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ORIGINAL ARTICLE

Community-based solid waste bank program for municipal solid waste management improvement in Indonesia: a case study of Padang city

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Abstract Indonesia has a regulation *UU No. 18/2008* which changes the paradigm from waste dumping to recycling. The purpose of this study is to understand the achievement and obstacles of community-based waste recycling through the solid waste bank (SW bank) program and its potency to improve the local MSW management in Indonesia. SW bank program is a unique organization developed among Indonesian communities to facilitate citizen participation in solid waste recycling. The banking system is adopted, and the community deposits the wastes instead of money. Case study was done for Padang city. The existing condition in 2013 suggests that the amount of solid waste recycled by SW bank activity was only 0.05 % of the total MSW generation. This condition results in 35 % waste without proper treatment. To improve the existing condition, development scenario is planned for 15 years. This development scenario may result in the increase of recycling amount of SW bank activity to 6 % of the total MSW generation in 2028. SWOT analysis suggests that some strategies such as creating a local regulation may be adopted to utilize the potency of SW bank for local MSW management improvement.

Keywords Recycle · Solid waste (SW) bank · MSW management · Mass balance · SWOT analysis

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Introduction

The increasing population and urban activity in Indonesia result in an ever-increasing solid waste generation. The increase of volume and type of waste without proper management is a widespread problem found in most Indonesian cities. Most capital cities in Indonesia are yet to fully implementing the mandates of government regulation *UU No. 18/2008,* about solid waste management. *UU No. 18/2008* changes the paradigm from waste dumping to waste recycling. *UU No. 18/2008* rules that the MSW should be managed by reduction and handling. Reduction includes minimization of SW generation, recycle and reuse. Handling includes waste separation, collection, transportation, treatment and landfill [1]. Unfortunately, most local governments handle their solid waste just by collecting, transporting and dumping to landfill. Currently, reduce, reuse and recycle (3R) activities are not optimally practiced.

Nowadays, mismanagement of municipal solid waste (MSW) is a serious problem faced by local governments in developing countries. By considering the Millennium Development Goals (MDGs) on poverty reduction, and strategy to increase the recycle rate, the main challenge in MSW management for developing countries is to find the best solution for developing the quality of life, working condition and recycling efficiency in this informal sector [2]. Suttibak et al. suggested that the most effective way to solve this serious problem is to integrate the waste recycling effort into existing MSW management [3]. Pasang et al. conducted research in Jakarta, the capital city of Indonesia. They suggested that the major obstacles to MSW management in Jakarta include non-involvement of stakeholders in planning and decision making, unskilled staff, the absence of long-term waste management strategies, and

weak coordination between authorities and neighborhood associations. This paper also explains that the Government of Jakarta has not systematically applied recycling to deal with complex MSW problems. Poor ongoing commitment of local government, lack of community awareness, becomes the reasons why a number of 3R initiatives have ceased to operate [4]. Agarwal et al. studied the MSW recycling in the Indian Capital city of New Delhi. They reported that the recycling of MSW is mostly carried out by an informal sector in Delhi without support from the government creating small place operations that are highly polluting and unhealthy. Therefore, the recyclers might need to be formally incorporated in the waste management system of the city [5]. These previous researches suggested that involvement of communities and integration of waste recycling effort into local MSW management might have a major effect to the implementation of a waste reduction program.

The government of Indonesia has launched many programs and campaigns on the reduction of waste transported to landfill through 3R activities since the introduction of the *UU No. 18/2008*. However, recycling becomes the most emerging activity in communities due to financial benefit. Generally, there are three types of recycling activity in Indonesia, namely recycling by informal sectors including scavengers; recycle dealers; and recycle industries, composting activity at small SW treatment facility and SW bank by communities. Among them, the SW bank program would stimulate direct participation of the citizens. In addition to initiating this program, the Ministry of Environment also issued regulation *PermenLH No. 13/2012,* which rules the guidelines on reduce, reuse and recycle through SW bank. This regulation considers that current MSW management is yet to implement 3R concept and that the SW management needs a comprehensive and integrated implementation. Therefore, it would give economic benefits, increase public health, save the environment and change the community behavior [6]. The development of this program would give a real implementation of *UU No. 18/2008* to separate and to give economic value of waste and to improve the quality of life of communities. Therefore, the communities must be encouraged to participate in this program.

Statistic for February 2012 of the SW bank in Indonesia revealed that there were 471 SW banks with 47,125 depositors and 755,600 kg/month solid waste handled which generate a turnover of $147,000/month. Three months later, the number of SW bank increased to 886 with 84,623 depositors and 2,001,788 kg/month solid waste handled and generated a turnover of $283,000/month [7]. The leading cities in implementing the SW bank program are Malang and Surabaya, East Java. Malang has Bank Sampah Malang (BSM) which services almost the entire city and handles almost 2,000 kg of waste per day. Surabaya has Bank Sampah Bina Mandiri (BSBM) with a turnover of around $10,000/month and 91 SW banks under its guidance [7]. These numbers show that there is a serious concern of some stakeholders in Indonesia to maintain the existence of SW banks among the communities.

Padang is the capital city of West Sumatera Province and the largest city along the western coast of Sumatera Island. Padang has the population number almost identical to Malang city, around 862,157 people in 2012. Padang has 11 districts and 104 villages with the total area of 695 km^2 [8]. SW banks have also been emerging in Padang city since 2011, but the achievement is still relatively low. Therefore, Padang city may represent most cases for the real achievement, obstacles and potency in implementing the SW bank program in Indonesia. Location of Padang city as a capital city of West Sumatera Province is displayed in Fig. 1. The purpose of this work is to study the achievement and obstacles of community-based waste recycling through the SW bank program and its potency to support the local MSW management in Indonesia. SWOT analysis was employed to identify and formulate SW bank strategies that allow the integration to local MSW management.

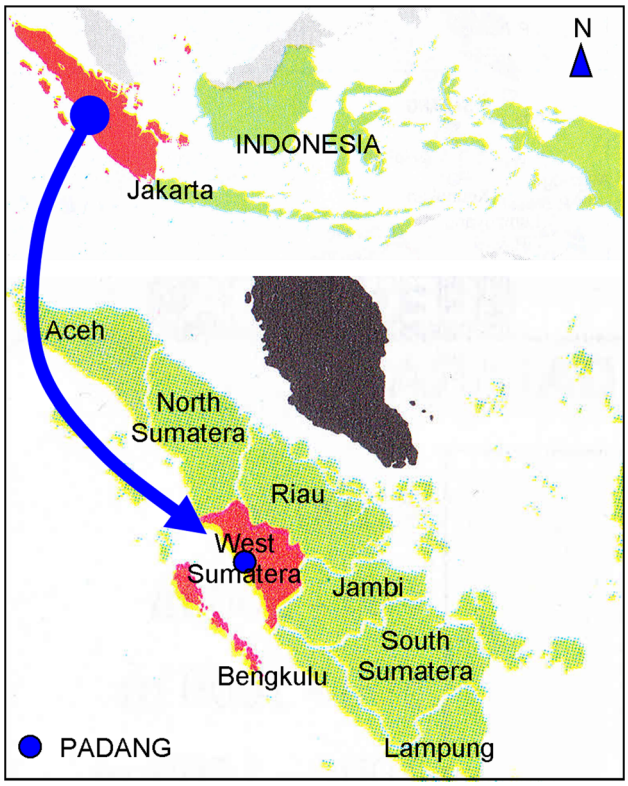

Fig. 1 Location of Padang City

Framework of SW bank program

Indonesia has decided to adopt a sustainable MSW management. It is realized through reduce, reuse and recycle (3R) concept. As communities' awareness is still relatively low, the main obstacle is to transform such concept into a public execution program. The Ministry of Environment has created SW bank program as a social engineering tool for applying 3R concept among communities. SW bank program is different from other informal sectors such as waste pickers, scavengers and itinerant buyers. SW bank program aims to disseminate 3R concept and train its citizens at the level of application. SW bank program is created for various levels of society, waste separation at source as a habit and a sustainable society preparation. Whereas, the other informal sectors are only done by unemployed people, emerged just to get money, forced to sort SW at transfer station or landfill site. Therefore, both have different concept and purpose. However, the most developed activity in SW bank program is likely waste separation, collection and recycling which is possible to support local MSW management. SW bank is still being improved and is expected to develop a collective awareness among people.

According to regulation *PermenLH No. 13/2012,* the three main targets of the SW bank program are to implement the 3R concept among the communities, create a comprehensive and integrated MSW management and increase community awareness on MSW management. SW bank is operated by the communities around their daily life. The central government is responsible for providing technical assistance, integrating SW bank with Extended Producer Responsibility (EPR), monitoring and evaluating SW bank operation in Indonesia. The local government gives technical assistance, training, monitoring and evaluation for their local area to solve the SW problem in an integrated and comprehensive way. SW bank is a place for separating and collecting recyclable waste that has economic value. Institutional form of SW bank is cooperative or foundation. SW bank adopts the banking system. The community deposits the wastes instead of money. Even SW bank adopts the banking system, but it is a non-profit organization.

The framework of SW bank as displayed in Fig. 2 tells that people should sort their wastes at least in two main categories: compostable wastes (food, yard, etc.) and marketable wastes (paper, plastic, metal, etc.) [9]. Types of marketable wastes that currently can be deposited to SW bank are displayed in Fig. 3. SW bank can serve as a unit to help people deposit their marketable wastes by establishing cooperation with informal sectors such as recycle dealers or recycle industries. Working mechanism of SW bank as explained in the regulation includes waste separation, waste deposit, waste weighing, bookkeeping, bankbook recording of waste deposit sale and revenue sharing between depositor and SW bank. Revenue sharing is 85 % for depositor and 15 % for SW bank. Revenue sharing between depositor and SW bank means that a person who

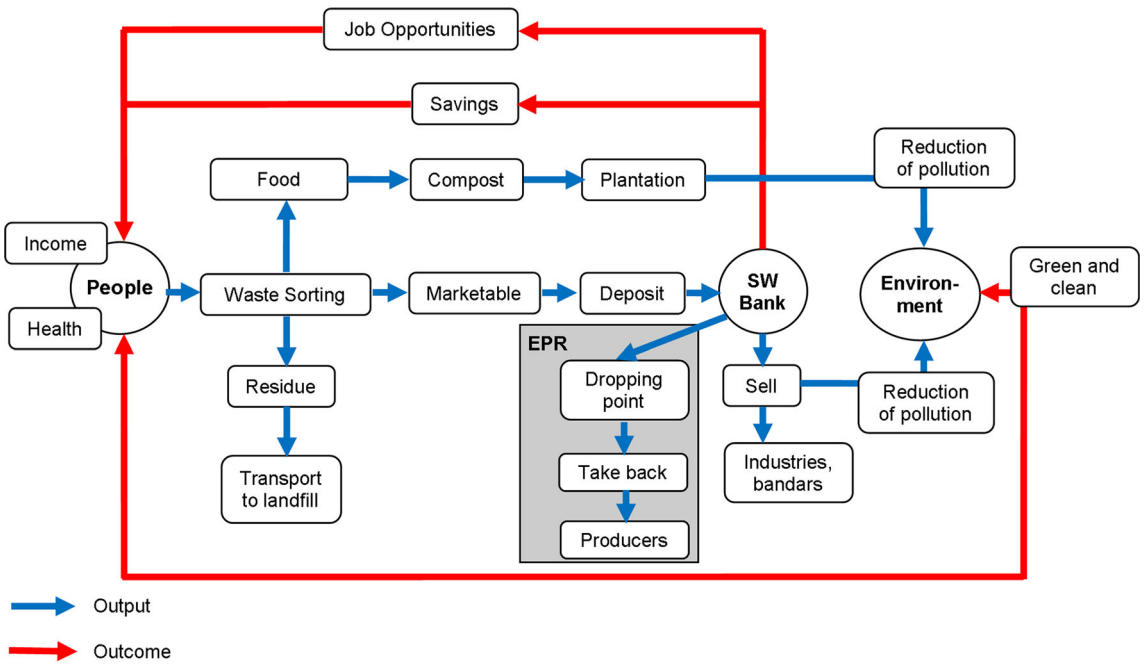

Fig. 2 Framework of solid waste bank

deposits SW into SW bank would receive money as written in his/her bankbook. Extended Producer Responsibility (EPR) is another idea that SW bank could also serve as a dropping point for the producers to take back their post-consumer products. Therefore, the government could share the MSW management responsibilities with the private sector. SW bank activity would give income and health to people and green and clean to the environment. Figure 4 displays some SW bank counters and storage rooms in Padang city.

Fig. 3 Marketable wastes of solid waste bank

Methodology

This research combined qualitative and quantitative method. Qualitative method was carried out to study the social behavior toward the SW bank through surveys and observations. The survey composes of interviews and questionnaires of the stakeholders, while the observational method includes the close observation on the object of research [10]. Some stages were done including literature reviews, secondary and primary data collections, data processing and analysis. Previous researches, regulations related to SW management, SW management standard, etc., were reviewed. Secondary data includes SW generation; composition and recycling potency, while primary data includes the activities and the ability of SW bank to recycle the generated waste. Quantitative method includes the calculation of SW generation of Padang city, analysis on existing MSW management, analysis of questionnaires and interviews to find the actual condition of SW bank

Fig. 4 SW bank counters and storage rooms

activity. Furthermore, mass balance analysis on existing condition of MSW management of Padang city in 2013 was conducted and compared to the potency of waste recycling. To improve the existing condition, development scenario of SW bank program based on national target and the potency of recycling is planned for 15 years (2014–2028). Mass balance analysis on improved condition in 2028 was arranged and compared with the existing condition. SWOT analysis was used to find the best strategies in increasing the number of SW bank activity. Finally, technical integration of SW bank program to local MSW management was proposed.

The first SW bank in Padang was established in 2010. Currently, there are 29 SW banks composed of 8 community SW banks and 21 educational institution SW banks. There is no difference in working mechanism between community SW bank and educational institution SW bank. The only difference is their depositors. They can process around 319 kg of waste per day. 12 SW banks chosen for this study are described below:

1. Community SW bank: there are 8 community SW banks, 3 of them were chosen for sampling which represented the urban, suburban and marginal area of the city.
2. University SW bank: there are only 2 SW banks operated in University, 1 was selected.
3. Senior High School SW bank: there are only 3 senior high school SW banks, 2 of them were selected for this study. They represented urban and suburban area.
4. Junior High and Elementary School SW bank: there are 8 SW banks of each junior high and elementary school. 3 of each category were selected for sampling. They represented urban, suburban and marginal area of the city.

Results and discussion

Analysis of mass balance on existing Padang MSW management (2013)

Figure 5 shows that, in 2013, Padang has a total SW generation of 598,966 kg/day. Only 5 % of the total SW generation is managed by recycling activity. This number is much lower than the national target of 20 % achievement by 2014. Current achievement of Padang recycling activity is 3, 2 and 0.05 % done by the informal sectors, small treatment facility and SW bank, respectively. It suggests that the direct participation of people in Padang MSW management is still relatively low. Analysis of mass balance also indicates that the percentage of SW dumped to Air Dingin Landfill is around 60 %, therefore, the amount

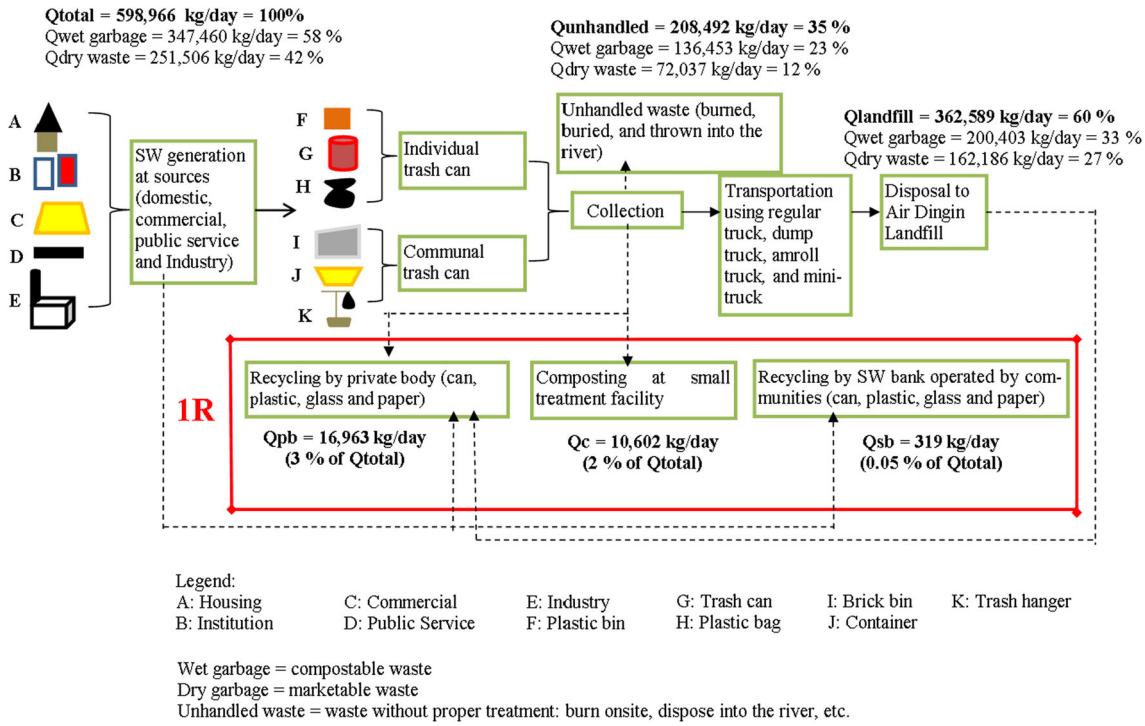

Fig. 5 Analysis of mass balance on existing condition of MSW management in Padang city, Indonesia in 2013

of SW without proper treatment is expected to be around 35 %. Generally, there are three types of SW handling: by simply transporting and dumping into landfill, 3R program and by disposing into environment without proper treatment such as burn onsite and dispose into the river. In Padang, most of SW is simply transported and dumped into Air Dingin Landfill. Recycling activity in Padang is mostly carried out by informal sector. This activity is not well integrated as a city-waste reduction program. Low recycling activity and limited collection and transportation capacity result in a number of SW without proper treatment.

Analysis of mass balance on improved Padang MSW management (2028)

To improve the existing condition in "Sect. 3.1", development scenario is planned for 15 years (2014–2028). It is divided into stage I (2014–2018), stage II (2019-2023) and stage III (2024–2028). Explanations for this scenario are shown in Fig. 6. It shows that the national target of 20 % recycling activity of the total SW generation must be achieved by 2014. This national target becomes the main target in this scenario. By considering the local condition, the realistic development will be at 30 % in the year 2028. Firnanda suggested that the recycling potency of Padang city is 83 % of the total SW generation including wet garbage (food waste, yard, etc.) 46 % and marketable waste (paper, plastic, metal, etc.) 36 % [13]. The total recycling activities in 2013 are only 5 %, including 2 % of wet garbage and 3 % of marketable waste. By proportional calculation, it is assumed that in 2028, the target achievement of marketable waste recycling will be 90 % of 18 %. This development scenario will be achieved by improving the activity of SW bank and informal sectors. Furthermore, the increasing rate of SW bank activity is assumed for stage I, II and III at 0.21 %/year, 0.29 %/year and 0.58 %/year, respectively. The increasing rate of informal sectors is a balance of marketable waste. This scenario is summarized in Table 1.

Figure 7 shows analysis of mass balance in 2028 MSW management in Padang city if above scenario were done. Amount of SW handled by recycling activity increases to 27 % which consists of 11, 11 and 6 % done by informal sectors, personnel of small treatment facility and communities of SW bank, respectively. The SW handled by SW bank may be improved from 0.05 to 6 % of the total SW generation. This condition is expected to reduce the amount of SW without proper treatment to 12 %.

The development scenario of SW bank results in the form of total number of SW bank and the quantity of waste handled by each SW bank as shown in Table 2. Figure 7 suggests that SW bank activity has a potential to recycle 6 % of the total SW generation in 2028. Therefore, the total number of SW bank may be increased as many as 412 with the maximum SW handled per each SW bank around

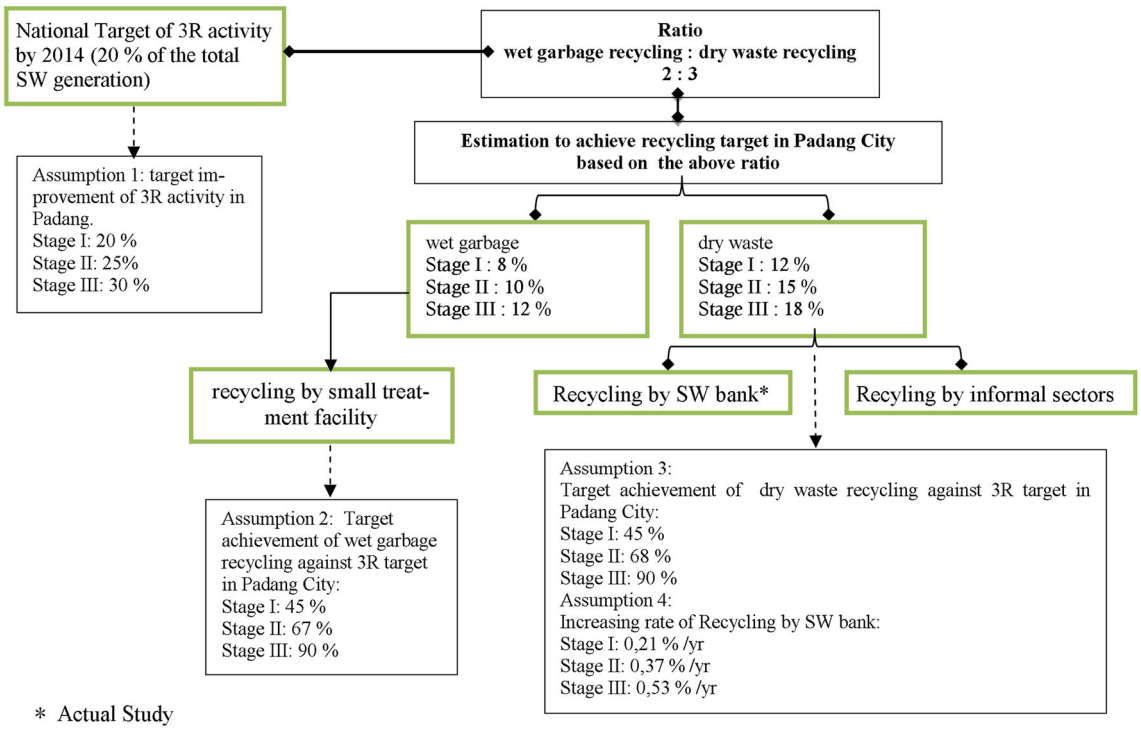

Fig. 6 Development scenario of SW bank integrated with MSW management in Padang city, Indonesia

Table 1 Summary of recycling development scenario for dry waste

Year	Assumption 3[b] (total achievement/stage)	Assumption 4[b]	Increasing rate of informal sectors	Increasing activity of dry waste recycling (%)	
				SW Bank[a]	Informal sectors
2013 Existing	–	–	–	0.05	2.83
Stage I					
2014	5.4 % (45 % of 12 %)	0.21 %	0.29 %	0.26	3.12
2015				0.47	3.41
2016				0.68	3.71
2017				0.89	4.00
2018				1.10	4.30
Stage II					
2019	10.2 % (68 % of 15 %)	0.37 %	0.59 %	1.47	4.89
2020				1.84	5.47
2021				2.21	6.06
2022				2.58	6.65
2023				2.95	7.23
Stage III					
2024	16.2 % (90 % of 18 %)	0.53 %	0.67 %	3.48	7..90
2025				4.01	8.57
2026				4.54	9.24
2027				5.07	9.91
2028				5.62	10.58

[a] Actual study

[b] See Fig. 6

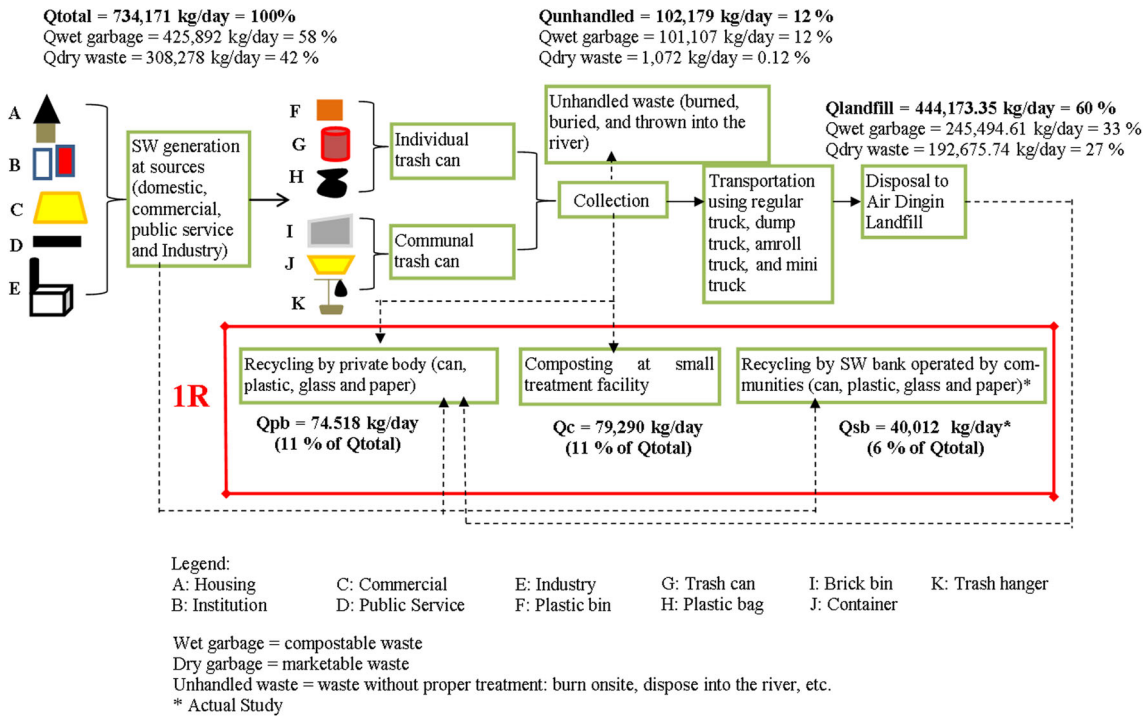

Fig. 7 Analysis of mass balance on improved condition of MSW management in Padang city, Indonesia in 2028

Table 2 SWOT Matrix analysis on SW bank development integrated with MSW management in Padang, Indonesia

Internal factors		
Strengths (*S*)	Weaknesses (*W*)	
Low establishment cost Simple in operational management Easy in marketing	Low personnel commitment and skill Difficult to get the initial investment	
External factors	Strategy: $S \Leftrightarrow O$	Strategy: $W \Leftrightarrow O$
Opportunities (*O*)		
Global awareness on eco city concept	Joining Green Sister City Program with Kitakyushu Eco Town Japan	Improving human resources of SW bank
Support from central and local government through programs and regulations	Creating a local regulation to integrate the SW bank with local MSW management	Increasing the involvement of government and private sector for the initial investment
The presence of corporate social responsibility (CSR) from private sectors	Establishing at least one SW bank for every village with the help of private sectors	
External factors	Strategy: $S \Leftrightarrow T$	Strategy: $W \Leftrightarrow T$
Threats (*T*)		
SW bank development program is not integrating with local MSW management	Improving the local municipal SW separation system	Conducting dissemination about the empowerment of local government and communities to develop SW bank
Low awareness in waste sorting	Designing and applying a technical integration of SW bank into the local MSW management	Creating cooperation with Kitakyushu University in environmental education

100 kg/day. The total number of SW bank (S) is increased from 29 units (2013) to 412 units (2028) with the increasing rate of around 5 % per year.

Strategy formulation for SW bank program development in Padang city

SWOT analysis identifies the strengths, weaknesses, opportunities and threats in developing the SW bank program in Padang city. Support from the government and regulations, motivation found in communities, obstacles faced by the stakeholders, etc., were collected by questionnaires, interviews and observations. They were used to arrange the strengths, weaknesses, opportunities and threats. This SWOT matrix can be found in Table 2.

External factors include opportunities and threats. Global awareness on Eco city Concept has been a familiar word in Indonesia, which forces the government to prepare sustainable program. SW bank has support from national and local regulation (*UU 18/2008, PP 81/2012, PermenLH 13/2012, Perda No. 5/2012*). The presence of Adiwiyata and Adipura Program also supports the development of SW bank. Adiwiyata and Adipura are awarded for schools and cities in Indonesia that successfully manage their environment. These programs are held by The Ministry of Environment. One of their assessment criteria is the achievement of SW bank operation. The possibility to find the initial investment for SW bank comes from the presence of corporate social responsibility (CSR) from private sectors. Another external factor is threats. Local government is not optimally supporting the integration of SW bank program into MSW management. It is likely that the executing agency on city cleaning of local government [Dinas Kebersihan dan Pertamanan (DKP)] does not own SW bank as the local program since it was initiated by the central government (Ministry of Environment). Its representative at municipal level, or known as *Bapedalda kota* executes the SW bank program without coordination with the *DKP*. Therefore, there is no any technical planning how to make integration between SW bank program and MSW management. Role of SW bank is not clear in local MSW management. Existing MSW management operated by the *DKP* does not obey the principle of recycling such as separation or scheduling during collection and transportation. It will decrease the spirit of communities in sorting the waste at source.

Internal factors include strengths and weaknesses. Strengths include low establishment cost, simple in operational management and easy in marketing. SW bank can be operated by just two persons (director and teller) with small area and simple tool such as weight balance. Depositor of SW bank can deposit their waste any time they want. Weaknesses include low personnel commitment and skill and difficult to get the initial investment.

Table 3 Scenario of amount of SW handled per each SW bank (q) and total number of SW bank (S)

Year	SW generation (kg/day)	Increasing activity of SW bank (%)	Amount of SW handled (kg/day)	Scenario	
				q (kg/day)	S
2013 Existing	598.966	–	–	11	29
Stage I					
2014	610.359	0.26	1.587	15	40
2015	621.610	0.47	2.922	20	60
2016	623.953	0.68	4.243	25	75
2017	634.954	0.89	5.651	30	90
2018	645.872	1.10	7.105	35	105
Stage II					
2019	656.718	1.47	9.654	45	120
2020	658.602	1.84	12.118	50	145
2021	669.308	2.21	14.792	55	172
2022	679.969	2.58	17.543	60	203
2023	690.589	2.95	20.372	65	232
Stage III					
2024	692.185	3.48	24.088	70	273
2025	702.719	4.01	28.179	75	315
2026	704.198	4.54	31.971	80	355
2027	723.709	5.07	36.692	90	382
2028	734.170	5.62	41.260	100	412

SWOT matrix suggested that the following strategies may be adopted:

1. Strengths–opportunities strategies:

- Joining Green Sister City Program with Kitakyushu Eco Town Japan.
  Kitakyushu is an international city with an outstanding resource-circulating society. One of its international environmental strategies is to share experiences internationally with the aim of creating better society [11]. Surabaya entered into an agreement with Kitakyushu to become a green sister city, in November 2012. Through this cooperative activity, Surabaya has achieved more than a 20 % reduction in waste generation [12].
- Creating a local regulation to integrate the SW bank with local MSW management.
  The local government must issue a regulation that rules the important position and function of SW bank in local MSW management. The important points must be considered including how to develop and integrate the SW bank into existing and future MSW management. The regulation should also rule sanctions that are followed with law enforcement.
- Establishing at least one SW bank for every village with the help of private sector.
  As indicated in Table 3, the government with the help of private sector must support the establishment of at least one SW bank starting from 2018 for a total of 104 villages. Gradually, the number of SW bank in each village must be increased until 2028.

2. Strengths–threats strategies:

- Designing a technical integration of SW bank into the local MSW management.
  Based on local regulation above, the local government makes a technical aspect of integration such as what part of local MSW system that SW bank must be connected with, e.g., at separation and collection.
- Improving the MSW separating system.
  The existing condition shows that the SW is totally mixed during collection and transportation. The local government must improve their separation system to implement the recycling concept. It will raise concrete motivation of the public to engage in their government‘s program.

3. Weaknesses–opportunities strategies:

- Improving human resources of SW bank.
  The important factor to get the SW bank goes well in operation is its personnel. The local government may set a workshop or training and comparative study for SW bank's personnel.
- Increasing the involvement of government and private sector in the initial investment of SW bank.
  The local government must have data on which areas and communities are feasible for establishing the SW bank so that the distribution of initial investment can reach the appropriate target. The local government can raise funds by creating network with industries of other private sectors through corporate social responsibility (CSR) program.

4. Weaknesses–threats strategies:

- Conducting dissemination about the empowerment of local government and communities to develop SW bank.
  The best concepts and practices owned by the central government should be disseminated to the local governments and their communities.
- Creating cooperation with Kitakyushu University in environmental education.
  Through cooperative activity, Kitakyushu University shares the best practices of Kitakyushu Society in waste reduction and management.

Integration of SW bank into local MSW management

The local governments in Indonesia must integrate the SW bank program into their local MSW management to increase the recycling activities. The proposed technical integration can be suggested as displayed in Fig. 8. Recycling activity must be carried out at source (group of 200–2,000 households) and at municipality scale. SW bank program must be a compulsory tool operated at both scales. Direct participation of people should be facilitated by the SW bank at source scale, while the SW bank at municipality scale is positioned as second line facility. Figure 8 also shows that separated transportation instead of current mix transportation should be established by the local government. As calculated in mass balance analysis, 412 SW banks should be operated by 2028. The local government must secure this target by issuing a local regulation, e.g., every village must run SW bank. Table 4 below summarizes things that must be changed during the process of integration. The changes listed in Table 4

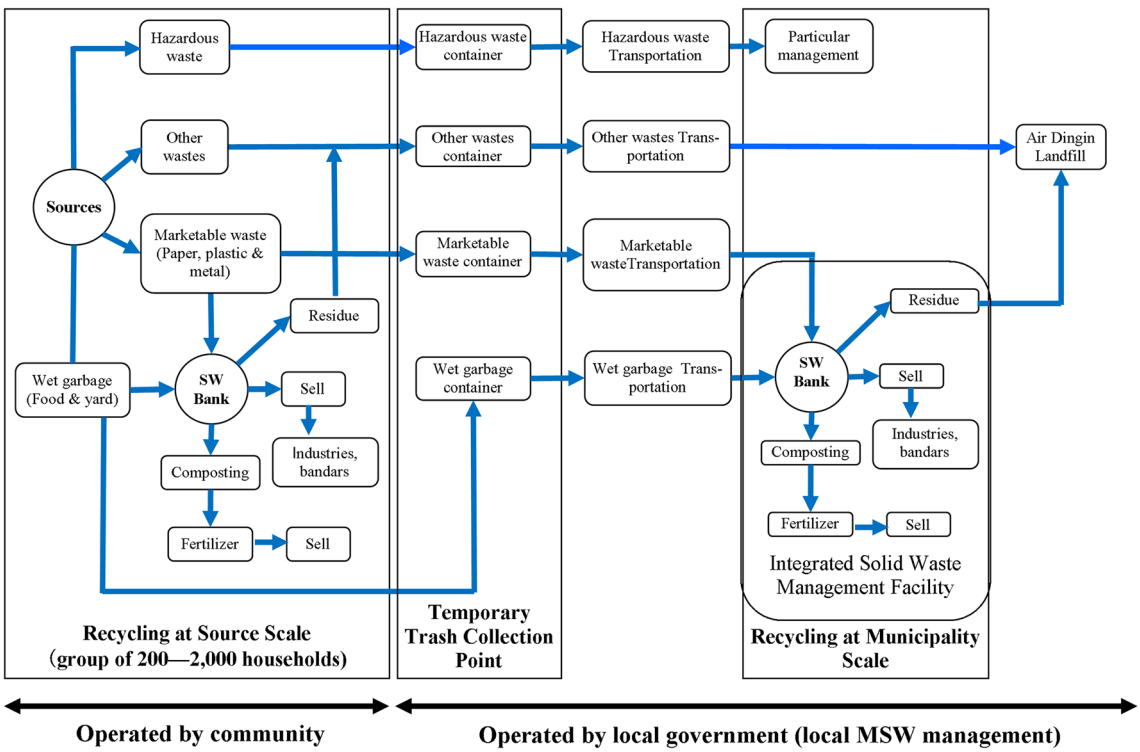

Fig. 8 Proposed integration of SW bank with local MSW management

Table 4 Things that must be changed during the process of integration

Section	Existing	Change
1. Sources	Almost no waste separation	Every household must separate their waste in 4 categories, marketable waste, wet garbage, hazardous waste and other wastes
2. SW bank at source scale	The number of SW bank is still limited	Every village must establish SW bank and composting facility with the help of local or central government and private sector
	Only marketable waste handled	Not only marketable waste, but wet garbage must also be handled
	Not included in village government program	SW bank will sell their collected marketable waste and produce fertilizer from wet garbage
3. Collection and transportation system at source scale	Almost no waste separation	Every household brings and deposits its marketable waste and wet garbage to SW bank. The deposited waste will be recorded as savings
		Hazardous waste and other wastes from household, residue from SW bank and composting facility at source scale are collected and transported by the local government (DKP). Hazardous waste must be handled with particular management by the local government (DKP). Other wastes and residue must be transported to landfill
4. Collection, transportation and SW bank system at municipal scale operated by the local government	Almost no waste separation There is no integrated solid waste treatment facility	Households that are outside of source scale SW bank service area must put their waste on temporary trash collection point in respective container
	Temporary trash collection point does not have separated container	Temporary trash collection point must have separated container in 4 categories
		Transportation system operated by the local government (DKP) brings marketable waste and wet garbage from temporary trash collection point to integrated solid waste treatment facility. Hazardous waste must be handled with particular management. Residue and other wastes must be transported to the landfill
		The local government must establish integrated solid waste treatment facility which includes at least waste sorting, waste crushing, composter and SW bank. It serves as recycling facility at municipal scale

suggest that the SW bank system can be integrated to local MSW management as a method to increase the people participation in separation, collection and recycling of generated solid waste.

Conclusion

Mass balance analysis on Padang Municipal Solid Waste (MSW) management in 2013 suggests that the achievement of recycling activity is much lower than the national target and the recycling potency of local MSW. The actual recycling activity only manages 5 % of the total MSW generation compared to 20 % national target and to 83 % recycling potency. Whereas, the solid waste bank (SW bank) program which is supported by The Ministry of Environment only manages 0.05 %. This condition results in 35 % solid waste without proper handling. Development scenario on SW bank program for 15 years suggested that the total number of SW bank may be increased as many as 412 with the maximum SW handled per each SW bank around 100 kg/day. SW bank program must be a compulsory tool operated at district and village level and at transfer station. Mass balance analysis of Padang MSW management in 2028 if the development scenario applied suggested that total SW reduced by recycling activity and the amount of SW handled by SW bank could be increased to 28 and 6 %, respectively. The amount of SW without handling could be also reduced to 12 %. Some strategies were formulated to realize the development scenario. Major strategy includes the creation of local regulation to ensure the integration of SW bank into MSW management, design of technical, organization and other non-technical aspects management. Proposed technical integration

suggests that the SW bank system can be integrated to local MSW management as a method to increase the people participation in separation, collection and recycling of generated solid waste.

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