

Roles and Integration of Informal Waste Sector in Municipal Solid Waste Management: The Case of Transfer Facilities in Bangkok, Thailand

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ABSTRACT

Many cities in developing countries including Bangkok are facing with several problems in municipal solid waste management (MSWM). In Bangkok, municipal garbage collection crews and waste pickers are key players of informal waste sector (IWS) at transfer stations contributing to waste recycling. This study analyzes the roles of IWS and how IWS activities at a transfer station and other formal facilities are integrated into the wider MSWM system. The study used a mix of methods, including questionnaire survey and key informant interviews, along with a review of pertinent documents. Descriptive analysis and content analysis were then applied. The results show that those engaged in the IWS could earn extra income and/or their living from selling recyclables collected and separated from trash bins. They sell recyclables based on their relationship with waste dealers. The finding also demonstrates good opportunities for win-win cooperation between the IWS and MSWM by introducing synergies including enhanced recycling rates, provision of livelihood for the poor, and saving the city's waste management costs. However, unhealthy and unsafe working conditions, limited market information, lack of concern from society and government authorities are the barriers for the integration. To strengthen their practices and the synergies, conflicts between IWS and formal system should therefore be considered and addressed for formal-informal integration toward an inclusive society.#

Keywords: Formal-informal sector integration, Informal waste sector, Municipal solid waste management.

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Introduction

The increased generation of municipal solid waste (MSW) is fueled by population growth, economic development, increased consumption, and urbanization becomes one of the biggest challenges of the urban world (Laohalidanond et al. 2015, UN-HABITAT 2010). Most MSW generated in developing countries is decomposable and recyclable, therefore, has some potential for materials recovery. Indeed, material recovery and recycling are among the critical options for managing urban waste in any development setting. In developing countries, the informal waste sector (IWS) exists alongside with formal municipal solid waste management (MSWM) system and plays a significant role in recycling rate. According to Wilson et al. (2009), IWS recovers about 20% to 50% of recyclables from waste stream. In addition, such activities also provide cities substantial cost savings in waste management activities and provide a livelihood for many. (Wilson et al. 2006, Velis et al. 2012; Masood 2013). Hence, if properly managed and depending on local context, IWS would provide some opportunities for socioeconomic development in countries.

As with many developing countries, Thailand now is facing with severe problems in MSWM. According to Pollution Control Department (PCD), the total of MSW generated nationwide in 2015 is 26.85 million tons, with 4.19 million tons generated in Bangkok accounted for 16% of the total. The Bangkok Metropolitan Administration (BMA) currently considers waste as one of the most important problems they must deal with because of its effects on environment and public health. As limited space for disposal sites, BMA has placed emphasis on the reduction of waste at the source. BMA has launched 3R (reduce, reuse, and recycle) programs in 50 districts to promote waste reduction and separation at source. Such programs, however, have been unsuccessful in part because of low levels of residential awareness (BMA 2015).

Generated wastes are discarded into the containers in front of households or at designated locations (Sukholthaman and Sharp, 2016). After that, sorting, segregation, collection for recycling is actively performed by IWS and is funded entirely from sales of the recovered materials. In BMA, IWS is sitting alongside with formal MSWM system and is presented by large and diversified stakeholders including municipal garbage collection crews, street waste pickers collecting in public disposal points; waste pickers at transfer station (TS); *salengs*, who are itinerant waste buyers riding small motorcycles or tricycles to buy waste directly from households, markets, and stores. Although, many stakeholders are involved in waste recycling, recycling rate in BMA remains low, at approximately 11% to 14% (PCD 2015). According to Jungrungrueng (2014), MSW composition at transfer stations of Bangkok is about 20% of recyclable materials, thus presenting greater potential for recycling. Moreover, local government targets to increase the recycling rate not less than 20% in 10 year-period 2018-2022 (Bangkok Metropolitan Administration and Chulalongkorn University 2013); hence, there is a clear need to enhance recycling activities among different stakeholders.

In the past, numerous studies have been done to study the practices and contributions of different participants of IWS in MSWM system in developing countries. However, there are few studies on IWS in Thailand, including Bangkok, which mainly focus on the organization and working conditions of IWS using qualitative analysis (Chikarmane and Narayan, 2009). Although a huge amount of recyclable materials reach transfer stations, which provide another space for sorting of recyclables before disposal at landfill, there is no existing study on the recycling activities of IWS at TSs. In this study, therefore, transfer facilities are selected as strategic points for an investigation of the potential contributions of related IWS in the waste recycling activities. Municipal garbage collection crews, waste pickers and waste dealers involved in the waste recycling at the facilities were investigated to analyze opportunities and barriers for the integration of IWS into the MSWM system in BMA, Thailand. However, the formal recycling industries were not focused as they have indirect relationship with the IWS in

this study. This study focused on informal activities of municipal garbage collection crews, not their formal aspects.

Material and Methods

Due to population growth, migration, rapid urbanization and economic development, BMA currently faces with critical problems in MSWM including increasing waste generation, inefficiency in waste separation and limited budget for waste management (BMA 2015). Therefore, it rises pressure for MSWM system requiring proper collection, transportation and disposal. The three TSs in BMA are considered as three sub-systems of waste collection and transportation system. In this study, Sai Mai TS is selected as a study site representing current performance of waste collection and transportation services provided to BMA residents in the service area. According to BMA, total 24% of MSW generated in 18 districts of BMA are collected and transported to Sai Mai TS, before being ultimately disposed at the Khampangsaen sanitary landfill in Nakhon Pathom province by formal private sector. The station works 24 hours to ensure no waste residue remains within the city for more than a day.

Municipal garbage collection crews and waste pickers at the station were selected for questionnaire survey to investigate their current practices in waste recycling as well as their contributions to MSWM system. The semi-questionnaires were developed to obtain information related to their activities including the quantity of recyclables collected per day, the selling prices of recyclables, and factors considered when collecting and selling recyclables, the main difficulties in waste collections activities, followed by the suggestions for enhancing waste collection for recycling. Moreover, the study also focused on their interaction with formal sector such as local government, private company operating the station, and waste dealers surrounding via key informant interview. Secondary data collection were also obtained by reviewing relevant official documents and reports. Additionally, field observations were conducted to better understand their activities, and living and working conditions.

Obtained data from both primary and secondary sources were then analyzed by descriptive and content analysis. Of which, descriptive analysis was applied to carry out the current situation of waste recycling of IWS such as types of recyclables collected, the quantity of recyclables collected, the main factors considered when collecting and selling recyclables of IWS. Content analysis was applied to analysis information from key informant interview of local government officers, private company and the owners of waste dealers surrounding Sai Mai TS to better understand their perceptions and relationships with IWS.

Results and Discussions

Roles of municipal garbage collection crews in waste recycling

Waste generated in BMA increases steadily, therefore, to keep BMA clean and green, municipal garbage collection crews, who are employed and managed by 50 district offices, are responsible for waste collection activities. Generally, during their formal waste collection activities, they also make use of time to separate recyclables from trash bins for selling. Most municipal garbage collection crews separate recyclables mainly because of secondary income as this job provides good opportunities for earning extra income. According to local government officers at Department of Environment, municipal garbage collection crews can separate recyclables to earn additional income, however, they must make sure all waste are collected and transported to transfer stations for sanitary disposal at landfills (Interview of local government officers at BMA's Department of Environment, January 2017).

An overwhelming share (96.4%) of the surveyed BMA's garbage collection crews earn secondary income from separating and selling recyclables. They collect everything that can sell, however, the main recyclables collected from garbage bins are paper, plastic, glass, aluminum can and metal. These materials are classified and put into different bags. The recyclables then

are transported along with the collected waste to the station. Most waste collection trucks come to sell recyclables at waste dealer shops nearby before going to the station as Figure 1. There are five waste dealers are located near the TS. Each truck has a fixed waste dealer shop to sell recyclables or may sell to any preferable waste dealer. From the questionnaire survey, it was found that 61.8% of the respondents sell recyclables to a fixed waste dealer as they are in close relationship or provide promotions. 65% of respondents paying close attention into value addition of recyclables. A lesser focus is on the location of waste dealers and market information. These factors are considered by 55% and 35% of respondents, respectively.



Figure 1. Municipal garbage collection crews trading recyclables at waste dealer shops. Source: field observations, March 2017.

Municipal garbage collection crews separate all types of recyclables; however, they prefer separating recyclables depending on the quantity of recyclables in waste stream (100%), followed by the market prices of recyclables (90%) and accepted materials bought by waste dealers (60%). Thus, the quantity of plastics collected by municipal garbage collection crews is highest percentage by weight (38%), followed by glass (36%) and paper (22%). Aluminum cans, and metal were present in the lowest percentage with only 2% (Table 1). It is shown that 260.63 kg is the average amount of recyclables collected by BMA garbage collection crews per truck per day. Nevertheless, the number of waste collectors is also different for each type of waste collection trucks, thus, it also affects the amount of collected recyclables. Five-ton compacting truck type separates the highest quantity of recyclables with 334 tons/truck/day, followed by two-ton compacting trucks, eight cubic meter lifting trucks and 1.5-ton loading trucks, which about 253.5, 239 and 216 tons/truck/day, respectively.

After separating valuable materials, they sell and share benefits together. The results from interview of five waste dealer shops determine the prices of recyclables, the number of trucks come to trade per day, which also reflect the current situation of buying process as well as relationships of BMA garbage collection trucks and waste dealer shops surrounding the station (Table 2). It can be seen that the second shop gets biggest number of trucks coming to trade recyclables as they provide the highest prices, followed by the first shop as they provide promotion with extra 15% of total amount of recyclables sold. The more waste collection trucks come, the greater the benefit they receive. However, the number of trucks coming to trade is inconsistent, and it might be more at the rush hour. They sell waste to recycling plant every day as they need more space for storage. These waste dealers are managed by Sai Mai district, and they also meet a lot of competition in terms of market prices, workers, and the quantity of recyclables.

Table 1. The Quantity of Recyclables Collected by Each Type of Trucks

| Type of recyclable | Average amount (kg/day) | | | | | Percentage (%) |
|--------------------|---------------------------|----------------------------|---------------------------------|-----------------------------|-----------------------------|----------------|
| | Two-ton compacting trucks | Five-ton compacting trucks | Eight cubic meter lifting truck | 1.5-ton side loading trucks | Average collected per truck | |
| Plastic bottles | 54.00 | 86.00 | 42.00 | 38.00 | 55.00 | 21.10 |
| Plastic bags | 43.00 | 51.00 | 27.00 | 24.00 | 36.25 | 13.91 |
| Mixed plastic | 5.00 | 13.00 | 6.50 | 8.00 | 8.13 | 3.12 |
| Cardboard | 39.00 | 50.00 | 42.00 | 35.00 | 41.50 | 15.92 |
| Mixed paper | 14.00 | 21.00 | 18.00 | 15.50 | 17.13 | 6.57 |
| Glass bottles | 89.00 | 100.00 | 96.00 | 88.00 | 93.25 | 35.78 |
| Aluminum cans | 4.50 | 6.00 | 4.00 | 3.50 | 4.50 | 1.73 |
| Metal | 5.00 | 7.00 | 3.50 | 4.00 | 4.88 | 1.87 |
| Total | 253.50 | 334.00 | 239.00 | 216.00 | 260.63 | 100.00 |

Source: Questionnaire survey of municipal garbage collection crews, March 2017

Table 2. Purchasing prices of recyclables at waste dealer shops surrounding Sai Mai transfer station and its links to number of trucks arriving at each waste dealer

| Type of recyclables | Buying prices (Baht/kg) | | | | | Average (Baht ¹ /kg) |
|------------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|---------------------------------|
| | 1 st waste dealer | 2 nd waste dealer | 3 rd waste dealer | 4 th waste dealer | 5 th waste dealer | |
| Plastic bottles | 8 | 11 | 9 | - | 7 | 8.75 |
| Plastic bags | 2 | 3 | 5 | - | 2 | 3.00 |
| Mixed plastic | 1 | 2 | 7 | - | 1 | 2.75 |
| Cardboard | 4.5 | 5 | 2 | - | 2 | 3.38 |
| Mixed paper | 2 | 3 | - | - | 1 | 1.50 |
| Glass bottles | 1 | 1.5 | 1 | - | 1 | 1.13 |
| Aluminum cans | 40 | 30 | 30 | - | 25 | 31.25 |
| Metal | 2.5 | 7 | 5 | - | 3 | 4.38 |
| Trucks come to sell per day | 70-90 | 80-100 | 60-70 | - | 50-100 | |

Source: Interview of waste dealers surrounding Sai Mai transfer station, March 2017

¹ \$ 1 US = 33 Baht

Being a BMA garbage collector is an attractive job, since the waste collector not only gets monthly salary but also earns extra income from selling recyclables. Each truck has different levels of income (Table 3), depending on type of truck and the number of collection trips per day.

Table 3 shows that five-ton compacting trucks get highest income which is about 1,472.1 Baht/day, followed by two-ton compacting trucks, eight cubic meter lifting trucks and 1.5-ton side loading trucks about 1,030.5, 883.4 and 793.8 Baht/day, respectively. However, after equally sharing benefit, the two-ton compacting trucks get highest individual income level with about 515.3 Baht/cap/day. The second and third individual income levels are 1.5-ton side loading trucks and five-ton compacting trucks which accounted for 396.9 and 368 Baht/cap/day. The special case is eight cubic meter lifting trucks because they normally hire another worker to collect and separate for them with 300 Baht/day, therefore, they could earn in average about 583.4 Baht/cap/day. Thus, they get the most benefit from selling recyclables in term of individual income level of municipal garbage collection crews.

Table 3. Income level determined for type of trucks and municipal garbage collection crews

| Type of recyclable | Income level for each type of waste collection trucks | | | |
|---|---|----------------------------|---------------------------------|-----------------------------|
| | Two-ton compacting trucks | Five-ton compacting trucks | Eight cubic meter lifting truck | 1.5-ton side loading trucks |
| Plastic bottles | 472.50 | 752.50 | 367.50 | 332.50 |
| Plastic bags | 129.00 | 153.00 | 81.00 | 72.00 |
| Mixed plastic | 13.75 | 35.75 | 17.88 | 22.00 |
| Cardboard | 131.63 | 168.75 | 141.75 | 118.13 |
| Mixed paper | 21.00 | 31.50 | 27.00 | 23.25 |
| Glass bottles | 100.13 | 112.50 | 108.00 | 99.00 |
| Aluminum cans | 140.63 | 187.50 | 125.00 | 109.38 |
| Metal | 21.88 | 30.63 | 15.31 | 17.50 |
| Total income (Baht/truck/day) | 1,030.50 | 1,472.10 | 883.40 | 793.80 |
| Individual income (Baht/cap/day) | 515.30 | 368.00 | 583.40 | 396.90 |

Source: Questionnaire survey of BMA garbage collection crews, March 2017

Roles of waste pickers in waste recycling

After collected by municipal garbage collection crews, MSW is transported to TS. At these places, waste pickers sort out recyclables and sell to waste dealer inside the station. At Sai Mai TS, most of waste pickers come from Northeast of Thailand (70%), and the remaining from Cambodia (30%). Most of them are married, and only 8% of respondents are still single. They work in couple. Some also bring their children and live together. Some children also work at the station to help their parents. Most of them do not go to school. Most waste pickers have been doing this work for several years.

The Sai Mai TS operates in an area of 52 Rai (1 Rai = 40m*40m), and a private company invests 18 container trucks with capacity of 38 tons per truck to transfer waste to landfill (Interview of local government officers at Sai Mai transfer station, March 2017). However, if

there is no container truck at site, waste is poured onto a dumping platform where waste pickers sort out recyclables. Currently, there are about 40-60 waste pickers working inside the station. The waste dealer, who signs the sub-contract with the private company for running recycling business at sites, provides free accommodation and water for waste pickers, but waste pickers must pay for electricity use. To get permission to work inside, waste pickers must register with the waste dealer, and they must sell all recyclables for them. The waste pickers must buy supporting tools for their work by themselves, and the waste dealer does not provide them health insurance or other benefits. Waste pickers collect everything that they can sell (Figure 2). The more waste come to TS, the more recyclables they can collect.



Figure 2. Waste pickers at Sai Mai transfer station. Source: field observation, March 2017.

Waste pickers collect all type of recyclables; however, their interests are also different. Of which, 96% of respondents collect and separate recyclables depend on available of recyclables, followed by market prices of recyclables which is about 88% of respondents. About 30% of respondents collect every type of recyclables accepted by waste dealers. As a result, 36% of respondents collect only plastics. About 28% of respondents collect both plastics and glasses, followed by 20% of respondents collecting only glass bottles. The remaining, 16% of respondents collect everything that they can sell such as shoes, metal, papers, and so on. On average, waste pickers collect about 318.8 kg of recyclables per day per capita. Of which, plastic is the most preferred material collected, accounted for 147.56 kg/per capita /day, followed by glass with about 107.5 kg/cap/day. Papers, metals and other types of recyclables have less interested comparing to the first two types, which is about 27.30, 18 and 16.44 kg/per capita/day, respectively. The waste dealer accepts to buy 26 types of recyclables that waste pickers need to separate in different types of recyclables before selling, with different buying prices as shown in Table 4.

The waste dealer divides the trading area into 3 zones for trading glass, papers and plastic. The waste dealer buys paper first, then glass and plastics. Waste pickers take the records and collect their money at the trading area for plastic. Most of respondents (66%) can earn from 100 to 300 Baht per day, and about 20% of respondents get income level of 301 to 500 Baht per day. A smaller percentage of respondents earn more than 500 Baht or less than 100 Baht per day which accounted for 10% and 4%, respectively. The overall average income of waste picker at Sai Mai transfer station is 275 Baht/day. According to the results of questionnaire survey, on average, a waste picker work about 9.6 hours per day with maximum of 13 hours per day and minimum of 5 hours per day. They work 7 days per week. The waste pickers collect waste at different time slots. Some work at night time from 8 pm to 8 am, some work from 12 am to 5 am or 8 am. The remaining group works during the day time from 8 am to 5 pm or 6 pm. Most waste pickers use supporting facilities to collect waste such as gloves, shoes and masks. However, they do not have protective clothing. 68% of respondents said that they do not have any health problems, and 32% of respondents mentioned that they have health problems during working inside the TS such as itchy causing by contamination from waste and leachate. Besides, some also blame about bad and strong smell from waste.

Table 4. Purchased prices of recyclables

| Type of recyclables | | Buying price (Baht/kg) | Type of recyclables | | Buying price (Baht/kg) |
|---------------------|--------------------|------------------------|---------------------|--|------------------------|
| Plastic | HDPE bottles | 4 | Shoes | | 3 |
| | PET bottles | 4 | Sack | | 1 |
| | PET colour bottles | 3 | Foam | | 3 |
| | Black plastic bag | 1 | Board | | 5 |
| Metal | Steel | 2 | Brass | | 30 |
| | Steel can | 1 | Linoleum | | 1 |
| | Beer can | 10 | Glass | | 1 |
| | Aluminium foil | 10 | Sack | | 1 |
| | Thin aluminium | 20 | Mattress | | 2 |
| | Cast iron | 10 | CD | | 10 |
| | Copper | 100 | Mixed paper | | 1 |
| | Electric wire | 10 | Cardboard | | 2 |
| | Backhoe steel | 3 | | | |

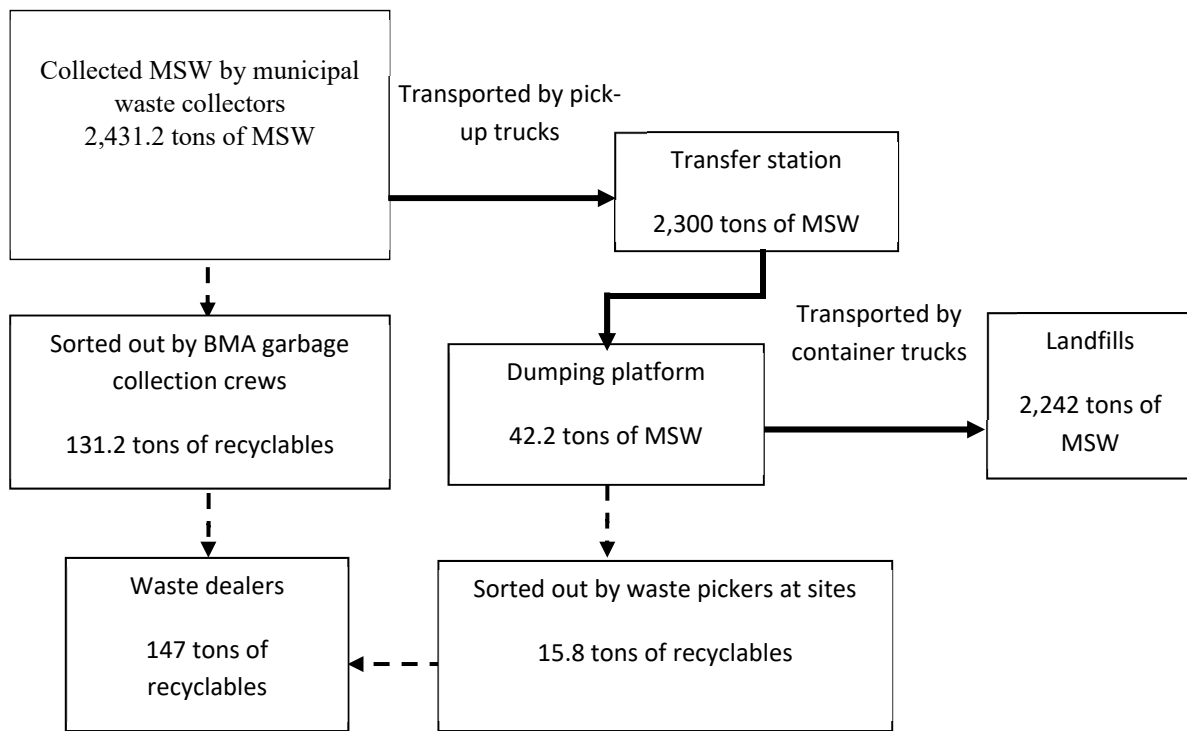
Source: Interview of waste dealers, March 2017

Relationships of informal waste sector in MSWM System

As other developing countries, the IWS in the BMA also plays a significant role in MSWM system in terms of the environmental, economic and social aspects. First, the environmental role contributed by IWS is presented in Figure 3. The figure indicates that municipal garbage collection crews could separate about 131.2 tons of recyclables per day before waste is transported to the station, and waste pickers could collect about 15.8 tons of recyclables per day. Consequently, IWS at the station contributes into recycling rates in BMA about 147 tons of recyclables per day, equivalent to 1.3% of total waste generated in BMA per day.

Moreover, IWS directly contributes to reduction in MSWM costs, as well as environmental costs. In case study of IWS at the Sai Mai TS, the reduction costs are presented in Table 5. It is found that BMA could have saved approximately 39.32 million Baht/year for waste disposal in 2016 at Sai Mai TS. Or it is about 0.64% of total waste management costs of BMA. According to Policy and Planning Division, Department of Environment, BMA currently faces with the increase of budget in MSWM and the imbalance of the costs of waste management. Therefore, there is a need to enhance the practices of municipal garbage collection crews and waste pickers.

There are also social benefits associated with informal waste recycling activities that provide employment and livelihood for poor in urban sprawl. First, waste recycling activities of waste pickers at station provide major source of income for migrants of BMA. Secondly, working as waste pickers also provides additional job opportunities for poor urban population who are at lower education level and jobless. As a result, it helps to address social problems in the sprawling BMA. Finally, for municipal garbage collection crews, the waste separation practices provide an extra income to take care their family and other expenses. Although waste collection work presents health hazards, workers are satisfied because of an attractive extra income, which is a premium to supplement a small official salary from government job.



Notes:

—▶ The flow of municipal solid waste

- - - ▶ The flow of recyclables

Figure 3. The flow of waste at the Sai Mai transfer station per day.

Source: authors.

Table 5. The estimated waste disposal saving by informal waste sector

| Item | Factors | Value (Baht) |
|------|---|--------------|
| 1 | The quantity of recyclables recovered by BMA collection crews (tons/day) | 131.2 |
| 2 | Disposal fees that BMA contracted with private company at Sai Mai transfer station (Baht/ton) | 735.0 |
| 3 | The quantity of recyclables recovered by waste pickers inside Sai Mai transfer station (tons/day) | 15.8 |
| 4 | Landfill fee that private company must pay for sanitary disposal (Baht/ton) | 715.0 |
| 5 | BMA waste disposal saving (Baht/day) (= 1x2+3x4) | 107,729 |
| 6 | BMA waste disposal saving (Baht/year) (= 5x365) | 39,321,085 |

Source: Data analysis, March 2017

However, IWS also faces some difficulties as the mixed waste discarded from households takes more time in waste separation for municipal garbage collection crews. Besides, wastes are contaminated by wet wastes such as food waste, so some cannot be separated for sale. Moreover, most waste trucks collect waste at night, hence, there is not enough light for separating recyclables. For waste pickers, the most difficulty is the trucks coming to pour waste at the station. Trucks disturb their work, thus they could not separate recyclables continually. On average, there are about 400-500 trips of trucks come to the station per day. Traffic congestion is more popular inside transfer station, especially at night time. Consequently, waste collection of IWS also often increases loading time and reduce the efficiency of formal MSWM in waste transportation at TSs.

Nevertheless, waste pickers also meet difficulties in collecting recyclables at night as there is not enough light to work. Weather in the BMA is quite hot year around, therefore, some of waste pickers prefer to work at night. Also, to work more efficiency, they must provide light wear on their head while collecting recyclables. They suggested to provide light system inside the transfer station, then they can collect more recyclables. Another problem is smell inside transfer station, and leachate from waste. Finally, waste pickers must sell all recyclables to the waste dealer inside the station; however, they provide lower prices comparing to other waste dealers surrounding the station. Thus, the market information needs to have more concern from local government such as providing a stable price for recyclables to protect waste pickers. Although the IWS contributes a significant role to MSWM system in the BMA, they do not get any support or legal protection from the government. Waste pickers are unrecognized and unprotected recycling workers; therefore, they are daily earners with no security of earnings; have no access to formal institutional credit; have limited social protection or security that need to be considered for the integration.

Conclusions

Currently, waste separation in the BMA takes place at the middle stage in the waste stream system and is mainly undertaken by the IWS including municipal garbage collection crews and waste pickers. The IWS plays a vital role in MSWM in the study area by introducing the synergies with formal system such as increasing recycling rates, saving waste management cost, and providing an extra source of income and job opportunities for the poor in urban sprawl. The study thus proves clear opportunities for win-win cooperation of IWS in MSWM system which provides more confidence to the authorities and relevant stakeholders in BMA, as well as other areas in urban waste management. However, there are existing conflicts between formal and informal sectors within the waste separation and waste collection activities. The relationship between IWS and waste dealers at transfer facilities also affects their current practices. Finally, IWS also has the repressive public policy and negative society perception about their occupation. Therefore, there is a need to realize and address these problems while integrating IWS toward an inclusive society.

For the integration, BMA should first provide working space for IWS accessing to waste, such as promoting waste separation at sources and facilitating material recovery facilities at the TS. Moreover, BMA should improve the linkage along value chain by well-organizing waste dealers, middleman in the recycling market to reduce the fluctuation of recyclable prices as well as the gaps between IWS and formal recycling and industries. The training of health and safety education should also be provided for IWS annually, followed by facilitating their access to health care facilities. Raising awareness about the roles of IWS by documenting and publicizing benefits provided by IWS in waste management system should also be encouraged. Finally, local government should involve stakeholders in MSWM planning as well as issuing strategies to include IWS within overall waste management system.

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