Resources, Conservation and Recycling 89 (2014) 11–21

Contents lists available at ScienceDirect

Resources, Conservation and Recycling

journal homepage: www.elsevier.com/locate/resconrec

Household income, living and working conditions of dumpsite waste pickers in Bantar Gebang: Toward integrated waste management in Indonesia

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ARTICLE INFO

Article history:
Received 18 December 2013
Received in revised form 17 April 2014
Accepted 23 May 2014
Available online 12 June 2014

Keywords:
Dumpsite waste picker
Final disposal site
Indonesia
Income
Integrated waste management
Living condition
Working condition

ABSTRACT

This paper clarifies household income, living and working conditions of dumpsite waste pickers at Bantar Gebang final disposal site for municipal solid waste generated in Jakarta, and investigates the feasibility of integrating the informal sector into formal waste management in Indonesia. The first author did fieldwork for totally 16 months at the site and quantitative field surveys were conducted twice during the period. All respondents in the first round quantitative survey ($n = 1390$) were categorized as follows: waste pickers, family workers, wage labors, bosses, family of the bosses, housewives, pupils/students, preschoolers, the unemployed, and others. Based on the results of the second round quantitative survey ($n = 69$ households), their average household income was estimated to be approximately US 216 dollars per month ($n = 59$ households), which was virtually equivalent to the minimum wage in Jakarta in 2013. Living conditions of scavengers at the site were horrible, and their working conditions were dangerous due to medical waste and other sharp waste. Polluted groundwater was one of the serious environmental problems at the site. Despite the social, health and environmental problems, they were attracted to the freedom of entering the informal recycling system in Bantar Gebang and withdrawing from the system, in which a lot of opportunities were provided for the people having few marketable skills to obtain cash earnings. The freedom of their choice should be guaranteed as a prerequisite before integrating the informal sector into formal waste management. Furthermore, special attentions are required when incomes of scavengers are the same level as minimum wages and the national economy is rapidly growing, because scavengers cannot easily change their jobs due to few marketable skills. Indonesian national waste laws and regulations should be properly applied to facilitate a socialization process at final disposal sites. Measures need to be taken to prevent children from working as informal recycling actors, especially for waste pickers aged 15 or younger.

1. Introduction

1.1. Objectives

Recycling of municipal solid waste in developing countries relies largely on the informal recovery of materials from waste carried out by human scavengers (Medina, 2000), although informal recycling can be observed almost everywhere in the world regardless of national economic level. The scavengers make valuable contributions to society by converting unusable waste into productive resources as well as cleaning the city (Hayami et al., 2006). In the informal recycling, poor wages and low prices for products and services create viable profit margins from collecting and selling secondary raw materials (Wilson et al., 2006). If alternative employment opportunities and associated wages were higher, scavenging would be less financially attractive (Porter, 2002).

To better understand the politics of informal sector recycling in developing countries, there is a need to answer fundamental questions such as who are the actors and how are informal sector recycling activities shaped by place specific conditions (Adama, 2012). In addition, the structure of the informal sector recycling should not be based on a universal model but should instead

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http://dx.doi.org/10.1016/j.resconrec.2014.05.006
0921-3449/

take into account local contexts and conditions (Ezeah et al., 2013).

In recent years, some researchers referred to the necessity of integrating existing informal recycling systems into the operations of formal municipal solid waste management (Asim et al., 2012; Medina, 2005; Sembiring and Nitivattananon, 2010; Wilson et al., 2006, 2009). It is important to note that not every country will have the necessary financial, physical, human, public and social capital available to achieve social inclusion and raise prosperity and so the level of integration must be flexible (Ojeda-Benitez et al., 2002; Sembiring and Nitivattananon, 2010). In particular, the most serious issue in maintaining the integrated system is how much scavengers can earn their incomes through waste recycling. If scavengers can earn far more than minimum wages, the integrated system can be well managed and maintained. On the contrary, if alternative employment opportunities and associated wages were higher, scavengers would leave from the informal sector. Therefore, understanding household income, living and working conditions of scavengers precisely in local contexts is of crucial importance to investigate the feasibility of interventions toward integrating the informal sector into formal waste management.

The objectives of this work are (1) to clarify demographic composition of residents at the site, (2) to estimate average household income of waste pickers, (3) to discuss relative socioeconomic status of waste pickers in reference to minimum wages in Indonesia, and (4) to investigate the feasibility of integrating the informal sector into formal solid waste management system at the site, considering their household income, living and working conditions.

1.2. Previous studies on incomes of scavengers

The earning of a scavenger depends on the availability of waste and how rich is the waste for recyclable item (Asim et al., 2012). The incomes of the scavengers were higher than the minimum wage in cities of Nigeria (Afon, 2012; Agunwamba, 2003; Nzeadibe, 2009; Nzeadibe and Ajaero, 2011; Nzeadibe and Anyadike, 2012), while contradictory results were also reported in cities of India (Hayami et al., 2006) and Pakistan (Asim et al., 2012). Hayami et al. (2006) reported that the incomes of most pickers were below the poverty line set by the Planning Commission of India, whereas the majority of collectors earned marginally higher than the poverty-line income. Medina (2000) also reported that scavenger/waste picker income was very low, although they were not necessarily the very poorest in society.

1.3. Previous studies on solid waste management in Indonesia

Previous studies on solid waste management in Indonesia were mainly performed in Java (Chaerul et al., 2013; Damanhuri et al., 2009; Meidiana and Gamse, 2011; Pasang et al., 2007; Sasaki and Araki, 2013; Sembiring and Nitivattananon, 2010; Sicular, 1991; Supriyadi et al., 2000) and Bali (MacRae, 2012; Zurbrügg et al., 2012), because the population density of Java is the largest among all islands of Indonesia and that of Bali is the second largest. Besides the studies above, Aye and Widjaya (2006) performed a life cycle assessment and an economic analysis of traditional market waste. Material flows were analyzed for solid waste in Bandung (Damanhuri et al., 2009) and e-waste in Indonesia (Andarani and Goto, 2013).

Despite numerous numbers of the studies above, the studies on informal sector recycling in Indonesia are very limited. Sembiring and Nitivattananon (2010) discussed the role of informal recycling in solid waste management in Bandung based on the material flow method and questionnaire survey results. Sicular (1991) estimated monthly incomes and expenses of scavengers in Bandung in the early and mid-1980s. Sasaki and Araki (2013) discussed the employer–employee and buyer–seller relationships among scavengers at Bantar Gebang final disposal site.

1.4. National waste laws and regulations in Indonesia

Indonesia has enacted national legislation in support of scavengers in 1992, and then the President Suharto declared that scavengers were beneficial to the country's economy and environment (Medina, 2000). Since then, the government of Indonesia supported the formation of cooperatives of dumpsite and street waste pickers (Medina, 2000).

On the other hand, at the national level there was no law regulating waste management before 2008. The Waste Law No. 18/2008 was enacted in May 2008 by the government of Indonesia and covers issues related to public service principles, waste management, an incentives and disincentives mechanism, funding scheme, shared responsibilities among waste authorities, private sector participation, community-based waste management and penalties for disobeying the law (Meidiana and Gamse, 2011). In particular, Article 22 and 44 require the local governments to run environmentally sound landfill (Meidiana and Gamse, 2011).

Subsequently, the Waste Law No. 81/2012 was enacted in October 2012 by the government of Indonesia to fulfill legal obligations required by the Waste Law No. 18/2008, and covers issues related to household and industrial waste. In addition, the government of Indonesia issued the Regulation No. 19/PRT/M related to the guideline on zoning districts surrounding final disposal sites in November 2012.

1.5. General situation of scavengers in Indonesia

Scavengers or waste pickers in Indonesia are called "*Pemulung*". It is hard to estimate the exact figure of the number of persons employed as scavengers (Supriyadi et al., 2000). In 1992, it was estimated that there were at least 40,000 people involved in waste recycling in Jakarta (Anon., 1992). Activities of the informal sector are not considered illegal in Indonesia (Chaerul et al., 2013). In Indonesia, the formal sector consists of municipal agencies whereas the informal sector consists of unregistered, unregulated individuals, groups, or small businesses (Sembiring and Nitivattananon, 2010).

In solid waste activities, the informal sector refers to recycling activities that are conducted by scavengers, itinerant waste pickers, or itinerant waste buyers (Sembiring and Nitivattananon, 2010). Sembiring and Nitivattananon (2010) categorized scavengers in Bandung as follows: (1) street waste pickers who collect recyclable materials from bins or waste left in the streets, (2) temporary storage site scavengers who pick up recyclables from temporary storage sites, (3) landfill site scavengers who collect recyclables from final disposal sites, (4) domestic servants or maids who collect recyclables from households, then sell them to itinerant waste buyers, (5) itinerant waste buyers who buy recyclables door to door, (6) municipal waste collection crews who segregate waste and sell to scrap dealers, (7) small scrap dealers who buy the recyclables directly from scavengers or itinerants, (8) small- or large-scale enterprises who buy recyclables from scrap dealers, and (9) intermediates who usually connect large-scale enterprises with manufacturers.

As shown in Table 1, scavengers who collect recyclables at Bantar Gebang final disposal site were often referred to as their managerial names, and then at least 8 types of recycling actors were identified: (1) big boss (*bos pemulung*), (2) small boss (*bos kecil*), (3) big middleman (*bos tengkulak*), (4) small middleman (*tengkulak kecil*), (5) live-in waste picker (*anak buah rumah*), (6) live-out waste picker (*anak buah lapangan*), (7) independent waste picker (*sendiri*), and (8) daily worker (*buruh*). The names directly

Table 1
Recycling actors in Bantar Gebang.

No.	Name of recycling actors		Explanation
	In English	In Indonesian	
(1)	big boss	bos pemulung	Bos pemulung literally means the boss of waste pickers. English translation in this table emphasizes the distinction between bos pemulung and bos kecil.
(2)	small boss	bos kecil	Smaller ones of No. 1 in this table
(3)	big middleman	bos tengkulak	Bos tengkulak literally means the boss of middlemen. English translation in this table emphasizes the distinction between bos tengkulak and tengkulak kecil.
(4)	small middleman	tengkulak kecil	Smaller ones of No. 3 in this table
(5)	live-in waste picker	anak buah rumah	Waste pickers who live in the residence provided by their big bosses
(6)	live-out waste picker	anak buah lapangan	Waste pickers who do not live in the residence provided by their big bosses
(7)	independent waste picker	sendiri	Sendiri is the abbreviation of Pemulung sendiri, which means independent waste pickers. They do not serve for any specified bosses.
(8)	daily worker	buruh	Part-time workers who have different jobs other than informal recycling

Source: Sasaki and Araki (2013).

suggested their positions and roles as informal recycling actors in the community of scavengers at the site. Live-in and live-out waste pickers were continuously employed by their bosses, while independent waste pickers and daily workers depended on temporary employer–employee relationships. The positions of the recycling actors were not always fixed and there were many paths of career tracks and setbacks mainly due to individual economic status. In addition, all big bosses and big middlemen have built direct connections with recycling factories, and the community of scavengers at the site recognized them as big bosses and big middlemen due to the connections (Sasaki and Araki, 2013).

In this paper, the word 'scavengers' is used as a generic term to express informal recyclers. Scavengers at the site mean 8 types of recycling actors as above-mentioned. Waste pickers are the persons who collect recyclables at the site, that is, live-in waste pickers, live-out waste pickers and independent waste pickers.

2. Methodology

2.1. Survey site

Bantar Gebang final disposal site for solid waste generated in Jakarta is adjacent to Bekasi final disposal site in Bekasi municipality, West Java Province. The surrounding slums, formed mainly by scavengers in private lands close to the final disposal sites, were selected as the survey site (Fig. 1). The slums have scavengers of 1534 households according to a report published by a local NGO (Sasaki and Araki, 2013).

2.2. Preliminary fieldwork to identify major issues and recycling actors at the site

Preliminary fieldwork was conducted 7 times for totally 11 months (1st: February to March, 2010; 2nd: June to July, 2010; 3rd: September to December, 2010; 4th: October to December, 2011; 5th: March to May, 2012; 6th: December, 2012; 7th: January to February, 2013) to identify major issues as well as recycling actors at the site (see Table 1). During the fieldwork, the first author continued to stay in the slums and obtained information through daily conversations with scavengers at the site in Indonesian language.

2.3. First round quantitative survey on demographic composition

The first round quantitative survey of 504 households, the 8th fieldwork, was conducted for 21 days on March 2013 to quantify demographic composition with respect to the roles of respondents in informal recycling system and covered 33% of all households at the site (Fig. 2).

2.4. Second round quantitative survey on the amounts of transacted recyclables

The second round quantitative survey, the 9th fieldwork, was conducted to estimate household income of waste pickers for

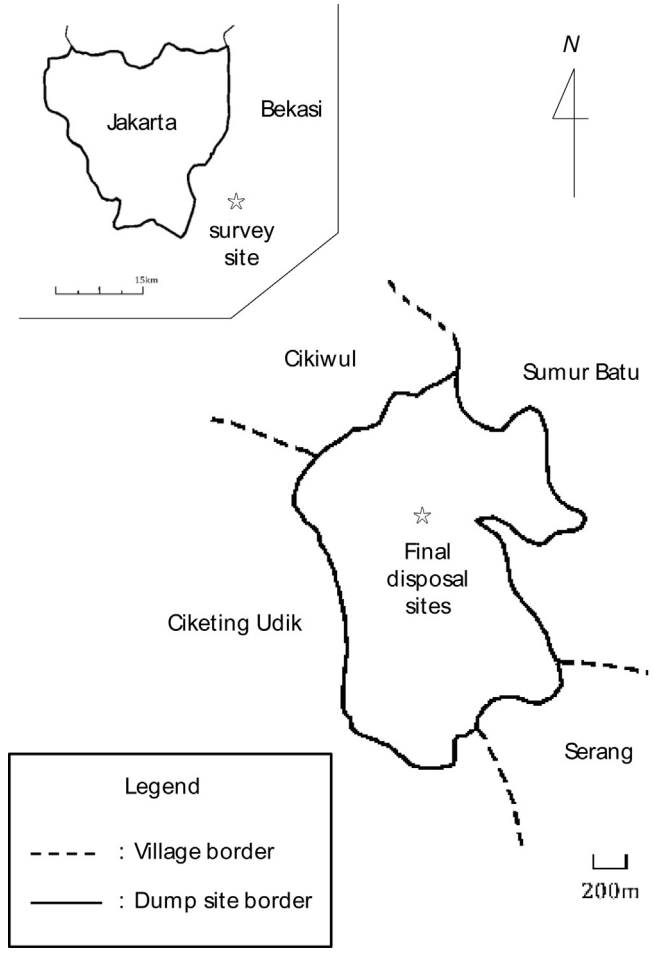
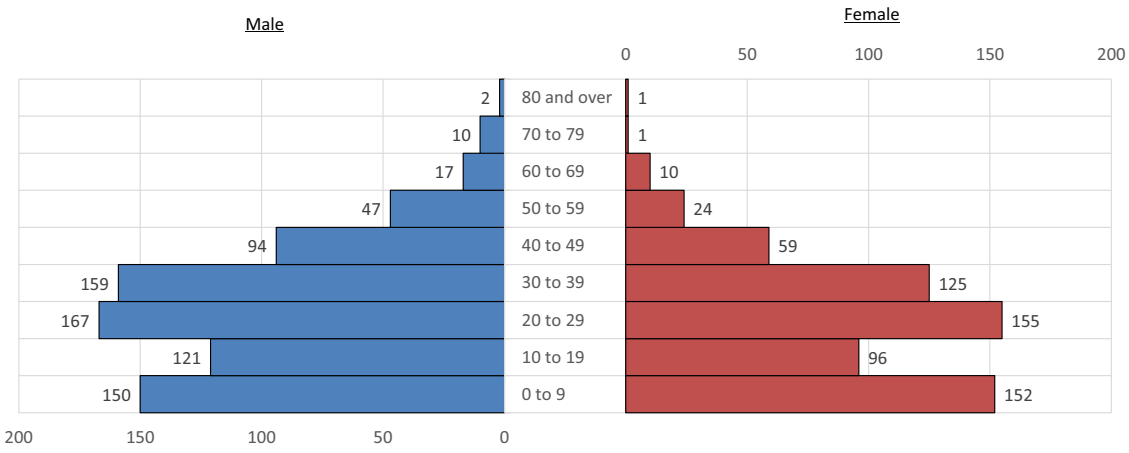


Fig. 1. Map of the survey site in Bantar Gebang.



Age	0 to 9	10 to 19	20 to 29	30 to 39	40 to 49	50 to 59	60 to 69	70 to 79	80 and over
Male	150	121	167	159	94	47	17	10	2
Female	152	96	155	125	59	24	10	1	1
Total	302	217	322	284	153	71	27	11	3
%	21.7	15.6	23.2	20.4	11.0	5.1	1.9	0.8	0.2
% cumulative	21.7	37.3	60.5	80.9	91.9	97.1	99.0	99.8	100.0

Fig. 2. Demographic pyramid of 1390 respondents in the first round quantitative survey.

43 days from June to July 2013 and covered respondents of 69 households. The procedure for estimating their household income is described in the following sections.

2.4.1. Collection of pay slips for massively transacted recyclables

Recyclables are routinely transacted among scavengers at the site and the way of their transactions is called "*Nimbang*". The word *Nimbang* literally means measurement in Indonesian language and is a generic term used to refer to weight measurement of recyclables for transactions among scavengers at the site. In most cases of *Nimbang*, massively collectable recyclables such as plastics are transacted at low unit prices.

Normally buyers of recyclables are the employers of sellers and always issue the pay slips of *Nimbang*. When a waste picker deal with his employer, normally the waste picker (see No. 1 in Photo 1a) and one person representing the employer (see No. 2 in Photo 1a) weigh recyclables on the scale together. The weight of the recyclables is read aloud and is recorded in a notebook (see Photo 1b) by a person representing the waste picker (see No. 3 in Photo 1a) and the person representing the employer (see No. 4 in Photo 1a). Based on the transaction records in the notebook, pay slips are issued by the employer (Photo 1c). Finally, the waste picker receive a payment from the employer according to the pay slips.

In the present study, average daily amounts of recyclables transacted by means of *Nimbang* in each household were estimated by dividing the amounts of recyclables written in the pay slip by the number of days elapsed since issue of the previous pay slip. Therefore, a consecutive set of pay slips is required to estimate the average amounts. The first author confirmed that all pay slips were properly dated at the site.

2.4.2. Consecutive interviews for slightly transacted recyclables

Pay slips are not issued for several recyclables transacted by means other than *Nimbang*. Normally these recyclables can be slightly collected and transacted at high unit price on an as-needed basis. In the present study, the first author have visited homes of respondents every day for consecutive two weeks to interview them on which recyclables they transacted by means other than *Nimbang*.

2.4.3. Data sets obtained through second round quantitative survey

Respondents of 69 households in the second round quantitative survey were classified into four data sets: main data set and validation data sets No. 1 to No. 3 (Table 2). Main data set includes the data of *Nimbang* and consecutive interviews. Validation data set No. 1 includes the data of consecutive interviews and was used to investigate the effect of the difference in frequency of *Nimbang* on the pattern of collecting recyclables.

Average amounts of recyclables among scavengers may vary at different periods. Validation data set No. 2 includes the data of *Nimbang* for half a year from January to June 2013 and was used to investigate the difference in the amount of recyclables at different periods. Validation data set No. 3 includes the data of *Nimbang* for half a year and consecutive interviews and was used to check if respondents of main data set have the same pattern of transacting recyclables by means of and other than *Nimbang*.

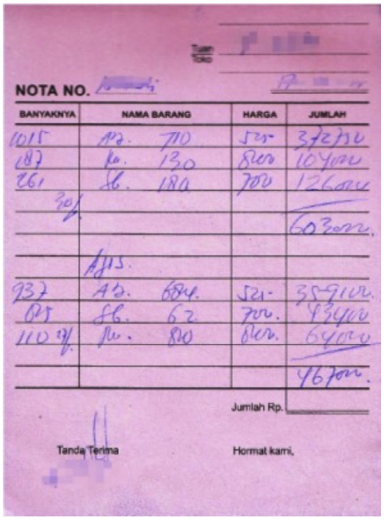
In order to make the data of pay slips reliable, all pay slips were cross-checked using original ledgers (see Photo 1b) and notes by the first author. In particular, pay slips in the validation data sets No. 2 and No. 3 are issued in the same scavenger group which is managed by a big boss, Boss-M (not real name). When the fifth fieldwork was conducted from March to May 2012, the first author stayed in the house of Boss-M (Sasaki and Araki, 2013). Since then, Boss-M continues to allow the first author to make the first author's home in the place where Boss-M governs. Such a trusting relationship between Boss-M and the first author enabled the first author to access to all his original ledgers (see Photo 1b) and to all pay slips owned by his followers.

2.4.4. Estimation of daily incomes

Average daily incomes from the recyclables transacted by means of *Nimbang* in each household were estimated by dividing the payment of sale written in the pay slip by the number of days elapsed since issue of the previous pay slip. On the other

(a)

(b)



(c)

Photo 1. Transactions of recyclables among scavengers at the site by means of *Nimbang*: (a) Nimbang process, (b) original ledger, and (c) pay slip of transaction.

Table 2
Datasets obtained in the second round quantitative survey.

Data set No.	Recyclables sold during two consecutive weeks	Pay slips collected	Number of households
Main data set	Interviewed	1 month (June or July 2013)	51
Validation data set No. 1	Interviewed	N/A	10
Validation data set No. 2	N/A	6 months (January–June 2013)	4
Validation data set No. 3	Interviewed	6 months (January–June 2013)	4

hand, average daily incomes from the recyclables transacted by means other than *Nimbang* in each household were estimated by dividing the total income during consecutive two weeks by 14.

2.5. Follow-up fieldwork

Follow-up fieldwork was conducted twice for totally 3 months (10th: August to September, 2013; 11th: October to November, 2013) to investigate the feasibility of integrating the informal sector into formal waste management.

3. Results and discussion

3.1. Demographic composition and modes of labors at the site

Age, gender and occupation of respondents in the first round quantitative survey are presented in Table 3. All respondents in the

Table 3
Age, gender and occupation of respondents in the quantitative survey.

Occupation	Age										Total	Percentage[a]
	0–9	10–15	16–19	20–29	30–39	40–49	50–59	60–69	70–79	80 and over		
Involved in informal recycling: 860 respondents												
Waste picker												
Male	2	25	44	139	136	74	39	13	7	1	480	70.5
Female	0	1	3	31	46	27	12	5	0	1	126	
Total	2	26	47	170	182	101	51	18	7	2	606	43.6
%	0.3	4.3	7.8	28.1	30.0	16.7	8.4	3.0	1.2	0.3	100.0	
Family worker												
Male	0	0	0	0	0	1	0	0	0	1	2	18.8
Female	0	2	11	75	51	13	4	3	1	0	160	
Total	0	2	11	75	51	14	4	3	1	1	162	11.7
%	0.0	1.2	6.8	46.3	31.5	8.6	2.5	1.9	0.6	0.6	100.0	
Wage labor												
Male	0	0	2	15	8	2	2	0	0	0	29	3.8
Female	0	0	0	2	1	1	0	0	0	0	4	
Total	0	0	2	17	9	3	2	0	0	0	33	2.4
%	0.0	0.0	6.1	51.5	27.3	9.1	6.1	0.0	0.0	0.0	100.0	
Boss												
Male	0	0	0	4	13	16	5	2	1	0	41	5.0
Female	0	0	0	0	0	2	0	0	0	0	2	
Total	0	0	0	4	13	18	5	2	1	0	43	3.1
%	0.0	0.0	0.0	9.3	30.2	41.9	11.6	4.7	2.3	0.0	100.0	
Family of boss												
Male	0	0	2	1	1	0	0	0	0	0	4	1.9
Female	0	0	0	5	2	5	0	0	0	0	12	
Total	0	0	2	6	3	5	0	0	0	0	16	1.2
%	0.0	0.0	12.5	37.5	18.8	31.3	0.0	0.0	0.0	0.0	100.0	
Not involved in informal recycling: 530 respondents												
Housewife												
Male	0	0	0	0	0	0	0	0	0	0	0	13.8
Female	0	1	6	36	19	6	4	1	0	0	73	
Total	0	1	6	36	19	6	4	1	0	0	73	5.3
%	0.0	1.4	8.2	49.3	26.0	8.2	5.5	1.4	0.0	0.0	100.0	
Pupil/student												
Male	40	32	8	0	0	0	0	0	0	0	80	33.2
Female	49	47	0	0	0	0	0	0	0	0	96	
Total	89	79	8	0	0	0	0	0	0	0	176	12.7
%	50.6	44.9	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	
Preschooler												
Male	73	0	0	0	0	0	0	0	0	0	73	27.4
Female	72	0	0	0	0	0	0	0	0	0	72	
Total	145	0	0	0	0	0	0	0	0	0	145	10.4
%	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	
Unemployed												
Male	35	4	2	2	0	0	1	1	0	0	45	19.4
Female	31	13	10	2	0	1	1	0	0	0	58	
Total	66	17	12	4	0	1	2	1	0	0	103	7.4
%	64.1	16.5	11.7	3.9	0.0	1.0	1.9	1.0	0.0	0.0	100.0	
Others												
Male	0	0	2	6	1	1	0	1	2	0	13	6.2
Female	0	0	2	4	6	4	3	1	0	0	20	
Total	0	0	4	10	7	5	3	2	2	0	33	2.4
%	0.0	0.0	12.1	30.3	21.2	15.2	9.1	6.1	6.1	0.0	100.0	

Source: Quantitative survey on March 2013.

[a] The upper lines show the percentages in formal or informal recycling actors and the lower, those in all respondents.

first round quantitative survey ($n = 1390$) were categorized as follows: (1) those involved in informal recycling ($n = 860$) as waste pickers, family workers, wage labors, bosses, and family of the bosses, and (2) those who are not involved in informal recycling ($n = 530$): housewives, pupils/students, preschoolers, the unemployed, and others.

Those involved in informal recycling occupied over 60% of all respondents. In particular, waste pickers occupied over 70% of all the above-mentioned labors. Waste pickers include live-in waste pickers, live-out waste pickers, independent waste pickers or a part of small bosses (see Table 1) and earn their livelihoods by selling collected recyclables to their bosses or middlemen. Most of them are continuously engaged in collection, sorting and packaging of recyclables, and the rest are in collection and sorting, or sorely in collection.

Almost all of family workers were female and were engaged sorely in sorting recyclables without any wages. They do not obtain any incomes before the sorted recyclables are sold to some buyers.

Male wage labors earn their livelihoods by the day and are normally engaged in a couple of the following work patterns of processing recyclables: sorting, packaging, buying, measurement, washing, cutting, drying and transport. On the other hand, female wage labors are engaged sorely in sorting them and are paid by the piece on the net weight basis.

Bosses include big bosses, small bosses, big middlemen and small middlemen (see Table 1). All types of the bosses normally make payment to their followers and transact recyclables by themselves. Big and small bosses earn their livelihoods by collecting and selling them in their own groups, while big and small middlemen, by purchasing and reselling them. Considerable numbers of small

bosses collected them by themselves at the site to supplement their limited incomes. Among the small bosses of 29 households surveyed, 19 small bosses were engaged in collecting them at the site. Small middlemen mostly have no followers. Spouses and children of the bosses assist their works.

Over 60% of those who were not involved in informal recycling were pupils/students (33.2%) or preschoolers (27.4%). Numbers of housewives were less than half of the females who were involved in informal recycling as family workers.

3.2. Child labors

As shown in Table 3, 427 respondents were the children aged 15 or younger at the site and the detail was as follows: 28 waste pickers, 2 family workers, 1 housewife, 168 pupils and students, 145 preschoolers, and 83 of the unemployed. Child waste pickers are engaged in collection of recyclables or industrial homework all day, every day except holidays. In addition, some pupils/students help their parents after school and some of the unemployed collect recyclables once or twice a week to make a bit of extra money. Over 60% of the unemployed were elementary school dropouts at the site. Although child waste pickers were less than 10% of all child respondents aged 15 or younger, considerable numbers of pupils, students and the unemployed are temporary child workers. An NGO working with children there estimates that as many as 550 children ages 7–15 work at the dump to help their parents (U.S. Department of State, 2002). At least, it is obvious that measures need to be taken to prevent children from working as informal recycling actors, especially for child waste pickers aged 15 or younger.

3.3. Living and working conditions: social, health and environmental issues

Poor living conditions, limited access to facilities and infrastructure, no provision of urban services such as water supply and sewerage and absence of social safety networks are typical of scavenging communities (Wilson et al., 2006). Living conditions of scavengers at the site were horrible due to the stench of waste and vast amounts of pests such as flies, mosquitoes and roaches. Polluted groundwater was one of serious environmental problems at the site. They uses the polluted water as daily life water to wash white rice and vegetables, although drinking water, purified from the polluted water, is used to boil rice and to drink. In addition, they often eat vegetables and mushrooms grown at the dumpsite.

Working conditions of waste pickers collecting recyclables at the site were dangerous due to medical waste and other sharp waste such as injection needles and nails. Falling down from the waste dump often results in the injury of needing stitches. It is fair to state that the recycling activities here take place in a

Table 4
Price list of recyclables collected by dumpsite waste pickers in the site.

No.	Recyclables	No.	Local name (in Indonesian)	Price[a]			Unit
				Average	Median	Mode	
1	Soft plastic	1	*AD*	515	550	550	Rp./kg
		2	*MR*	516	525	525	Rp./kg
		3	*ITM*	489	525	525	Rp./kg
		4	*PEE*	747	750	750	Rp./kg
		5	*PP*	583	600	500	Rp./kg
		6	*Sablon*	580	600	600	Rp./kg
		7	*Karung*	487	500	500	Rp./kg
		8	*Slop*	618	600	500	Rp./kg
		9	*Nilek*	1282	1200	1200	Rp./kg
2	Hard plastic	10	*Ember*	1420	1500	1500	Rp./kg
		11	*LD*	3000	3000	2500	Rp./kg
3	Iron	12	*Kaleng*	1029	1200	1200	Rp./kg
		13	*Besi*	1607	1600	1300	Rp./kg
4	Carpet	14	*Karpet*	414	400	500	Rp./kg
		15	*Busa*[b]	1500	N/A	N/A	Rp./kg
5	Rubber	16	*Lapak*	585	600	600	Rp./kg
		17	*Ban dalam*	1038	1000	1000	Rp./kg
6	Paper	18	*Kertas*	338	300	300	Rp./kg
7	Glass	19	*Botol*	342	350	400	Rp./kg
8	Alminum	20	*Alminium*	6582	7000	5000	Rp./kg
9	Bone	21	*Tulang*	482	500	500	Rp./kg
10	Copper	22	*Tembaga*[b]	40,000	N/A	N/A	Rp./kg
11	Silver	23	*Perak*	4900	5000	5000	Rp./g
12	Brass	24	*Kuningan*	3118	3000	2000	Rp./unit
13	Spoon/Fork	25	*Sendok/Garpu*	394	250	250	Rp./unit
14	Fluorescent bulb	26	*Lampu*	115	100	100	Rp./unit
15	PP woven bags	27	*Karung bijian*	206	200	200	Rp./unit
16	Glass	28	*Botol bijian*	3888	2000	2000	Rp./unit
17	Car tire	29	*Ban mobil*	4893	5000	5000	Rp./unit
18	Bike tire	30	*Ban motor*	909	1000	1000	Rp./unit
19	Used CD	31	*Kaset*	88	100	100	Rp./unit
20	Faucet	32	*Babet*	2125	2000	2000	Rp./unit
21	Cellular phone	33	*HP*	3544	3000	3000	Rp./unit
22	Transformer coil	34	*Travo*	3000	2000	2000	Rp./unit
23	Watch	35	*Jam tangan*	4250	3500	2000	Rp./unit
24	Hair	36	*Rambut*	3318	3000	3000	(eyeballed)
25	Medicine	37	*Obat*	4139	3000	2000	(eyeballed)

[a] Rp. 10,000 = US 1 dollar.
[b] Data obtained by interview surveys.

very dirty environment which can be detrimental to public health (Monirozzaman et al., 2011). Health and safety risks associated with informal recycling include (1) occupational health risks posed to scavenger/waste pickers and (2) community health risks posed to the related community or general public, and then these risks can originate from the nature of the waste or the process of collecting, processing, recycling and disposing of it (Wilson et al., 2006).

Despite the social, health and environmental problems associated with informal recycling at the site, scavengers are attracted to the freedom of entering the informal recycling system in Bantar Gebang and withdrawing from the system. Since the establishment of the final disposal site in 1989, the informal recycling system has provided a lot of opportunities for the people having few marketable skills to obtain cash earnings. It provides employment and a livelihood for impoverished, marginalized and vulnerable individuals or social groups (Medina, 2000).

3.4. Income sources

3.4.1. Collecting and selling recyclables

The degree to which a particular material is recycled depends on income levels, the existence of local and national markets, need for secondary raw materials, level of financial and regulatory governmental intervention, prices of virgin materials, international trade in secondary raw materials and relevant treaties (Wilson et al., 2006). During the second round quantitative survey, 37 recyclables were transacted twice or more among scavengers at the site (Table 4). Some local names of recyclables such as *AD* (No. 1), *MR* (No. 2), *ITM* (No. 3), *PEE* (No. 4), *Sablon* (No. 6), *LD* (No. 11) and *Lapak* (No. 16) are the specific terminology inside the community of scavengers at the site, and all other local names are general words in Indonesian language (Sasaki and Araki, 2013).

The classification of recyclables shown in Table 4 is most commonly used at the site but not always. In extreme cases, all of them are transacted without any sorting process. Bottle caps of water dispensers (*LD*, No. 11) can be often transacted as a part of *Ember* (No. 10).

The differences between the average prices and median prices were less than 15% for 28 recyclables. The average trading prices in the slum of the site are affected by the buying prices set by recycling factories as final buyers, which are determined by the international prices of recyclables. Bosses and middlemen offer their own buying prices to waste pickers, considering the prices set by recycling factories. In addition, the big bosses and middlemen who have direct connections with recycling factories tended to offer higher buying prices than other small bosses and middlemen because they do not need to resale them to other intermediate buyers.

Subdividing recyclables raises the prices, as shown in the prices of *Ember* (No. 10) and *LD* (No. 11) (Table 4). Removing impurities from them also makes them more valuable. During the survey period, soft plastics with many impurities were transacted at Rp. 250 per kg, while dried soft plastics with few impurities were at Rp. 700 per kg.

The differences between the average prices and median prices were 15% or more for the following 7 recyclables: spoon/fork (*Sendok/Garpu*; No. 25), fluorescent bulb (*Lampu*; No. 26), glass (*Botol bijian*; No. 28), cellular phone (*HP*; No. 33), transformer coil (*Travo*; No. 34), watch (*Jam tangan*; No. 35), and medicine (*Obat*; No. 37). The prices were determined by the original prices before recycling.

3.4.2. Wage labors

Wage labors work by the day or on commission or by fixed wages. Stacking recyclables, weighed by bosses, are paid at Rp. 20,000 or Rp. 25,000 per one wage labor as fixed wages. Purchased recyclables bought by bosses are transported for reselling, and waste pickers are hired as the workers for stacking them to a truck. Some of the bosses hire their followers by the day, and they do the stacking.

The wages of stacking recyclables bought from other places into trucks are Rp. 50,000 or Rp. 75,000 per one truck, depending on the size of trucks and the weight of recyclables to be stacked. Some of the bosses of scavengers buy solid waste in shopping malls and factories, and then bring them to the final disposal site to make their followers pick up recyclables from the solid waste. These bosses hire the stacking staff, normally and continuously engaged in stacking them, by the day on the basis of their commissions.

Wage labors engaged in processing recyclables are paid on the basis of day wage or commission. A big boss paid Rp. 15,000 per 100 kg of recyclables to commission labors as the commission wage for sorting recyclables, Rp. 35,000 per day to day wage labors engaged in sorting recyclables, and Rp. 50,000 per day to day wage labors engaged in sorting, packaging, weighing, stacking and transporting recyclables.

Table 5
Breakdown of average yearly incomes of dumpsite waste pickers (Unit: US Dollars/year).

No.	Recyclables	No.	Local name (in Indonesian)	Income	
				Average	%
1	Soft plastic	1	*AD*	431.5	16.5
		2	*MR*	202.1	7.7
		3	*ITM*	176.6	6.7
		4	*PEE*	376.3	14.4
		5	*PP*	38.1	1.5
		6	*Sablon*	288.3	11.0
		7	*Karung*	50.1	1.9
		8	*Slop*	32.6	1.2
		9	*Nilek*	14.4	0.5
			Subtotal	1610.1	61.4
2	Hard plastic	10	*Ember*	461.4	17.6
		11	*LD*	37.6	1.4
			Subtotal	499.1	19.0
	Subtotal (soft and hard plastic)			2109.1	80.5
3	Iron	12	*Kaleng*	67.4	2.6
		13	*Besi*	30.2	1.2
			Subtotal	97.6	3.7
		14	*Karpet*	12.3	0.5
4	Carpet	15	*Busa*	5.0	0.2
			Subtotal	17.2	0.7
		16	*Lapak*	32.0	1.2
5	Rubber	17	*Ban dalam*	10.3	0.4
			Subtotal	42.3	1.6
6	Paper	18	*Kertas*	16.0	0.6
7	Glass	19	*Botol*	70.9	2.7
8	Aluminum	20	*Alminium*	51.9	2.0
9	Bone	21	*Tulang*	12.6	0.5
10	Copper	22	*Tembaga*	9.8	0.4
11	Silver	23	*Perak*	7.0	0.3
12	Brass	24	*Kuningan*	3.6	0.1
13	Spoon/Fork	25	*Sendok/Garpu*	16.9	0.6
14	Fluorescent bulb	26	*Lampu*	36.3	1.4
15	PP woven bags	27	*Karung bijian*	9.2	0.4
16	Glass	28	*Botol bijian*	9.3	0.4
17	Car tire	29	*Ban mobil*	8.8	0.3
18	Bike tire	30	*Ban motor*	7.2	0.3
19	Used CD	31	*Kaset*	1.0	0.0
20	Faucet	32	*Babet*	9.7	0.4
21	Cellular phone	33	*HP*	6.2	0.2
22	Transformer coil	34	*Travo*	0.9	0.0
23	Watch	35	*Jam tangan*	0.4	0.0
24	Hair	36	*Rambut*	2.0	0.1
25	Medicine	37	*Obat*	18.2	0.7
26	Others	38	*Dll*	89.5	3.4
			Total	2620.9	100.0

Table 6
Average monthly income of dumpsite waste pickers.

Explanation of household	Monthly income (USD)	SD	Number of household
51 households (main data set[a])	218.4	98.6	51
8 households (validation data sets No. 2 and No. 3[a])	213.4	93.3	8
Average of monthly income of all dataset	216.0	96.0	59

[a] See also Table 2.

Table 7
Average monthly income of wage labors.

Types of wage labors	Monthly income (USD)	SD	Number of households
1. Day wage labors	94.5	N/A	7
2. Commission for sorting recyclables	49.3	28.1	5
3. Commission for loading waste/recyclables	216.0	96.0	3

3.5. Income level

3.5.1. Collecting and selling recyclables

Average household income in the main data set (see Table 2) was estimated to be US 2620.9 dollars per year (Table 5), or US 218.4 dollars per month (Table 6 and Fig. 3). Soft and hard plastics were two main income sources of waste pickers, reaching over 80% of all recyclables. In particular, soft plastic was the largest income source and reached over 60%. Contrastingly, aluminum was not the important income sources for dumpsite waste pickers at the site, although aluminum cans are frequently collected recyclables by waste pickers in developed countries as well (Medina, 2007).

The average monthly income of waste pickers of 59 households at the site was approximately US 216 dollars (Table 6). Missing data in the validation data sets No. 2 and No. 3 was extrapolated from the main data set under the assumption that missing data is just the same as the data in the main data set. The extrapolated data occupied 9.0% of the total income, as shown in the recyclables from No. 10 to No. 26 in Table 5. Almost no significant differences were found among the subcategories of 51 households at the 5% level (data not shown). The only exception was found between the subcategories of households with no children and with two or more children.

3.5.2. Wage labors

Based on the data of pay slips and consecutive interviews (see Section 2.4), average monthly household incomes of wage labors were estimated to be US 94.5 dollars for day wage labors, US 49.3 dollars for commission labors engaged in sorting recyclables, and US 216.0 dollars for commission labors engaged in loading waste or recyclables (Table 7).

3.6. Relative economic status of waste pickers in reference to minimum wages

Indonesian minimum wages are determined by 33 provincial governments every year, and the minimum wages in Jakarta were approximately US 150 dollars in 2012, US 220 dollars in 2013, and US 240 dollars in 2014. The average monthly income of waste pickers at the site was approximately US 216 dollars, which was equivalent to the minimum wage in Jakarta in 2013. So far collecting recyclables in the site is also a good income-generating sources for dumpsite waste pickers as poor immigrants, as pointed out by Medina (2000).

However, the relative economic status of waste pickers at the site significantly depends on the changes of economic growth in Indonesia. The minimum wage in Jakarta in 2014 increases by approximately 60% over 2012. On the other hand, the prices of soft plastics, the largest income sources for waste pickers, remain unchanged since 2011. Living expenses of scavengers are determined by the national economic level, while their incomes are strongly influenced by the international prices of recyclables. Therefore, integrating the informal sector into formal municipal solid waste management in the countries where the national economy is growing might have negative results. In particular, it should be noted that scavengers cannot easily change their jobs because they have no marketable skills. Many scavengers may not be able to enter formal sector employment because of poor education or physical disability, and then this inability to enter more conventional occupations and the resulting absence of real choice needs to be recognized by interventions that attempt to change the role and working practices associated with informal recycling (Wilson et al., 2006).

3.7. Challenges toward integrating the informal sector into formal waste management

It has become increasingly evident that incorporating existing informal recycling systems into the operations of formal MSWM can bring significant benefits; however, Integration of informal recycling with formal MSWM systems continues to face many challenges (Wilson et al., 2006).

3.7.1. Financial challenge

The involvement of the informal sector needs additional cost and this is one of the reasons why integrating the informal sector into solid waste management is still a major challenge in developing countries (Sembiring and Nitivattananon, 2010). Considering these budgetary constraints of local governments in Indonesia, Sembiring and Nitivattananon (2010) argued that before integrating the informal sector into solid waste management system, the first step is to increase the ability of the informal sector to add value to collected materials. In the case of Bantar Gebang, it is obvious that living and working conditions of dumpsite waste pickers should be improved; however, any interventions for improving their living and working conditions needs additional costs as well.

3.7.2. Dilemmas decision makers face

Breaking down the barriers so as to allow the utilization and integration of the informal sector into the overall economy is a major challenge (Sembiring and Nitivattananon, 2010; Ezeah and Roberts, 2012). Decision makers face dilemmas in integrating the informal sector into formal municipal solid waste management: the informal sector contributed to solid waste management but still requires basic service needs and social rights, while improving collection and technology will limit the contribution of the informal sector (Sembiring and Nitivattananon, 2010).

3.7.3. Insufficient implementation of waste laws and regulations

The government of Indonesia enacted the Waste Law No. 81/2012 related to household and industrial waste in October 2012 to fulfill legal obligation in the Waste Law No. 18/2008 related to waste management. In addition, the government of Indonesia issued the Regulation No. 19/PRT/M related to the guideline on zoning districts surrounding final disposal sites in November 2012. However, these laws and regulations are not fully implemented. Good implementation should be based on strong policy and accompanied by law enforcement, good infrastructure,

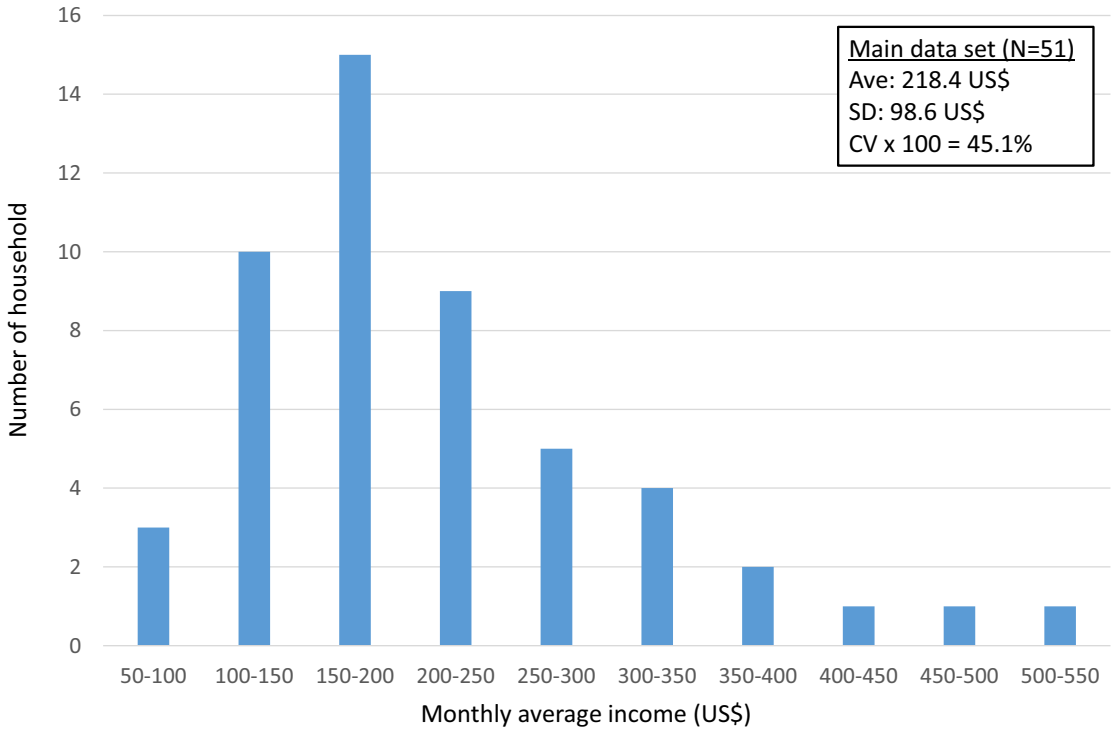


Fig. 3. Income distribution of dumpsite waste pickers at the survey site.

sustainable finance and technology, capable human resources and community awareness (Meidiana and Gamse, 2011).

4. Conclusions

Living conditions of scavengers at the site were horrible due to the stench of waste and vast amounts of pests. Their working conditions were dangerous due to medical waste and other sharp waste. Polluted groundwater was one of serious environmental problems at the site. Despite the social, health and environmental problems associated with informal recycling at the site, they were attracted to the freedom of entering the informal recycling system in Bantar Gebang and withdrawing from the system, in which a lot of opportunities were provided for the people having few marketable skills to obtain cash earnings.

The freedom of their choice should be guaranteed as a prerequisite before integrating the informal sector into formal waste management. Furthermore, toward integrating the informal sector into formal waste management, special attentions are required when their incomes are the same level as minimum wages and the national economy is rapidly growing. Their average household income was found to be approximately US 216 dollars per month, which was virtually equivalent to the minimum wage in Jakarta in 2013. Integrating the informal sector into formal waste management in the countries where the national economy is growing might have negative results, because they cannot easily change their jobs due to few marketable skills.

One of the challenges for the future is to quantitatively investigate the feasibility of integrating the informal sector into formal waste management in Indonesia. Legal issues of their living in the slums of the site could not be comprehensively covered in this paper, although these are very crucial and politically sensitive. Overall conditions of child labors need to be further investigated. Although child waste pickers were less than 10% of all child respondents aged 15 or younger, considerable numbers of pupils, students and the unemployed, mostly elementary school dropouts, were temporary child workers at the site. At least, it is obvious that measures need to be taken to prevent children from working as informal recycling actors, especially for child waste pickers aged 15 or younger.

If national laws and regulations are properly applied in Indonesia, problems surrounding final disposal sites would not be worse than at present. Unfortunately, such a socialization process cannot be observed in many cases. Political will can therefore be seen as one of the major factors defining the level of integration (Ezeah et al., 2013).

Acknowledgements

The research was financially supported by the Sasakawa Scientific Research Grant from The Japan Science Society. The authors would like to thank the anonymous reviewers for their valuable comments and suggestions to improve the quality of the paper.

References

Adama O. Urban livelihoods and social networks: emerging relations in informal recycling in Kaduna, Nigeria. Urban Forum 2012;23:449–66, http://dx.doi.org/10.1007/s12132-012-9159-8.

Afon A. A survey of operational characteristics, socioeconomic and health effects of scavenging activity in Lagos, Nigeria. Waste Manage Res 2012;30:664–71, http://dx.doi.org/10.1177/0734242X12444894.

Agunwamba JC. Analysis of scavenger's activities and recycling in some cities of Nigeria. Environ Manage 2003;32:116–27, http://dx.doi.org/10.1007/s00267-002-2874-5.

Andarani P, Goto N. Potential e-waste generated from households in Indonesia using material flow analysis. J Mater Cycles Waste Manage 2013., http://dx.doi.org/10.1007/s10163-013-0191-0.

Anon. Scavengers and waste recycling. Kompas 1992(June) (in Indonesian).

Asim M, Batool SA, Chaudhry MN. Scavengers and their role in the recycling of waste in Southwestern Lahore. Resour Conserv Recycl 2012;58:152–62, http://dx.doi.org/10.1016/j.resconrec.2011.10.013.

Aye L, Widjaya ER. Environmental and economic analyses of waste disposal options for traditional markets in Indonesia. Waste Manage 2006;26:1180–91, http://dx.doi.org/10.1016/j.wasman.2005.09.01.

Chaerul M, Fahruroji AR, Fujiwara T. Recycling of plastic packaging waste in Bandung City, Indonesia. J Mater Cycles Waste Manage 2013., http://dx.doi.org/10.1007/s10163-013-0201-2.

Damanhuri E, Wahyu IM, Ramang R, Padmi T. Evaluation of municipal solid waste flow in the Bandung metropolitan area, Indonesia. J Mater Cycles Waste Manage 2009;11:270–6, http://dx.doi.org/10.1007/s10163-009-0241-9.

Ezeah C, Roberts CL. Analysis of barriers and success factors affecting the adoption of sustainable management of municipal solid waste in Nigeria. Journal of Environmental Management 2012;103:9–14.

Ezeah C, Fazakerley JA, Roberts CL. Emerging trends in informal sector recycling in developing and transition countries. Waste Manage 2013;33:2509–19, http://dx.doi.org/10.1016/j.wasman.2013.06.020.

Hayami Y, Dikshit AK, Mishra SN. Waste pickers and collectors in Delhi: poverty and environment in an urban informal sector. J Dev Stud 2006;42:41–69, http://dx.doi.org/10.1080/00220380500356662.

MacRae G. Solid waste management in tropical Asia: what can we learn from Bali? Waste Manage Res 2012;30:72–9, http://dx.doi.org/10.1177/0734242X10386138.

Medina M. Scavenger cooperatives in Asia and Latin America. Resour Conserv Recycl 2000;31:51–69, http://dx.doi.org/10.1016/S0921-3449(00)00071-9.

Medina M. Serving the unserved: informal refuse collection in Mexico. Waste Manage Res 2005;23:390–7, http://dx.doi.org/10.1177/0734242X05057698.

Medina M. The world's scavengers: salvaging for sustainable consumption and production. Lanham, MD: AltaMira Press; 2007.

Meidiana C, Gamse T. The new waste law: challenging opportunity for future landfill operation in Indonesia. Waste Manage Res 2011;29:20–9, http://dx.doi.org/10.1177/0734242X10384013.

Monirozzaman S, Bari Q, Fukuhara T. Recycling practises of solid waste in Khulna City Bangladesh. J Solid Waste Technol Manage 2011;37:1–15, http://dx.doi.org/10.5276/JSWTM.2011.1.

Nzeadibe TC. Development drivers of waste recycling in Nsukka urban area Southeastern Nigeria. Theoretical and Empirical Researches in Urban Management 2009;4:137–49 http://www.um.ase.ro/No12/11.pdf

Nzeadibe TC, Ajaero CK. Development impact of advocacy initiatives in solid waste management in Nigeria. Environ Dev Sustain 2011;13:163–77, http://dx.doi.org/10.1007/s10668-010-9254-8.

Nzeadibe TC, Anyadike RNC. Social participation in city governance and urban livelihoods: constraints to the informal recycling economy in Aba, Nigeria. City Cult Soc 2012;3:313–25, http://dx.doi.org/10.1016/j.ccs.2012.10.001.

Ojeda-Benitez S, Armijo-de-Vega C, Ramirez-Barreto E. Formal and informal recovery of recyclables in Mexicali, Mexico: handling alternatives. Resour Conserv Recycl 2002;34:273–88, http://dx.doi.org/10.1016/S0921-3449(01)00105-7.

Pasang H, Moore GA, Sitorus G. Neighbourhood-based waste management: a solution for solid waste problems in Jakarta, Indonesia. Waste Manage 2007;27:1924–38, http://dx.doi.org/10.1016/j.wasman.2006.09.010.

Porter CR. The economics of waste. Washington, DC: Resources for the Future (RFF) Press; 2002.

Sasaki S, Araki T. Employer–employee and buyer–seller relationships among waste pickers at final disposal site in informal recycling: the case of Bantar Gebang in Indonesia. Habitat Int 2013;40:51–7, http://dx.doi.org/10.1016/j.habitatint.2013.02.003.

Sembiring E, Nitivattananon V. Sustainable solid waste management toward an inclusive society: integration of the informal sector. Resour Conserv Recycl 2010;54:802–9, http://dx.doi.org/10.1016/j.resconrec.2009.12.010.

Sicular DT. Pockets of peasants in Indonesian cities: the case of scavengers. World Dev 1991;19:137–61, http://dx.doi.org/10.1016/0305-750X(91)90252-D.

Supriyadi S, Kriwoken LK, Birley I. Solid waste management solutions for Semarang, Indonesia. Waste Manage Res 2000;18:557–66, http://dx.doi.org/10.1177/0734242X0001800606.

U.S. Department of State. Indonesia: country reports on human rights practices. Bureau of Democracy, Human Rights, and Labor 2001; March 4, 2002. http://www.state.gov/j/drl/rls/hrrpt/2001/eap/8314.htm

Wilson DC, Araba AO, Chinwah K, Cheeseman CR. Building recycling rates through the informal sector. Waste Manage 2009;29:629–35, http://dx.doi.org/10.1016/j.wasman.2008.06.016.

Wilson DC, Velis C, Cheeseman C. Role of informal sector recycling in waste management in developing countries. Habitat Int 2006;30:797–808, http://dx.doi.org/10.1016/j.habitatint.2005.09.005.

Zurbrügg C, Gfrerer M, Ashadi H, Brenner W, Küper D. Determinants of sustainability in solid waste management – the Gianyar waste recovery project in Indonesia. Waste Manage 2012;32:2126–33, http://dx.doi.org/10.1016/j.wasman.2012.01.011.