, cable, cassettes, plastic chairs, furniture, artificial wood

Source: Kamala, 2013.

2.6
tons

Municipal
garbage
collection
crews



Average amount
of recyclable
plastic waste
collected daily

2
tons

Informal
waste
pickers



The formal and informal sectors
make similar contributions
to recycling efforts in Sai Mai

Recovering plastic waste prevented
21,681 TONS OF CO₂
equivalent emissions
per year from avoided
fossil fuels

INFORMAL WASTE SECTOR

Plastic waste is gathered from communities,
institutions, and businesses

Differences in sale value
determine materials collected

CLOSING THE LOOP

INTERMEDIARY

Plastic waste is sorted by type and
color and amassed at transfer centers

The plastic waste buyers demand
certain kinds of plastic more than others

**AVOIDED EMISSIONS
ARE EQUIVALENT TO THE
ANNUAL CO₂ EMISSIONS...**



from
287 trucks'
worth of
gasoline



from
2.76 billion
smartphones
charged



avoided by
operating
4.6 wind
turbines

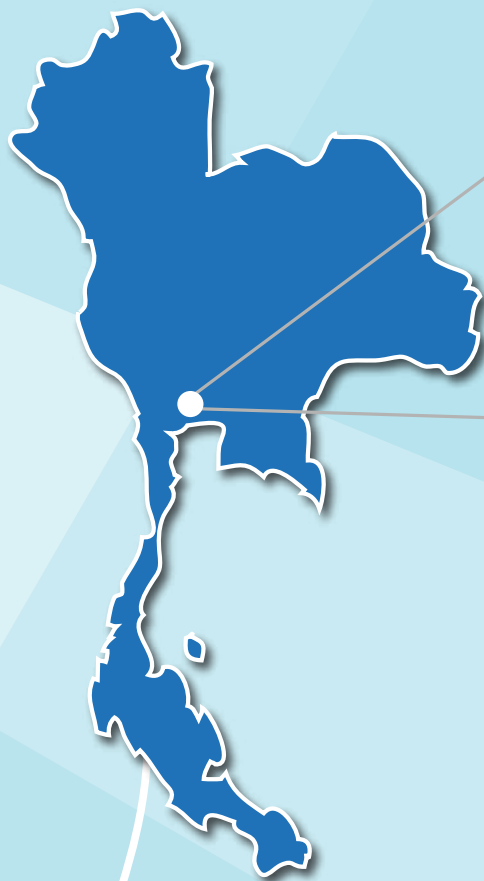
unlocking an
inclusive
circular economy
approach

**Sai Mai District
Bangkok**

Recyclable plastics are broken down,
cleaned with additives, and packaged

Plastic pellets and flakes are sold to
manufacturers to be produced into new goods

PRODUCTION SUPPLY CHAIN



AN ADDITIONAL
1404 TONS GOES
UNCOLLECTED DAILY



THERE ARE AN ESTIMATED
250 SALENGS
(INTERANT WASTE PICKERS) AND
100 STREET WASTE PICKERS



This is the only point
in the value chain where
mechanical technology
is utilized



Pellets and
flakes sell for
26-27 TBH/kg

Lack of recognition

- Officially **register** informal waste workers, provide ID cards
- Provide **health and safety equipment** and **welfare services** to informal workers
- Leverage social media to promote **positive public narratives**

CHALLENGES AND ACTION POINTS

- **Household level** education on waste separation before entering waste stream
- Provide environmentally friendly, safe **sorting spaces**
- **Educate** informal workers on **impacts** of illegal dumping

Limited separation
at source and
illegal dumping

- Encourage workers to organize e.g. into **cooperatives**
- Expand **innovation and experimentation** with waste management technologies

Lack of technical
capacities and
financial incentives

5. Environmental impacts of plastic waste management

Formal and informal workers in the municipal solid waste system are important in plastic waste recycling and recovery in Sai Mai District. They provide significant contributions in terms of environmental benefits to the district, city and surrounding environment. Quantifying this contribution, however, requires the collection of primary data on the population of informal workers engaged in municipal solid waste management activities. Such data collection was beyond this scope of this study.

For the purposes of this discussion, we used secondary data from the 2003 *Thailand Environment Monitor* (which focused on solid and hazardous waste management) to help generate quantitative estimates of the number of informal waste workers in Sai Mai District. In 2003, there were an estimated 25,000 people informally working in the waste sector across Bangkok's 50 districts, including around 15,000 salengs.¹⁵ From this, we assumed there to be roughly 300 salengs and 100 street waste pickers in Sai Mai District.¹⁶ We believe these to be conservative estimates; it is reasonable to expect that the total number of informal waste workers in Bangkok has significantly grown in the past 15 years.

By using these estimates, we were able to give qualitative information and calculate rough quantitative figures for the important contribution made by different groups of workers in the plastic recycling value chain in one district of Bangkok. All calculations based on these estimates, however, should be understood as containing a considerable margin of error. More substantial data collection is needed to provide robust quantification of the environmental benefits, particularly regarding the numbers of informal workers in Bangkok.

5.1 Impacts of recycling

Based on the data presented in section 4 and the estimated total numbers of informal workers (above), we calculated that in Sai Mai District, salengs collect 30 tonnes of plastic waste per day (300 salengs x 100 kg per day) and street waste pickers collect a total of 5 tonnes of plastic waste per day (100 street waste pickers x 50 kg per day). Also noted in section 4, municipal garbage collection crews in Sai Mai District collect about 100 kg of plastic waste per day per trip, amounting to 2.6 tonnes per day. Waste pickers at the Sai Mai transfer station collect about 2 tonnes per day of plastic waste for recycling (although this is collected from the waste that originates from the 18 districts that the Sai Mai transfer station services). This leads to a total amount of plastic waste collected from all sources in Sai Mai District (including the sorting at the Sai Mai transfer station) of around 39.6 tonnes per day, which amounts to 14,454 tonnes per year.

For every 1 kg of recycled plastic material, an estimated 1.5 kg of CO₂ equivalent is avoided. Thus, the formal and informal actors in Sai Mai District are helping to reduce more than 21,681 tonnes of CO₂ equivalent from avoided fossil fuels per year. The plastic waste collected by informal actors is returned to the plastic production cycle, which reduces the amount of plastic waste entering rivers and oceans and reduces the amount of new plastic that is needed.

Nonetheless, secondary environmental pollution does occur during the collecting, separation and cleaning of plastic waste for recycling by both the formal and informal workers. Plastic waste that is contaminated by wet waste is often cleaned to increase the price it can be sold for. Plastic residues that are of no value are also often discarded directly into canals, thus causing environmental pollution as well as potential plastic leakage into the ocean.

Another negative impact may include potential water pollution from recycling process at recycling plants, such as cleaning of plastic waste with additives. Finally, there is potential noise pollution created by recycling machinery and air pollution from storage yards. Finally, there is concern that alternatives to recycling, such as incineration (including waste to energy) emit hazardous waste and air pollution as well as potentially reducing opportunities of informal waste pickers to earn income through the sale of recyclable material. This issue warrants further investigation to compare alternative strategies to managing recyclable municipal solid waste, including plastic waste, to understand the barriers and opportunities to recycling.

5.2 Leakages

As shown in figure 7, there are several potential leakages of plastic waste in the study area that contribute to marine litter. By understanding where plastic could be leaking, the decision makers then should take action to first try to estimate the leakage and then seek solutions to it.

The first potential leakage is illegal dumping of waste before it enters the waste management stream, typically in cases in which waste collection services are not available or where citizens live near waterways. The Chao Phraya river meanders through Bangkok in a southward direction, and although the BMA provides waste collection services for the whole city, many people living near the river – or canals that feed into the river – choose to dump their waste directly into these waterways. According to the *Bangkok State of Environment 2015–2016* report, around 18 tonnes are collected from these waterways per day.¹⁷

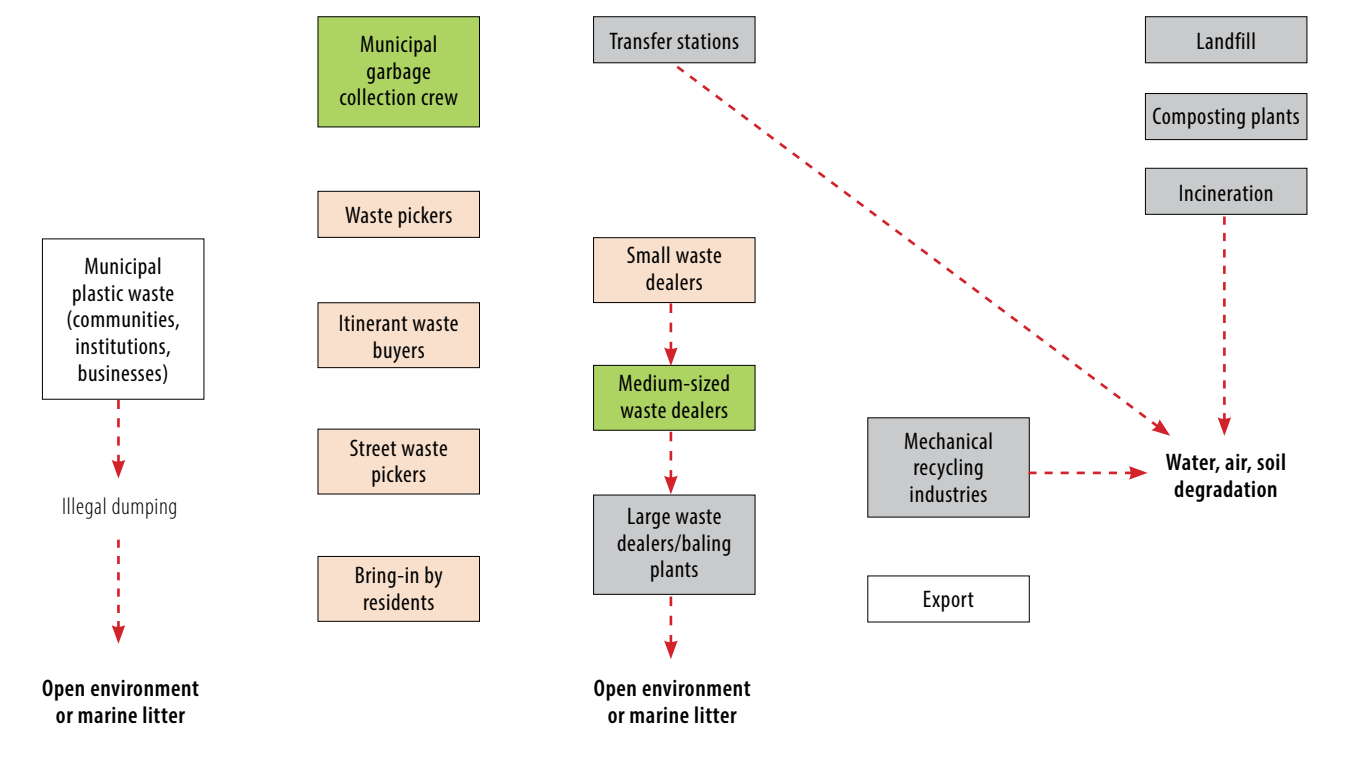
Another factor leading to plastic leakage from waterways into the ocean is flooding during the rainy season, which brings about 50 inches of rain.¹⁸ To enhance the waste collection from the BMA, it is imperative to raise awareness among households on the importance of separation at source and appropriate disposal of waste. It is also important to educate urban residents about the detrimental environmental impact of low-value single use plastics and the need to reduce the consumption of single-use plastics.

For the plastic waste collected and entering the plastic recycling value chain, the second potential plastic leakage is illegal dumping of residue from waste dealers. Not all plastic material sold to waste dealers and recycling plants is recycled properly. There are some types of plastic residue that are separated because they have little or no value and cannot be easily recycled. Thus, they are dumped into the surrounding environment and leak into the rivers and ocean. According to the survey of waste dealers and recycling plants, most of these residues are labels, caps of plastic bottles and other parts of plastic products. Materials separated in recycling plants are often sent as waste to energy plants and/or cement factories for fuel production, but others are discarded directly into the open environment.

Thus, there is a need to further educate all actors in the waste management sector, including informal actors, of the need to protect the environment from such harm and to properly dispose of plastics that have no recycling value.

The final potential leakage of plastic waste is directly from landfill sites where wind, heavy rains and storms might lead to leakage of plastic waste. Because plastic waste has a longer lifespan than other waste, much of the municipal solid waste at old landfill sites is plastic waste. With inappropriate management and control, plastic waste, such as plastic bags, are easily taken away by wind and stormwater after heavy rains. This plastic waste then enters the drainage system, passing into waterways and finally the ocean.

Figure 7: Potential plastic leakages into the environment



Source: Authors.

6. Socioeconomic impacts of plastic waste management

This study found some important socioeconomic impacts of informal workers' contribution to plastic waste management in Bangkok, based on the activities taking place in Sai Mai District. As with the environmental impacts, however, more in-depth research is required to quantify the financial savings, income generation and health impacts associated with informal plastic waste management.

6.1 Financial savings from informal recycling

Informal waste collectors directly contribute towards reducing solid waste management costs in two ways: first, by reducing the amount of waste going into the transfer station and, second, by reducing the amount of waste going into landfill. The estimated cost savings in Sai Mai District generated from these two practices are presented in table 4. Maintaining the estimate of 300 salengs and 100 street waste pickers in Sai Mai District (see section 5.1), we calculated they collect at least 35 tonnes per day of plastic waste, while the BMA garbage collection crews in Sai Mai District collect only 2.6 tonnes per day. The collection, processing and recycling of this waste means it does not go to the transfer station, thus avoiding the disposal fees that the BMA must pay the company running the transfer station for every tonne of waste it unloads. The avoided cost of these disposal fees is estimated at 10 million baht (\$316,000) per year.

Across Bangkok's 50 districts, this avoided expense could amount to 500 million baht (\$15.8 million per year, which is greater than the average of 437 million baht per year that the BMA spent for waste collection between 2011 and 2013.¹⁹ These avoided costs are also comparable to what other cities around the world experience: In their study, Scheinberg and others (2010) estimated that informal waste collectors in Lima (Peru), Cairo (Egypt) and Quezon City (Philippines) – cities similar in size to Bangkok – contributed to annual avoided waste collection and disposal costs of around \$15.9 million, \$13.7 million and \$3.9 million, respectively.²⁰ These estimated cost savings indicate a strong financial incentive for the BMA to support informal actors in continuing and improving their role in reducing and managing plastic waste in Bangkok.

There is also an incentive for private companies managing waste transfer stations to support informal actors, particularly waste pickers inside the transfer stations, to reduce the volume of waste. In the Sai Mai transfer station, which receives waste from up to 18 districts within Bangkok, informal waste pickers collect roughly 2 tonnes of plastic waste per day. They collect this waste from among the municipal solid waste that is unloaded in the transfer station, for which the BMA pays them 735 baht per tonne. The company running the transfer station has to then pay 715 baht per tonne to send this waste to landfill. The 2 tonnes of plastic waste per day collected by the informal waste pickers inside the transfer station saves the company 1,430 baht per day and almost 522,000 baht (\$16,500) per year in avoided landfill fees. Hence, the more plastic waste collected within the transfer station that is prevented from going to landfill, the more profit the company makes.

Table 4: Estimated avoided costs from collection of plastic waste in Sai Mai District and Sai Mai transfer station

Type	Value	Unit
Estimated avoided costs in Sai Mai District		
Plastic waste recovered by <i>salengs</i> in Sai Mai District	30	tonnes/day
Plastic waste recovered by street waste pickers in Sai Mai District	5	tonnes/day
Plastic waste recovered by municipal garbage collection crews in Sai Mai District	2.6	tonnes/day
Total plastic waste recovered by <i>salengs</i> , street waste pickers and municipal garbage collection crews in Sai Mai District	37.6	tonnes/day
Disposal fee (which includes landfill costs) that BMA pays the private company running Sai Mai transfer station	735	baht/tonne
Daily BMA waste disposal savings in Sai Mai District	27,636	baht/day
Annual BMA waste disposal savings in Sai Mai District	10,087,140	baht/year
Estimated avoided costs in Sai Mai transfer station		
Plastic waste recovered by waste pickers inside Sai Mai transfer station	2	tonnes/day
Landfill fee that the private company running Sai Mai transfer station pays for sanitary disposal at landfill site	715	baht/tonne
Daily private company landfill fee savings	1,430	baht/day
Annual private company landfill fee savings	521,950	baht/year

Source: Calculation from estimated populations of informal workers in Sai Mai District and data from interviews (in September 2018) with BMA officers and managers of the private company managing the Sai Mai transfer station.

Beyond the avoided disposal and landfill costs, there are considerable savings on labour costs for the services provided by informal workers who collect and recycle plastic waste, as well as the avoided labour costs for cleaning the environment had that plastic waste not been collected and recycled but instead dumped into the environment. It is clear that the BMA benefits in terms of labour costs from the activity of informal workers in plastic waste management. The study by Scheinberg and others (2010) estimated the number of informal workers in the waste sector in Cairo, Lima and Quezon City to be roughly 33,000, 17,500 and 10,100, respectively.²¹ As referenced in the previous section, the 2003 *Thailand Environment Monitor* cited an estimate that the Bangkok metropolitan area had 25,000 people working informally in the waste sector, providing services that the municipal authority is expected to undertake using government funds.²² If the number indeed has grown significantly in the past 15 years, which is reasonable to expect, then the cost savings are likely much higher. Further research is required to better analyse this issue, and a full life-cycle analysis would help to calculate other financial savings, such as avoided costs due to the disruption to fishing from plastic-related incidents and the avoided costs of cleaning litter from waterways and oceans.

6.2 Social impacts on informal workers

Living and working conditions are the main focus in terms of social aspects of informal waste pickers because they typically come from poor, marginalized and vulnerable groups.²³ Nguyen (2017) estimated that, on average, a waste picker at a transfer station in Bangkok works about 9.6 hours per day, with the longest work day at 13 hours and the shortest at 5 hours, and they work seven days per week. The informal waste pickers collect waste at different times: Some work at night, from 8 p.m. to 8 a.m., and some work from 12 a.m. to 5 a.m. or 8 a.m. The informal waste pickers we interviewed mentioned they often prefer

to work at night to avoid the sunlight and hot weather. However, they encounter some challenges while collecting recyclables at night due to the lack of lighting. Another challenge is that at night time, more trucks come to dump waste than in the day time; as a result, it is hard for them to work because traffic jams occur inside the transfer station, which disturbs their routine. Working at night can also be a concern for female informal waste pickers; some studies have highlighted incidents of sexual harassment. This was not reported by any of the informal waste pickers we interviewed.

The group of informal waste pickers working during the day, begin around 8 a.m. and stop around 5 p.m. or 6 p.m. During their working time, they take a break if they are tired, and normally they have lunch inside the transfer station. Most waste pickers interviewed use protective equipment to collect waste, such as gloves, shoes and mask. But they do not have protective clothing, and so are prone to injury, illness and disease from handling unclean, dangerous or hazardous materials. Most of the diseases involve irritation of the skin caused by contamination from waste and leachate. In addition, some waste pickers also complained about the strong, unpleasant smells from waste as well as leachate discharged from waste collection trucks that should be better controlled. The management body of the transfer stations should meet with the informal waste pickers to discuss solutions to improve their working conditions and discuss steps that would enable them to work more safely and effectively and thus divert more waste from landfills. As discussed previously, by reducing the amount of waste the private company needs to send to landfill, informal waste pickers in transfer stations are effectively providing a service to the private company and saving it money, despite working in challenging conditions and receiving limited support.

One of the main difficulties in waste separation for recycling is that most households discard plastic waste together with other waste, meaning it takes considerable time for waste separation. Much of the plastic waste is contaminated by food waste and sometimes cannot be separated for selling. Informal waste pickers suggest that households should separate plastic waste and other types of waste before discarding into trash bins so that pickers can easily collect and save their time for collecting waste. A difficulty for the municipal garbage collection crews is that most waste collection trucks collect waste at night, when there is limited lighting, making it hard to adequately separate plastic waste.

The main social benefit associated with informal waste recycling activities is the provision of employment or livelihood for poor households in urban areas. Waste collection for recycling activities of the *salengs*, street waste pickers and waste pickers at the transfer station provides a major source of income for migrants in Bangkok, which also helps them to earn a living as well as take care of their family. According to our survey findings and Nguyen's research (2017), the average income of waste pickers is 275 baht per day, for *salengs* it is 400 baht per day and for street waste pickers it is 300–400 baht per day. For municipal garbage collection crews, the waste separation practices help to provide an extra income for waste collectors. Municipal garbage collectors can earn much more if they work hard. Thus, they tend to not want to be promoted to a higher position. Although waste collection is hazardous work, they are satisfied because of the attractive extra income, which is a premium to supplement a small official salary from a government job.

7. Conclusions and entry points for action

This case study explored the plastic waste value chain in Bangkok's Sai Mai District to better understand the contributions of – and links between – formal and informal actors in plastic waste management. There are critical problems with the management of plastic waste in the capital city; increased waste from a rapidly growing population has outpaced the best efforts of the national and local authorities to regulate, collect and recycle it. Formal efforts to manage plastic waste are complemented by a large informal and semi-informal workforce actively engaged in the management of municipal solid waste, including plastic waste. Informal actors have a vital role in the recycling of plastic waste, a role that is of great environmental, financial and social benefit but largely undervalued and poorly understood.

Although accurately quantifying the impacts of the activities of informal actors in the plastic waste value chain was beyond the scope of this study, by using secondary data we made a rough estimate on the number of informal waste actors in Bangkok. The initial calculation indicates that informal actors are helping to ensure that large quantities of plastic waste are recycled rather than incinerated or stuffed into landfills and that they are contributing to significant reductions in greenhouse gas emissions. They are thus filling an even bigger role in alleviating the financial burden of plastic waste recycling and management on government. Additionally, their recycling of plastic waste saves the BMA an estimated 10 million baht per year in avoided disposal fees in Sai Mai District alone – not including the greater potential savings from avoided labour costs. Furthermore, informal actors have the opportunity to earn a living through this work, although they lack social recognition and protection.

There are a number of challenges to increased plastic recycling in Bangkok. First, there is an imbalance between formal and informal sectors in Bangkok's municipal solid waste management system, leading to unhealthy and unsafe working conditions for and negative perceptions of informal actors within the general public and among government authorities.

Second, there is limited waste segregation at the household level, which affects the value of plastic waste. Informal waste pickers and semi-informal waste dealers tend to focus on the more valuable plastic types in the waste stream to secure greater income. This can often result in the disposal of contaminated or less-valuable plastic waste materials and residue into the local environment and waterways.

Third, some plastics are not being recycled in Thailand because of the limited technical support and equipment for segregating, compressing and transporting plastic waste.

Fourth, there appears to be a lack of financial incentives for recycling, particularly given the low value of specific types of plastics and the consequences of the recent Chinese ban on plastic waste imports, leaving recycling companies in Thailand without a sufficiently sized end-market for raw recycled plastic.

Fifth, limited data means it is difficult to properly assess the value of waste pickers due to the hidden nature of the informal sector itself. Data on plastic waste generation is challenging to collect because of the many actors involved in separating plastic waste before it enters the municipal waste stream: households, cleaners and *salengs*.

A number of initiatives have been established to address these barriers, and efforts should be made to identify such initiatives, and capitalize on them and scale them up. For example, a group of entrepreneurs is developing smartphone applications to improve community waste collection processes, encouraging separation at source and allowing better planning of waste collection logistics. In addition, 7-Eleven and Chulalongkorn University have established partnerships to reduce generation of waste. The Zero Baht Shop is an example of a grassroots effort to organize informal actors, increase their incomes and educate them on sanitary waste collection practices and how to avoid potential hazards of waste collection. There are also instances where the government has successfully contracted waste collectors, including to collect waste during royal cremation ceremonies, or has partnered with franchises of vendors and clean junk shops.

Furthermore, Phitsanulok city in lower northern Thailand has successfully diverted almost 95 per cent of waste from being sent to landfill through a combination of strengthening partnerships between the informal and formal sectors, promoting the 3Rs approach and the polluter-pays principle, introducing community-based waste management and public participation, promoting household separation and community composting and recycling businesses, and applying mechanical biological treatment (MBT) prior to sanitary landfill.²⁴ The success of this integrated approach in Phitsanulok has resulted in the city being identified as an international example of good practice, with an initiative supported by the Institute for Global Environmental Strategies (IGES) aiming to share good practices between Phitsanulok and the municipality of Battambang, Cambodia.²⁵ This city-to-city cooperation included on-site intensive training in Phitsanulok for 22 participants from Battambang on how this type of participatory waste management approach could be replicated.

To address remaining barriers, we recommend the entry points for action listed in table 5.

Table 5. Entry points for action

Challenges	Entry points for action	Key actors
Lack of recognition of informal waste sectors from local government and residents	<p>Leverage social media to change the public narrative about informal waste pickers. The informal sector is often perceived in a negative way, but with the support of social media campaigns, social influencers, bloggers and celebrities, waster pickers' value in managing, reducing and recycling plastic waste could be recognized. Expand on initiatives such as the Zero Baht Shop that increase the visibility of the informal sector.</p> <p>Strengthen support for the informal waste management sector by registering informal waste workers officially, providing them with ID cards and investing in capacity building to strengthen their ability to collect waste more efficiently. The establishment of cooperatives should be supported, potentially by a government subcontractor.</p> <p>Promote the welfare and living standards of informal waste pickers – perks and initiatives could include annual health check-ups, life insurance and annual bonuses for collecting more than a certain amount.</p> <p>Consider using health as an entry point for engaging with the informal sector by establishing a health initiative and providing a complimentary service to informal workers to provide a platform for further engagement and capacity building.</p> <p>Encourage the private companies managing transfer stations to meet with the informal waste pickers who work in their premises to discuss solutions for improving the working conditions and how to enable them to more effectively divert waste from landfills, thereby also reducing landfill fees for the private companies and saving them money.</p>	Local government, citizens, private companies managing transfer stations
Limited waste separation at the source and littering and illegal dumping in public spaces	<p>Continue awareness-raising efforts at universities and schools by investing in educational partnerships.</p> <p>Invest in community education campaigns to inform the public on the harms of single-use plastic as well as the rules regarding which kinds of plastic can be recycled.</p> <p>Educate informal workers on the impacts of illegal dumping and encourage them to be environmental champions.</p> <p>Consider introducing initiatives at the household level so that waste can be separated before it enters the waste stream, enabling leakages to be managed from the start, as was implemented in Phitsanulok city.</p> <p>Encourage ministries, private companies and universities to establish partnerships and explore ways to reduce their waste generation, and promote existing efforts, for example by 7-Eleven and Chulalongkorn University.</p>	Citizens, local government, private sector
Lack of technical capacity and financial incentives to recycle	<p>Encourage the organization of informal actors into cooperatives or associations.</p> <p>Develop positive financial incentives to encourage the formal and informal sectors to recycle more, such as subsidies, pay-as-you-throw programmes and kerbside reward schemes.</p> <p>Adopt a whole-of-government approach to developing integrated policy approaches to recycling, supported by more cohesive institutional mechanisms.</p> <p>Develop and maximize green procurement policies to require ministries and departments to take into account environmental considerations when procuring goods and services.</p> <p>Encourage innovation and experimentation with waste-management technologies.</p>	Local government, plastic recycling industry, informal sector
Lack of data	<p>Enlist the support of NGOs and cooperatives to ease the burden on the BMA in quantifying and monitoring the actors and waste flows.</p> <p>Explore further how information technology and mobile applications could improve waste management capabilities, and build on and support existing entrepreneurial efforts to develop smartphone applications to improve community waste collection processes, encouraging separation at source and allowing better planning of waste collection logistics.</p> <p>Conduct research focused on improving corporate social responsibility for businesses to reduce plastic use.</p> <p>Invest in research on the effectiveness of different initiatives, including those aimed at behaviour change.</p>	Local government, NGOs, research institutions

Source: Authors and Bangkok workshop feedback, 13 Oct. 2018.

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