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ANALYSIS OF WASTE BANKS IN INDONESIA FOR PLASTIC WASTE MANAGEMENT

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Abstract

Waste management in Indonesia is a massive challenge due to its complexity. As a part of the solution, the development of recycling is an essential and promising measure to decrease environmental burdens. The Ministry of Environment promotes decentralized waste banks, Bank Sampah (Indonesian term of waste banks). These waste banks are waste collection points for the residents, although not all generated waste is accepted. In most cases, sorted recyclable waste is received that has economic value, such as paper, metal, plastic, and glass. Residents bring separated recyclable or less often organic waste to the waste bank where it is treated as a deposit. The waste deposits are converted mostly into money, which can be withdrawn by the residents. In Indonesia, the recycling rate is about 20%, from which the waste banks responsible for about 0.1-0.2%. The purpose of this study is to investigate the efficiency of waste banks. In the course of the analysis, ten waste banks in three areas of Indonesia were interviewed and evaluated based on a scorecard. The results show a potential contribution to the waste banks in the recycling rate rising. One of the most essential and successful attempts is the offer of educational events in the waste banks. Unfortunately, the waste bank system has several shortcomings too, which prevent their efficient operation, such as the density of sites, financial issues, lack of awareness among residents, and the opportunity to integrate the informal sector.

Abbreviations

BS	Bank Sampah
сар	Capita
EPR	Extended Producer Responsibility
kg	Kilogram
MSW	Municipal Solid Waste
MW	Municipal Waste
NGO	Non-profit Organization
SW	Solid Waste
t	Ton
TPS	Temporary disposal sites
TPST DKP	Temporary disposal site by the Cleansing and Landscaping Department
yr	Year
WB	Waste Bank

1. Introduction

Global waste generation is continuously rising; in 2016, cities of the world generated 2,01 billion t of solid waste, which equals to 0.74 kg/cap/day. The estimation for the future is worrisome. With the urbanization and population growth, the solid waste generation will increase by 70%, namely to 3,40 billion t in 2050. (World Bank, 2018)

The estimated combined population of ASEAN countries (Association of Southeast Asian Nations) is 625 million, 8.8% of the world's population. The population is projected to reach 650 million by 2020, and most of the people will be living in urban areas. Indonesia is one of the largest economies in Southeast Asia, with 255 million inhabitants (2014). More than half of the total population lives in urban areas, with a 2.7% average annual population growth rate. (UN, 2017)

The effect of population growth, fast development, rising living standards, and a high rate of urbanization increases the municipal solid waste (MSW) generation in urban areas. Developing countries are heavily impacted by improper, unsafe waste management. Many developing countries have not formed a waste management system, and waste often lands at open dumpsites, or it is openly burnt. (World Bank, 2018) Locally uncollected solid waste causes flooding, air pollution, public health impacts, for instance, respiratory ailments, diarrhea, dengue fever. (UN-HABITAT, 2010). From open dumpsites, waste often ends up in the ocean, rivers, canals, etc. Open burning pollutes the environment and has several further dangerous health effects.

Effective waste management is a huge challenge for developing countries due to its complexity. Several issues have been recognized as a contribution to poor operations of waste initiatives, such as inappropriate financing, cash flow management, low household participation, low community awareness, limited engagement of the informal sector, improper collection systems, and weak regulatory and enforcement systems. (Storey et al., 2015)

When solid waste is not collected separately at the source, the efficiency of the recycling stream is decreased. As a result of inappropriate separation, the waste materials become polluted, and its quality is lowered. When waste is separated at the source, the materials of the waste keep their higher quality. However, separate collection is a new trend in Asian countries. (Storey et al., 2015)

The estimated mass of plastic waste entering the ocean per year is estimated at eight million t, more than 80% of which comes from land-based mismanaged waste. Sixteen out of the top 20 contributors to plastic marine debris in 2010 were developing and middle-income countries with an inappropriate waste management system and a high quantity of mismanaged plastic waste. Indonesia is one of the most substantial contributors to plastic leakage into the oceans, primarily through the lack of appropriate waste management. (Deloitte, 2017; Jambeck et al., 2015)

In many developing and transitional countries, the informal sector plays a huge and important role; Indonesia is not an exception. Recycling, reuse, and repair are the determinative parts of the informal sector, which is achieving a significant efficiency, without cost to the formal waste management sector. (UN-HABITAT, 2010)

The target of the Indonesian government is to improve solid waste management and decrease the amount of mixed waste by 30% by 2019. It is planned to implement the "3 R policy" (Reduce, Reuse, Recycle) and to achieve the targets through waste banks (Bank Sampah). The installation of waste banks, the new strategic program shall educate people to collect appropriately and separate their mixed MSW for recycling purposes.

Based on the aspiration of the government (World Bank, 2018), one waste bank needs to be set up per 1,000 inhabitants, this density of waste banks would lead to about 4.5% recycling rate. The table below shows the potential effect of waste banks on the recycling rate. The table indicates in percentage the overall recycling rate in the country, depending on the collected recyclable waste/ waste banks and the number of waste banks in the country. Solely with an efficient waste bank system, the recycling rate could easily go up to 10% only through the waste banks.

	Ν	umber of ir	habitants/	waste banks	s (capita)
Collected amount of		1,000	5,000	10,000	50,000
recyclable	900	4.5%	0.9%	0.5%	0.1%
bank/month	1,500	7.5%	1.5%	0.8%	0.2%
(kg)	2,000	10.0%	2.0%	1.0%	0.2%
	3,000	15.1%	3.0%	1.5%	0.3%

Table 1 Recycling rate of waste banks

However, according to a study of Nugroho in 2016, the average amount of inhabitants per waste bank was about 50,000, and the collected valuable material per waste bank was 900 kg (Deloitte, 2017). Through the current density of waste banks, the recycling rate is 0.1% from all the generated MSW.

Comparing the aspiration of the government and the realized numbers, we can conclude that there is a huge potential in the waste bank system if the quantity in parallel with the efficiency (the recyclable material collection per waste bank and the number of costumers increase, therefore the unmanaged waste amount decreases) would raise. Therefore, in this thesis, comprehensive primary research will be conducted in order to find the most crucial inefficiencies in the current waste bank system and in order to theoretically enable the Indonesian government to achieve its MSW recycling goal.

1.1 Objectives

The following research questions will be covered in this thesis:

- How are the structure and recycling value chain of the "Bank Sampah" built up? (material streams, values chain, organization setup, financing)

- How effective is the Bank Sampah model in Indonesia when comparing collection rate, recyclability of the materials collected and recycling procedure to other solutions?

The study aims to analyze the current workflow of Bank Sampah-es by carefully observing the operation (financing, organization of the waste banks, stakeholders, collection system, plastic material stream, quantity, and quality of recyclable materials), and to compare the efficiency of waste banks based on a scorecard method. The results are based on primary field research and secondary literature analysis.

2. Methodology

Throughout the research work different methods were applied:

2.1 Data Collection

2.1.1 Literature review

In the beginning, the focus was on the waste management system in Indonesia, more specifically on waste banks as a strategic solution for recycling. Based on the collected information, an "interview guide" with a list of questions was designed to investigate the workflow of waste banks.

2.1.2 Field interview

Field observations, including primary surveys and field interviews (Annex 1), were carried out. The management was interviewed in ten waste banks at three different cities, organized by distinctive stakeholders. The personal interviews were vital points of the research work.

The investigated locations were Jakarta, the capital city of Indonesia, as an example of a large city, Bali, the most visited island by tourists in Indonesia and Lombok, which island has a similar size as Bali, however, the influence of tourism is not substantial.

The different waste banks were led and organized by diverse stakeholders such as private persons, companies, the provincial government, and NGOs.

Data collection from the government. The Ministry of Environment and Forestry have provided statistics directly, based on the required data.

Participation at related events. For instance, workshops, events held by NGOs such as EcoBali, Zero Waste Bali, Trash Hero, STOP.

2.2 Data Analysis

2.2.1 Evaluation of the interviews, based on the focus points of the questions

- Operation of waste bank
- Material flow
- Logistic of materials
- Financial aspects of a waste bank
- Human Resources
- Education of the general society

2.2.2 Calculation

1.) Recycling rate

P/∑WB= S/

SI*CW=CWB

 $(CWB^*12) / WG = Rr$, where

P: population of Indonesia (-)

WB: registered number of waste banks (-)

SI: served inhabitants per waste bank (-)

CW: collected recyclable waste per waste bank (t/month)

CWB: collected recyclable waste per waste banks in Indonesia (t/month)

WG: generated waste in Indonesia (t/yr)

Rr: recycling rate

2.) Sensitivity analysis

"Through this analysis the researcher gets a good overview of the most sensitive components of the model. Thus, sensitivity analysis attempts to provide a measure of the sensitivity of parameters, forcing functions, or submodels to the state variables of greatest interest in the model.

In practical modelling, the sensitivity analysis is carried out by changing the parameters, the forcing functions, or the submodels. The corresponding response on the selected state variables is observed. Thus, the sensitivity, S, of a parameter, P, is defined as follows:

$S=[\partial x/x]/[\partial P/P]$

where x is the state variable under consideration. (Joergensen, 2009)

With the application of the model, it can be shown how varies the recycling rate of the waste banks, if the collected amount of waste and/or the served number of inhabitants increasing.

2.2.3 Analysis of the waste management systems in Indonesia and in the European Union, focusing on Germany and Hungary based on literature review. The following aspects were reviewed

- Generated MSW (annual and per capita, per year)
- Composition of generated MSW
- Treatment of MSW
- Generated plastic waste per year
- Recycled municipal solid, and plastic waste rate

2.2.4 Comparison of the observed waste bank system based on the indicators to existing European recycling collection system

• Total recycling rate of: - MSW

- plastic waste

• Recycling rate of MSW by: - waste banks

- informal sector

Recycling rate of plastic by: - waste banks

- informal sector

• Income of: - formal sector in WB

- informal sector

2.2.5 Scorecard

After the field interviews, waste banks were evaluated based on a multidimensional scorecard. The scorecard was designed according to the evaluation guidelines of the European Commission for civic amenity sites. The report highlights the most important criteria that civic amenity site must meet.

A scorecard is a strategic tool to identify and improve various internal business functions and their resulting external outcomes. Hence with the introduction of a complex scorecard it was possible to identify the most important issues which prevent waste banks from successful operation.

The most significant operation errors were addressed through best practices from EU waste management and through the operation of waste banks in Thailand.

Table 2 shows the scorecard which includes and explains the categories by which the waste banks were evaluated.

Table 2 Waste bank score card

Determination	Score explanation			Score
	0	5	10	
Accessibility of the waste bank for local people	Hard to reach, incorrect contact information. There is no public information about the existence of waste bank	Hard to reach, but there is information through different channels of the existence about the waste bank	Easily reachable, well- connected to the road- network. Proximity of the sites to citizens. Local authorities define and inform the citizens about the location, the acceptable fractions. Information available through different channels	
Dissemination of the importance of waste separation in the local community	Waste bank does not give any information	Waste bank holds educational events	Waste bank holds educational events, and inform the residence about these events	
Motivating locals to use the waste bank system	Waste bank do not use any motivation tool	Waste bank pays off straight away the collected valuable materials	Waste bank operates as a bank, the money can be saved with extra benefits	
Sufficient opportunities for citizens to drop off recyclable waste	Opening hours are fully randomized	Fixed opening hours. The waste bank is open once a week.	Fixed opening hours. The waste bank is open at least 2 times per week once during the week days once on the weekend	
Professional knowledge of the staff about waste management	Waste bank neither has knowledge about waste management nor business acumen	Employees of waste bank got training about appropriate waste management	Waste bank has professional employees with academic degrees in waste management and business administration	
Proportionate density of waste banks	50,000 inhabitants per waste bank	10,000 inhabitants per waste bank	1,000 inhabitants per waste bank	

Sustainable financial situation	Waste bank does not receive financial support, and the selling price of waste is unpredictable	Waste bank receives financial support from the government	Waste bank receives support and has the collaboration with profit-oriented partners who buy the materials	
Current level of door- to-door collection	Customers have to bring their own recyclable material to the waste bank	Waste bank partially provides door-to door collection	Waste bank provides door-to-door collection	
Informal sector integration into the formal system through waste banks system	Waste bank does not have any connection with the informal sector	Waste bank cooperates with the informal sector but do not employ them	Waste bank employ informal waste pickers	
Recycling rate of the waste bank	Smaller than 1 %	1-10 %	Bigger than 10 %	

Through best practices two types of recommendations were suggested. Bottom-up solutions to force the organizations to use collective action from the local level to effect change at the local, regional, national, or international level. Furthermore, top-down (e.g. governmental) actions were also highlighted as optional good practices which could be implemented to improve the efficiency of waste banks in Indonesia.

2.3 Study area

The study collected data from three different parts of Indonesia.

Indonesia is an archipelagic country, in Southeast Asia, consisting of more than 17,500 islands, from which 6,000 are inhabited. (Damanhuri, 2017) In 2018 the population of the country is estimated to be 267 million people. The total area of the country is 1,811,570 square kilometers. (World Bank, 2019)



Figure 1 shows the map of Indonesia and the three areas of the study.

Figure 1 The map of Indonesia

Study Area 1.

Jakarta is the capital and the largest city of Indonesia, located on the north-west coast of Java (6°12'S 106°49'E). The estimated population in 2019 was more than 10 million. The city has an area of about 661.5 km². (http://worldpopulationreview.com/world-cities/jakarta-population). Jakarta has a tropical monsoon climate, with two seasons; dry season from June to September and the major one is wet season from October to May. The average temperature during the year is 27.6 ° C, and the average precipitation is 1,855 mm. (https://en.climate-data.org/asia/indonesia/jakarta-special-capital-region/jakarta-714756/)

Study Area 2.

Bali is a province of Indonesia, located east of Java and west of Lombok (8°20'06"S 115°05'17"E). The province includes of Bali and some smaller islands, namely Nusa Penida, Nusa Ceningan and Nusa Lembongan. The capital city of the province is Denpasar. The estimation of the population was more than 4.2 million in 2014. In 2017 the number of tourists who visited the area was approximately 5.7 million. The total area of the province is 5,780 km². (http://www.thebalitoday.com/bali/demographics/) Bali has a tropical climate with two main seasons; dry season between May and September, wet season between October and April. The average annual temperature Denpasar is 26.7 0 С, and the average rainfall 1,741 in is mm. (https://www.climatestotravel.com/climate/indonesia/bali)

Study Area 3.

Lombok is an island in West Nusa Tenggara province, Indonesia. Located to the west from Bali and to the east from Sumbawa (8.565°S 116.351°E). The provincial capital and the largest city is on the island, Mataram. Lombok has a similar density and size as the neighboring island, Bali. In 2014 the population was more than 3.3 million. The

total area is about 4,514 km². Lombok has a tropical climate with two main seasons; dry season from June to September and wet season from October to March. The average temperature is 24 ° C, and the average rainfall is 1,557 mm. (http://www.lombok-tourism.com/aboutlombok.htm)

3. Fundamentals

3.1 Plastic Waste in Indonesia

Indonesia is the second biggest waste producer in the world, after China. (World Bank, 2018) Due to the inappropriate collection and separation, the waste management chain is not adequate compared to the EU (European Union) countries.

In 2016, the yearly MSW generation in Indonesia was 64 million tons, and the population of Indonesia was 258.5 million people. (UN, 2017; Statista, 2019) The estimation of the generated MSW per capita was 248 kg/yr. In 2018, the total waste generation increased to more than 65 million tons. (Ministry of Environment and Forestry of the Republic of Indonesia, 2019)

According to the World Bank report in 2010, 3.22 million t of unmanaged waste has entered the oceans annually, and 0.48-1.29 million t of it was plastic. (World Bank, 2018)

Solid waste management services cover only about 47% of the total population; only 122 million inhabitants are served. (Lestari et al., 2019; Statista, 2019)

Solid waste is defined by EPA (the United States Environmental Protection Agency): "Any garbage or refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, resulting from industrial, commercial, mining, and agricultural operations, and community activities." (EPA, 2018)

However, waste definitions vary by country. In countries like Indonesia, waste could be often signified as valuable goods and could still be used after repairing them or by recycling the material in a way that they would be reusable. Solid waste is categorized as domestic waste and non-domestic waste. Non-domestic waste is further classified into nonhazardous waste and hazardous waste.

According to the report of World Bank (2018), Indonesia is categorized to lower-middleincome countries, based on this categorization. The composition of waste is the following: 55% biodegradable, 12% paper, 11% plastic, 4% glass, 2% metal, 16% other. (World Bank, 2018) Although the generated plastic waste is the third on the list with 11%, due to the growth of domestic plastic consumption (plastic packaging), it is predicted to grow by 3% yearly. A report of the Ministry of Environment and Forestry of Republic of Indonesia, 2019 shows, how waste composition differs in Indonesia, and the outstanding rate of plastic, with 15% (compare figure 2).



Source: Ministry of Environment and Forestry of Republic of Indonesia, 2019

Figure 2 Solid Waste Composition in 2018, Indonesia (Ministry of Environment and Forestry of Republic of Indonesia, 2019)

The importance of proper treatment (recycling, incineration) has to be taken into consideration. According to the study of Damanhuri (2017), the generated waste in 2013 was treated in the following way: 69% landfill, 8% open dumping, 5% open burning, 7.5% recycling and composting, 5% open burning, 8.5% other (rivers, streets, etc.).

The purpose of the government to improve solid waste management is to decrease the amount of unmanaged mixed MSW by 30% by 2019. It is planned to achieve the target through the implementation "3 R policy" (Reduce, Reuse, Recycle). Reaching the aim of a 30% reduction depends heavily on the participation of households. According to the World Bank report in 2018, only 1.6% of households presented active participation in "3 R" activities, and less than 0.5% of these households contributed to recycling and the reuse of plastic.

Table 3 Solid Waste generation rate, and the percentage of plastic waste in several cities in Indonesia (Lestari et al., 2019)

Cities	Estimation of SW generation rate	Percentage of pl waste
	(Tons/day)	%
Jakarta	7164.53	12.40
Surabaya	2790.89	19.44
Makassar	1425	16.29
Medan	1874	15.27
Denpasar	750	7.04
Semarang	1270.13	15.49
Yogyakarta	335	19.18
Pontianak	300	5.57
Padang	520	22.63
		Source: P.Lestari et. al,

As Table 3 shows, Jakarta generates the most significant amount of waste per day in Indonesia. The population of the city increased to more than 10 million people. More than 12 % of the generated MSW is plastic. Although the city needs adequate waste management, it is facing several technical and non-technical problems.

1) Waste separation, and the proper transport of the separated types

2) Waste collection, transport, lack of trucks, age and operability of trucks

3) Lack of space for facilities such as TPS-3R - transfer points for MSW with separation of valuable material (manually, conveyor or gravitational sorting machine) and composting activity before the waste is transported to the final disposal

4) Bantar Gebang landfill almost reached its maximum capacity.

The non-technical problems originate from the residents, the MSW is not separated properly, due to the lack of awareness.

Another focus of the study is Denpasar, the capital city of Bali. Denpasar generates 750 tons of solid waste, and from that amount, about 7% is plastic. The population of Denpasar in 2017 was estimated to 897,000 people. The enormous scale of tourism of the island also causes a significant waste quantity (Lestari et al., 2019).

3.2 Waste Management in Indonesia

3.2.1 Agencies Responsible for MSW Management

The population growth and urbanization in Indonesia result in an ever-increasing solid waste generation. The increasing quantity and the diverse type of waste without appropriate management is a widespread issue in most of the country.

In Indonesia, the MSW management is inaccurate from the following aspects: financial, institutional, environmental, technical, and social. Waste management policymaking, formulating regulations, and coordinating efforts in pollution control (waste collection and recycling) at the national level is controlled mainly by the Ministry of Environment and Forestry. (UN, 2017) Other line-ministries also contribute to regulation creation of specific waste streams. Ministry of Public Works and Housing provides technical advice, promoting pilot projects, and constructing/controlling solid waste facilities, for instance, landfills. (World Bank, 2018)

Often the complexity (for example, overlapping of responsibilities between the institutions and stakeholders) gives rise to the problems of coordination, which can be the major reason for mismanaged waste.

At local level, the provincial government and municipalities are directly responsible for waste management and services such as the collection, transfer, and disposal pathway. (UN, 2017) Local regulations often failed to comply with policies and regulations made on the national level. The Cleaning Services Unit and the Municipal Planning Agency are the principal local government agencies who have the responsibility to plan and implement solid waste management in the cities. (World Bank, 2018)

According to the World Bank Report (2018), the following responsibilities for specific stages of waste service provision can be identified:

• The neighborhood and community organizations are responsible for the collection and transport of household waste to temporary disposal sites or intermediate transfer facilities

• Local government is responsible for the transport of waste from the temporary disposal sites/temporary facilities to the landfill

• Estate management (residential, commercial, or industrial) is responsible for the collection and transport of solid waste from source to the temporary disposal sites/temporary transfer facilities or directly to the landfills. In place for MSW management, Indonesia has policies, regulations, strategies, projects, but these are often not efficient because they are not well implemented and forced at governmental levels. Solid waste is generated by houses, small businesses, industries, public places, and hospitals. The waste is collected, but not separated and without any treatment are disposed of. Segregation does not happen at the source.

3.2.2 Regulations

Until 2008 there was no national policy describing the concepts, objectives, and measures in waste management. The existing laws were covering environmental problems and hazardous waste, but there was no control over solid waste management. (Meidiana, 2010)

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Table 4 Important Lows.	regulations, policies	in Indonesia a	iccording to waste	e manadement
= = = = = = = = = = = = = = = = = = =				

Low / Regulation / Policy	Established (year)	Objective
Presidential Decree Number 61	1993	Basel Convention Ratification on the Control of Trans-Boundary Movement of Hazardous Waste and Their Disposal
Waste Law 18/2008	2008	Effective and efficient waste management promote waste as a resource Closure of all open dumping by 2013
Ministerial Decree 2/2008	2008	Recycling
Law 32/2009 on Environmental Protection and Management	2009	Environmentally sustainable development, environmental planning policy. Regulating industrial and hazardous waste
Government Regulation No. 81/2012	2012	Household solid waste & household-like solid waste management
Ministerial Regulation No. 13/2012	2012	Implementation 3 R concept (Reduce, Recycle, Reuse) through waste bank
Governmental Regulation No. 101/2014	2014	Hazardous Waste Management
Presidential Regulation No. 185/2014	2014	Acceleration of Water Supply and Sanitation
Presidential Regulation No. 97/2017	2017	National Policy and Strategy of Household Waste Management - 30% reduction of the country's waste (from the waste source generation)

		 to process and manage for at least 70% of the country's waste in order to avoid it from being accumulated in landfill
Presidential Regulation No. 35 of 2018	2018	Acceleration of development of waste energy project

The government of Indonesia enacted the Waste Law No. 18/2008 in 2008.

It determines the definition of solid waste and determines it as the residues of people's daily activities and/or residues of natural processes in solid forms. (Damanhuri, 2017) The law covers issues related to public service principles, waste management funding schemes, shared responsibilities among waste authorities, private sector participation, community-based waste management, and penalties. (Putra et al., 2018) Nearly all big cities in Indonesia are yet to adequately implement the directives of government regulation Law No. 18/2008 about solid waste management. The law transforms the existing scheme from waste dumping to waste recycling. It also regulates that MSW should be managed by reduction and handling. (Raharjo et al., 2015) To achieve the aims, all stakeholders have to use materials that generate the minimum amount of waste, which is reusable and recyclable and/ or it is simple to decompose by natural process. The government and the local government are required to implement the following activities:

- Assess the waste reduction goal increasingly within the limitation of time
- Support the activities of reusing and recycling
- Support the markets of the recycled products

However, it has to be clarified, how individuals, communities, producers, and the government share their responsibilities on the waste generation and management. (Damanhuri, 2017) Regarded to the hazardous waste; Ministry Regulation No.02/2008 concludes the following rules:

- Reuse: reuse the hazardous waste for the same objective without any biological, chemical, physical, thermal process.

- Recycle: through physical, chemical, biological, thermal processes, use valuable materials to produce a different or same product.

- Recovery: recover the valuable materials or energy through a biological, chemical, physical, or thermal process. Furthermore, Governmental Regulation 101/2014 was established. It assigns the hazardous waste management, including the mitigation, storage, collection, processing, transportation, utilization, landfilling, and dumping into

the sea. Hazardous waste mitigation is the purpose of the generator to reduce the quantity and the concentration of hazardous and toxic materials. (Damanhuri, 2017)

Government Regulation No. 81/2012 clarify more specifically concerning MSW management and its technical treatment, the 3 Rs concept, and the Extended Producer Responsibility approach. Each municipality or other governmental authorities are responsible for the management of MSW. The law specifies different types of waste such as

- Domestic waste: generated by daily activities by households (excluding the faces and specific waste.)

- Domestic waste from small entrepreneurs, commercial zones, social facilities, public amenities, special zones.

- Specific waste is all waste that requires unique management due to its characteristic, concentrations and/or quantity, waste containing hazardous materials, hazardous waste, waste caused by disasters, construction waste, none-processable waste due to the lack of technology. This governmental regulation also requires that local governments change the open dumping system to more environment-friendly dumping.

Presidential Decree No. 97/2017 was established for the improvement of solid waste management, covering National Policy and Strategy (JAKSTRANAS) for the management of Household Solid Waste and the alike. The JAKSTRANAS' aims are to raise solid waste management services and community participation. The cities targeted to mitigate their solid waste emission up to 30% in 2025. Another aim of JAKSTRANAS to accelerate solid waste services in the cities up to 70% in 2025. (Lestari et al., 2019)National strategies have been developed to address challenges related to waste and environmental management. These get addressed widely in their policy and regulatory framework and strategies such as green growth, sustainable development, and climate change. Pilot projects are in progress to reduce waste through greening production, lifestyle, and sustainable consumption. These projects have further aims, like present full-scale utilization of organic component of municipal waste, through the decrease of disposed waste amount, GHG reduction, energy recovery, and resource efficiency. Perception of zero waste programs and waste minimization needs to be extended. (UN, 2017)

Important ongoing programs related to solid waste management:

- Adipura Program, led by the Ministry of Environment and Forestry, the program evaluates the cities and regencies based on their cleanness, their environmental management performance, including MSW management and beyond compliance toward a sustainable city. (Adipura Kencana Program)

- Develop and enforce the 3 R concept, a program which helps to implement the 3 R program in city level and community-based scale, 365 cities introduced the pilot project

- Bank Sampah or Waste Bank program, offers waste banks in the neighborhoods with education about waste separation at source and then recycling with the opportunity of saving money, reducing the waste

- The PROPER program, a program for pollution control, evaluation, and rating, is a national-level public environmental initiative (Damanhuri, 2017).

3.2.3 Municipal Solid Waste Management in Indonesia

All most half of the generated MSW was not collected properly. (Lestari, 2019) The rest of the quantity was treated mostly at a household level like buried, composted, burnt, disposed of in river, other treatments. Data and information about waste handling, treatment facilities, technologies, are often missing. (Meidiana et al., 2010)

In Indonesia, there are three types of solid waste handling, namely the collect-hauldispose system, the 3 R program (Reduce, Reuse Recycle), and without any proper treatment disposing into the environment, like open burning and dispose of the river. (Raharjo et al., 2015)

Waste is collected mainly by manual labor and non-specialized trucks, and then the waste is transported to the final disposal site. (Chaerul, 2013) In areas that are difficult to reach, the general approach is to place waste collection points (temporary disposal sites, TPS) and request households to dispose of their waste in them, which should then be emptied and transferred to the final disposal site on an established schedule by the cleaning groups. In a report of the World Bank in 2018, it was shown that in most cities, the location of the temporary disposal sites (TPS) were located far from the residential areas. The result of this misallocation was that the households treated their waste in other ways, such as open dumping or open burning. Lack of waste management equipment, for example, bins, carts, waste, can cause the same problems.

In areas where there is a possibility for manual (human-drawn) waste carts to pass through, collection systems are organized on a fee-for-service basis. The waste is collected by the executive of the Indonesian Community Association or Indonesian Neighborhood Association on a weekly or monthly base.

In most cases the solid waste ends up in controlled landfills, where the waste is dumped and layered with soil. In some cities, sanitary landfill with gas extraction can be found. There is a significant variance in waste management between the settlements. The best waste management performance appears on the main island, Java. The divergence coheres to the difference in solid waste generation rates on the islands and assessed by the availability of finance and technology. (Lestari et al., 2019)

The central government supports the local government in the waste reduction program through the Ministry of Public Works and Housing. The government has created waste banks and another community-based system for treating compostable waste at source scale (a group of 200-2,000 households). Furthermore, the Ministry issued a regulation about waste treatment facility (TPST-3R) at the municipality scale. TPST-3R is a temporal waste dispose site including a waste bank treating dry recyclable and a composting site for compostable waste. Dry recyclable waste is recycled, the organic waste is composted, and the rest of the waste is transported further to the landfill. They function like a waste bank and compost center for the local communities (Raharjo, 2017; Hibino et al., 2019)



Figure 3 current MSW Management practice

Figure 3 shows the current MSW management practice based on the study of Raharjo, 2017. In waste banks, people bring their recyclable waste, which is mostly separated and sold further. In TPST DKP facilities (temporary disposal site by the Cleansing and Landscaping Department) they treat only organic waste for composting. In TPS 3R facilities, they compost and treat the separated plastic waste. (Hibino et al., 2019) In most cases TPS 3R facilities are mixed with waste banks. (Damanhuri, 2017)

According to the recycling process, there are two main flows. In the first flow, waste is collected at source by the formal and informal collectors. In the second flow, the materials are separated and recycled after the formal municipal waste collection by the municipalities. In this case, recycling means to reuse the product which previously categorized as "waste," either by directly self-reusing, making new product from the materials, or by selling to waste traders. (Damanhuri, 2017)

In Figure 4, an outline of the plastic waste chain is indicated. The first step is the collection, and then the waste is transported to waste banks, or to landfills. This is still not the end station of the plastic waste; it is used and reprocessed by intermediates, dealers, mechanical recyclers until it is disposed to the environment or recycled as a new product.



Source: Putri et al., 2018

Figure 4 Material flow of plastic waste in Jakarta (Putri et. al, 2018)

As part of the waste management development, recycling is getting essential and a promising method to reduce environmental burdens. Since the introduction of Law No. 18/2008, the Indonesian government initiated several projects and campaigns to reduce the amount of landfilled waste through the 3 R theorem. From the 3 R concept, recycling is the most popular activity in communities due to financial benefit. In Indonesia, the following three types of recycling activities are common.

- Recycling by informal sectors including waste pickers, dealers and recycling industries
- Composting activity at the small solid waste treatment facilities
- Waste banks by communities (Raharjo et al., 2015)

The Ministry of Environment promotes decentralized waste banks, Bank Sampah (Indonesian term of waste banks) as a social engineering tool for applying the 3 R concept among communities. The waste bank becomes a collection point for the involved communities, although not all waste generated is accepted. In general, sorted dry recyclable waste that has economic value is accepted, such as paper, metal. plastic, and glass. (Putra et al., 2018) Waste banks are typically set up in neighborhoods for about 1,000 inhabitants and usually operated by poorer people. Residents bring all their separated non-organic or less often their organic waste to the banks where it is treated as a deposit. Transactions are recorded in a bank book. The waste banks sell the deposited material to mobile agents to recycle or reuse. The waste deposits are transformed into money, which can be withdrawn by the customers (World Bank, 2018). Although, 1,900 waste banks have been launched in Indonesia by the central government, only 30% of them are regularly operating without complex statistics about their efficiency. The main reason for low efficiency is unseparated waste and the lack of information on the existence of these waste banks. (Zakianis et al., 2017). The waste separation on the household level would be the starting point of the whole waste management, the absence of relevant awareness and knowledge hinders the process. (Banga, 2011)

Overall, the lack of success can be the result of the wrong definition of long-term goals, the missing information for evaluation, planning and measuring, the lack of equipment,

and the fact that public consultation and participation are not integrated into the system. There is little or zero public information of the existing waste management system, and the effort to raise public awareness is limited. (Chaerul, 2013)

The government of Indonesia has several promising commitments about maximizing the efforts to decrease the waste emission of the county and finding the solution for the oversized waste generation. The government has been putting effort into strengthening the legal framework, while strategic education programs are being provided to improve the knowledge and awareness of residents about waste management. In recent years the "3 R - Reduce, Reuse, Recycle" concept was forced.

In addition to launching this program, the Ministry of Environment also issued a regulation PermenLH No. 13/2012, which sets down the guidelines on the concept of reducing, reuse, and recycle through the waste bank.

The current solid waste management system in Indonesia has not fulfilled the 3 R concept yet. It needs comprehensive and integrated implementation. The development of the program would foster the real application of the law 18/2008 on separation and - through separation - give an economic value to waste. Therefore, the communities would have a bigger motivation to participate in the program. Furthermore, it would bring better public health, economic benefits, environmental protection, and change in people's behavior. (Raharjo et al., 2015)

There are different difficulties in Indonesia to implement the 3 R concept, which are pointed out by the Indonesia Plastic Recycling Association, ADUPI (2018), namely:

- large population: over 255 million inhabitants

- vast land area, divided over thousands of islands (about 17,500 islands) (Nugroho, 2019)

The Indonesian government allocates 1 billion USD for urban waste management in the next five years. Not only Indonesia supports its waste management in the country, but other European countries invest in their development of the waste management chain. For example, Germany assists in installations of central dumpsites in the Java region. Cooperation with Norway and Denmark was set up to improve urban waste management. Norway contributed 1.4 million USD to the Indonesian Oceans, Marine Debris, and Coastal Resources Multi-Donor Trust Fund. Denmark also provided more than 800,000 USD to the fund.

3.3 Informal sector in plastic waste management

3.3.1 Waste pickers

The informal sector is described as small-scale, labor-intensive, mostly unregulated and unregistered manufacturing services, groups, small businesses. (Wilson et al., 2006) It usually operates at a low organization level. In general, these recycling segments have low fixed capital for technology and run as small enterprises, including the whole family. Often these informal businesses are not registered, thereby rules and regulations are avoided such as tax laws, health and safety regulations, laws about child labor, etc. (Chaerul, 2013)

The waste pickers provide valuable service to society by collecting waste from streets, segregating household waste, and turning them into usable products. The collection

and the sale of secondary raw materials represent valuable profit for the informal sector. (Sasaki et al., 2013)

In Indonesia, the informal sector is not part of the formal waste management system, but it is not illegal. Waste pickers in Indonesia are called "Pemulung." (Sasaki et al., 2013) However, a study by Scheinberg et al. (2010) shows that the border between the formal and informal sectors is often not clear. The materials recycled and collected by the informal sector frequently end up in formal recycling facilities or exporters. Furthermore, employees of the formal collection system often pick out the valuable material from the residual waste and sell them to informal sector dealers. The number of people who worked as waste pickers and were involved in waste recycling was estimated to be 40.000 persons in Jakarta, in 1992. (Sasaki et al., 2013)

According to the study of Sembring and Nitivattananon (2010) waste pickers were classified into the following categories: (a) street waste pickers, who collect the recyclable material from the streets and bins (b) temporary storage site waste pickers, who collect recyclable materials from temporary storage sites (c) landfill site waste pickers, who collect recyclables from dumpsites (d) domestic servants, who collect the recyclables from households (e) itinerant waste buyers, who buy the recyclables from the households, door to door (f) municipal collection crews, who separate and sell the recyclables (g) small scrap dealers, who buy directly the waste from waste pickers (h) small or large businesses, who buy waste from the scrap dealers (i) intermediates, who connect the larger enterprises with manufactures. Waste pickers are collecting and separating the waste from three different sources. (a) The waste is collected at the source before the authorized collection vehicle arrives. (b) The waste is sorted out during the loading procedure of the official collectors. (c) The usable materials are picked out at the dumpsite.

3.3.2 Living and working conditions

The income of waste pickers depends on the international prices of recyclables. In 2013 a research study made by Sasaki et al. observed that in Jakarta, the average income of an informal sector recycler's household was approximately 216 USD/month, which was equivalent to the minimum wage. From all recyclables, the essential incomes are coming from soft and hard plastic, reaching over 80% of all recyclables.

Health and safety risks are huge issues. Waste pickers often live and work in deplorable conditions; they often live on the dumpsites, or next to them. They have limited access to facilities and infrastructure. There is no provision of public services such as water supply, and there is a lack of built out sewerage systems and an absence of social safety networks. Collecting recyclables at the site is unsafe due to medical waste, other sharp objects such as injection needles, and the presence of different pests. Falling from the waste dump also often results in injuries. Inhalation of the smoke and fumes produced by open burning of the waste can cause health problems. Children, the elderly, and women often play an essential role in informal activities, and they are the ones exposed the most to these risks. (Wilson et al., 2006)

3.3.3 The role of the informal sector in waste management

Recycling is mostly an informal sector activity (15% of the total waste collected by the informal sector) with formal recycling systems capturing less than 3% of waste generated. (World Bank, 2018)

There are two possibilities to recover the material; one is through a door-to-door collection of material. In that case, the waste no longer needs to be collected by the formal sector, so all expenses (collection, transport, and disposal) are decreased. The second possibility that the material is recovered at the disposal site, then the transport, collection cost does not mitigate, but the disposal cost is reduced. This impact on the expenses shows that the informal sector should have access to the valuable materials as early as possible. At the first stage, the waste is less contaminated; therefore, it is less hazardous for the waste pickers. (Scheinberg et al., 2010)

A report of Deloitte (2017) showed the informal sector's importance in waste management. Current waste management was observed in Jakarta. It has been founded out that the waste banks, where individuals (10-80 clients/waste bank) have to bring their separated waste recover about 900 kg of waste/waste bank/month, while the other main part of the system, the waste pickers recover about 3,000 kg waste/waste pickers/month. The efficiency of waste banks often depends on the clients; they often struggle with the unstable quantity and low quality of the waste. (Putri et al., 2018) It indicates one of the formal sector's weakness that the inhabitants are not aware of the system and the importance of plastic recycling.

Furthermore, Scheinberg et al., 2010 drew the following conclusion based on their research results in six developing cities around the globe. The recycling programs of the formal sector may not be as profitable, as for the informal sector because:

- The orientation is more focused to avoid negative environmental effects from disposal than to produce revenue

- Often the recovered quantity is too small for efficient transportation to an industrial buyer

- The lack of knowledge of the formal sector entering into the recyclable market

3.3.4 Integration of the informal sector to the formal waste management system

The study of Sasaki et al., 2013 shows that the cooperation between the informal recycling systems and the formal MSW management has remarkable benefits, although it tends to be a challenging issue. It faces crucial problems such as additional costs, which are one of the major subjects for developing countries. The first step is to raise the ability of the informal sector to add value to the collected materials. Special attention is required regarding their incomes since they are at the level of the minimum wage. In a short-term perspective, improvement of working and living conditions need to be considered. Protective equipment such as gloves, footwear, and tools must be provided. Sanitation facilities near to their working and living place have to be laid.

Waste pickers need to be trained on how to use the equipment and to be aware of the health risks and the danger of their job. Furthermore, to prevent several diseases, vaccination is necessary for the workers and their family members. A control system has to be implemented, to have an overview of the activities, to identify the people who are working on dumpsites. (UN Habitat, 2010)

The integration of the informal sector has benefits not just for the waste pickers but also for the formal sector. Informal businesses have their huge experiences and knowledge about identifying materials and marketing, and making use of them in a flexible way. Furthermore, the recycled material collected by the informal sector has a lower carbon footprint, since they use human or animal muscle power. (Schneiberg et al., 2011)

By definition, the informal businesses are unregistered, which makes them vulnerable to exploitation and competition. According to the research of Scheinberg et al., 2010, the investigated enterprises would prefer to be registered as formal businesses, including paying taxes and fees.

3.4 Waste Bank System

The "3 Rs" concept in urban waste management is an integral part of sustainable waste management. The main objective is to lead the community to increase the quantities and qualities of reusable material. Further objectives are to ensure safe waste treatment from the point of health and human living environment. Besides that, the concept has further significant impacts. The economic effect of recycled materials and trading businesses are at least as important as the social and environmental influences. Market mechanisms are followed by the ensuing factors: price, product/material qualities, supply continuity that are based on their demanded, and the concerning profit amount of these economic activities. Through recycling, the economic value of the material will be increased if the end-product has a higher quality. For that reason, a mechanism is needed that guarantees the quality of products to be merchandised through, for instance, quality standards. (Damanhuri, 2017)

The legal framework for the waste banks is given in the Regulation of Ministry of Environment Number 13/2012 concerning the guidelines for the "3 Rs" of Reduce, Reuse, and Recycle.

Based on the regulation, the short definition: "a waste bank is a place for sorting and collecting of waste that can be recycled and/or reused which has an economic value." Besides waste banks linked with the serving of household waste collection and the creation of new products to manage household waste, which in return has the economic value. (Nugroho, 2019) Moreover, the waste bank is a community-based waste management system that authorizes the public to participate in controlling their environment actively.

At first, a waste bank system was implemented in Thailand in 1999 as a breakthrough in 'saving waste.' Two years later, in 2008, the first waste bank appeared in Indonesia too, it was founded by an entrepreneur in Bantul, Yogyakarta. (Wijayanti et al., 2014)

Bank Sampahs, as waste banks called in Indonesian, are typically set up in neighborhoods for about 1,000 inhabitants and usually operated by poorer people who would like to increase their income. The waste banks are more often organized in Kampung areas ("Kampung is typical of high dense urban settlement mostly inhabited by lower-middle-class people." (Wijayanti et al., 2014)) than in middle-class residential areas. In these areas, people are more interested in the benefits the waste bank can offer, because they are living in worse conditions than the middle-high income communities who have settled economy. (Wijayanti et al., 2014) Furthermore, companies often organized waste banks under their Corporate Social (CSR) programs.

Waste Banks are functioning like regular commercial banks, where customers open their account and then periodically bring their separated non-organic or less often their

organic waste (mostly it depends on the waste bank what they accept), which are weighted and given a monetary value, based on rates set by the bank itself. (Nugroho, 2019) Afterward, transactions are recorded in a bank book. The non-organic household waste is going to be recycled, and the organic household waste is going to be composted. The waste banks sell the deposited material to mobile agents to recycle or reuse. In bigger cities, often a central waste bank of the district collects the separated, valuable materials from the smaller neighboring waste banks, and then they can sell the appropriate amount straight to the recycling industry. The waste deposits are transformed into money, which can be withdrawn by the customers. (World Bank, 2018) The success of the waste bank concept depends on the "self-reliance" of a community both in managing business and monitoring the cleanliness of the neighborhood. (Wijayanti et al.,2014)

The Regulation of Ministry and Environment stated some requirements that have to be established to organize a waste bank. A management system should be evolved, and it needs a building. The management system requests the followings: the name of the waste bank, the address of the waste bank, the customer, the waste collector, the waste buyer, the role of the waste bank administrator, the recycling industry, and types of waste management in the waste bank. The tasks of the waste bank include waste sorting, the weighting of waste, recording, then the waste results which are submitted into saving the book, sale of the valuable materials for further traders or recycling industries, pay to the customers. The implementation of the waste bank includes the designation of working hours, minimum weight, acceptable waste types, pricing, withdrawal of savings accounts, borrowing money, ensuring of bank books, waste collection services, waste containers. (Nugroho, 2019)

There are no general rules laid down according to the customer's access to money; thus, there are many different types of waste banks.

- There are waste banks where the customers bring their valuable material and, they get their money immediately in cash.
- In other ones, it is working like in a bank they can save their money in the waste banks, and it can be withdrawn after a particular time (usually it is withdrawn around the Ramadan period).
- There are also waste banks where people can decide if they want to save their money or get it immediately, but often if they save it, they get some extra food or credit in the electricity company or communication company, etc.

As the previous examples are also showing waste banks works not just for wastereducing but also in a social way.

Furthermore, one of the most crucial aims of waste banks is education. Mostly they offer several educational programs, events, and workshops for children and adults too. On these occasions, people can learn how important it is to keep the environment clean, what are the consequences of untreated waste, how they can make benefit from their waste (e.g., manufacturing products from waste which can be sold). The waste bank program as a community initiative supports the government program by changing people's behavior to sort their waste. The main task of the waste banks is providing awareness and knowledge for the households about waste separation, as it is considered to be one of the critical drivers of recycling, which is reached through the concept "from trash to cash." Spreading appropriate knowledge, such as clear

instructions provided in a communication and collection campaign, can increase the probability of recycling behavior.

The Ministry of Environment and Forestry supports the waste bank program to increase the promotion of the 3 R concept and decrease the untreated waste amount. In 2012 the ministry reinforced the construction of about 1,200 waste banks, which are distributed across 55 regions and cities in Indonesia. Based on the Report of the Ministry of Environment and Forestry (MEF, 2012a), the waste bank strategy has shown a remarkable increase in the following areas:

- Has reached around 470 individuals in February 2012, it had been increased to 96,200 individuals in December 2012;

- The total amount of dry recyclable waste treated, collected in waste banks was around 0.76 t/month in February 2012 and grew to about 2,000 t/month in December 2012.

- In sum has generated around Rp.1.65 billion (USD 183,000) by February 2012, which has increased to around Rp.15.1 billion (USD 1.562 million) by December 2012. (Damanhuri, 2017)

The amount of waste banks across Indonesia is continuously changing, but in total, it is increasing. Based on the research of the Ministry of Environment and Forestry and the Ministry of Industry, in 2016, the total amount of waste banks around Indonesia reached more than 5,200 units in 34 provinces and 219 cities, as shown in Figure 5. Across Indonesia, three provinces outstanding for the total number of waste banks, namely East Java Province (1,009 units), West Java Province (732 units), and South Sulawesi Province (726 units). (Nugroho, 2019)



Figure 5 The distribution of waste banks across Indonesia (Nugroho, 2019)

Although the number of new waste banks is increasing, the report of Deloitte (2017) shows the registered waste banks' activity is relatively small, and they show limited economic activity. In 2016, on a total of 426 waste banks which were registered in Jakarta, only 280 were active, and 40 had regular and significant operations.

In many cases, waste banks are not financially sustainable and mostly rely on voluntary work and Corporate Social Responsibility funding. The combination of limited geographical reach and low participation from the inhabitants results in small collected volumes. Based on the data proceed by Deloitte in 2016, the average collected waste per waste bank increased to 900 kg/month. The estimation of collected waste by waste banks around Indonesia is 4,680 t/month.

4. Waste Bank system in Thailand

Waste banks in Thailand work in similar way as in Indonesia. The waste bank buys recyclable waste from the costumers in exchange of a deposit like the banking system, resulting in more efficient waste separation. It can provide a cleaner environment and an extra saving for residential. Furthermore, the involved students in school waste banks have the opportunity to understand waste management processes.

The central government provides technical and financial support to local governments strengthening the waste bank system. In many cases, the waste bank program operates in coordination with Wongpanit, a successful Thai recycling company.

Local authorities have introduced the 3R concept, focusing on waste separation, and the sale of recyclable material.

The waste bank system has been operational since 1999 in Phitsanulok Municipality and has been supported by collaboration between the Municipality and Wongpanit, recyclable waste buyer company. This initiative is being replicated nationwide in the form of 'school waste banks' and 'community waste banks'. (Yamamoto and Hosoda, 2016)

School waste banks are established in local schools, where students can bring their recyclable material. Students obtain either cash or prizes in exchange for their material. The prizes, sports equipment, stationery are financed by the profits from the sold recyclable waste. The children operate the waste banks with the support of the teachers.

Community waste banks are similar to the school waste banks, but operated by, communities and municipalities. In Phicit, the profit of the sold recyclable waste is invested in a communal convenience store, where members of the waste bank can buy products cheaper.

The "waste-for-eggs" project was established in the poorer districts of Bangkok. The main objective was to solve the flooding issues caused by the illegal waste disposal of the canals and sewerage systems. Inhabitants were motivated to collect the waste and exchange them for eggs. In six months, the area was cleaned by 160 tons of waste by the community. After this success the project is now operating in 23 communities within Bangkok. (World Bank, 2003)

According to the United Nations report in 2017, the estimated value of total waste collected by approximately 6,000 waste banks is 18,000-30,000 t/y. The estimated total generated municipal waste in the country is about 26.8 million t/y. Based on the data, calculating with the highest value (30,000 t/yr), the estimation of the recycling rate of the waste banks in Thailand is 0.1 %.

The efficiency of waste banks based on the recycling rate shows a huge similarity to the efficiency of Indonesian waste banks. However, according to study of the United Nations, 2017 waste banks cooperating with the recycling company Wongpanit work more successfully. The reason could be that there is a fixed buyer of their separated waste, and the company also supports the transportation of the waste.

5. Research results

During the research, field interviews were taken for the qualitative analysis of the study. Several stakeholders were questioned in ten different waste banks across Indonesia. The research was done in three different places: in Jakarta, Bali, and Lombok. An interview guideline (Annex 1.) was used with 19 questions, which was focusing mainly on the operation and the efficiency of the waste banks. The inquiry included questions concerning on the number of customers, the collected waste amount if the waste is treated somehow, material revenues, the human resource, the financial aspects of waste banks, the emerging issues that the waste banks struggle with, the possibility of the integration of in the informal sector.

5.1 Jakarta

5.1.1 Bank Sampah Vida Bekasi

Bank Sampah Vida Bekasi is located in the small city in Bekasi. The city placed on the eastern border of Jakarta. It is described as a commuter city of Jakarta. During the research, this waste bank was categorized into the group of Jakarta.

The interview was taken on 04.04.2019 with Aam Siti Aminah, the operator of Bank Sampah Vida.

The waste bank was founded in 2014 by local people with the support of a social enterprise, Waste4Change. The company is still a supporter of the bank sampah. Wast4Change is the permanent buyer of the waste that the waste bank collects and separates, thereby the prices are fixed on a contractual base. The waste bank pays by kg of valuable material, depending on the type of waste. Every 2 weeks, Waste4change collects the separated, cleaned, and in some cases, shredded waste and sell it further to recycling facilities. Unfortunately, the company did not want to share information about the exact prices that they pay for the waste bank, and get from the recycling facilities, only the prices of the material that the customer obtain was available. This bank sampah does not get any support from the government. The employees still work as volunteers; their number is changing between 5-15 people.

They only accept recyclable waste like plastic, bottle, paper, and metal. The area is a closed residential zone; therefore, the informal sector is not existent as a customer of the waste bank, mostly homemakers bring their valuable waste. Furthermore, the waste bank has schools as partners, where students can transfer their valuable dry recyclable material too. The average amount of waste collected per month is 1,200 kg. The prices of the materials (the customers get) depend on the type and cleanliness of the materials, which are changing between 200 - 5,800 IDR per kg. (approx. 0.01-0.37 EUR/kg) There are approximately 135 clients who bring their valuable materials two times per month, on Fridays. The amount, the type, and the value are written into a

bank book given from the waste bank. The customers can use their saved money in different ways; the waste bank has organized three programs. The first option is to use the money for their children; for education, they can withdraw the saved money every year before school starts. The other possibility is to get the money once per year during Ramadan for the Eid-al Fitr ("Festival of Breaking the Fast," Islamic religious celebration). Finally, people can use the money for donations.

On table 5 the evaluation of Bank Sampah Vida Bekasi is shown using the scorecard. The waste bank shows strength in the field of Accessibility of the waste bank for local people and Professional knowledge of the staff about waste management. It's easily accessible, and uses many channels to inform people. Furthermore, they have a close cooperation with Waste4Change Company, where employees have professional knowledge they can share with the workers of the waste banks.

However, the waste bank not just collects waste but offers educational programs for the inhabitants about separation, composting and environmental protection; still, the main problem in Bank Sampah Vida is the lack of awareness and knowledge of the inhabitants about waste separation.

The waste bank is capable of covering operational costs from the profit of trading. For greater success, the waste bank would need a more prominent place and a representative office in order to show people that waste is not necessarily a dirty thing, and they can get profit from it.

Table 5 Scorecard Bank Sampah Vida Bekas	si
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	Bank Sampah Vida Bekasi											
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score
Score	10	5	10	0	10	0	5	0	0	0	40	100

5.1.2 Bank Sampah Ciliber

In Bank Sampah Ciliber, the interview was taken on 17.07.2019 with the owner and operator, Tura Sugema. The place is located in West Jakarta. It was established in 2014 in line with the guidance of the community "Paguyuban Masyarakat Peduli Lingkungan" (Community Care Society for the Environment). The community is led by civilians who want to change their environment, supported by the Women Empowerment office (KPMP) and the Environment and Cleaning Services. Their motto is "Cinta Lingkungan Bersih" which means Love the Clean environment. Six people work for Mr. Tura as volunteers, including members of his family and housewives from the neighborhood who want to live in a cleaner place.

The government has supported the waste bank with smaller devices and tools like a scale for weighing, but does not provide monetary support. Overall the tools consist of a scale and a human hand cart. The waste is collected in a small stock room owned by Mr. Turak, and it is cleaned on the street. The government supports the waste bank with recognitions of their hard work in the form of certificates.

People can bring their dry recyclable waste, which does not have to be separated, but then it is not so beneficial as the separated one. The permanent users of the waste bank are estimated to be 100. People are informed through the internet, social media, and brochures. Waste can be brought in at every Sunday, and the bank sampah organizes workshops and events every month. The aim of the workshops and events is education. Their mission is to teach people how to create value from their nonrecyclable waste too. For instance, inhabitants can learn how to create objects like bags, toys, carpets from their waste.

The customers have their bank book where they keep a record of the collected amount. Bank Sampah Ciliber first sells the separated waste to the central waste bank in West Jakarta; then, in every third month, people can get their saved money in cash.

Table 6 shows the evaluation of Bank Sampah Ciliber using the scorecard. The results present that the waste bank suffers with many issues which prevents its efficiency. The most outstanding was the lack of Sustainable income, which contributed to further issues. They cannot make a real profit from the sold valuable materials, and they neither get real support from the government nor from companies. The waste bank cannot offer a salary for their employees. Therefore, there is no possibility to hire people from the informal sector and integrate them into the formal sector.

Table 6 Scorecard Bank Sampah Ciliber

Bank Sampah Ciliber												
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score
Score	0	5	5	5	0	0	0	0	0	0	15	100

5.1.3 Bank Sampah Induk Gesit

Bank Sampah Induk Gesit is the central waste bank in South Jakarta, and it has been operating since 2015. The interview was taken on 17.07.2019 with Ellen De Wilde, the operational manager of the waste bank. Eight people continuously work for the organization, five work voluntarily, and the government hires three. The waste bank is supported by trucks, and the government pays the overhead; they get further assistance from big companies like PLN, the electricity company, and BNI, an Indonesian bank.

The waste is collected from communities, institutions, schools, and smaller waste banks. They do not treat the materials; they only separate them and transfer it directly to the final users like UNILEVER, or recycling facilities. Altogether there are ten districts in South Jakarta with 365 small waste banks, of which 135 bring their dry recyclable material to Bank Sampah Induk Gesit. Approximately 2 tons of dry recyclable waste is collected every week, of which approximately 600 kg is plastic. The most common matters are PET bottles and cardboards.

After the valuable materials had been sold to the facilities, the central waste bank transfers the money to the smaller waste banks. The value depends on the type of material; the price for the plastic diverse from 500-7,000 IDR per kg (approx. 0.03-0.45 EUR/kg). The most precious plastic is the clean (no label, no cup) PET bottle, represent
a value of 7,000 IDR per kg (approx 0.45 EUR/kg). As it was described as a huge problem, the prices that the final processor often gives changes, but Bank Sampah Induk Gesit has to stay with its fix prices.

Table 7 shows the evaluation of the waste bank using the scorecard. Bank Sapmah Induk Gesit is one of the most outstanding waste banks among the observed ones.

The main objective here is also to increase the awareness of people about waste. They provide an educational program for schools, communities, and waste banks. The educational programs mostly concentrate on increasing awareness of waste management and implementation of the '3 R' program. Workshops are organized for producing products at home from waste, which can increase the income of people after selling them. The educational events are provided by professional employees of the organization.

Furthermore it is easy to reach the site, and information about the waste bank through is spread through several information channels.

Bank Sampah Induk Gesit is one of the few interviewed waste banks which employs workers for salary and supported by the local government. These employees are hired from the informal sector and used to be customers of the waste banks. They picked waste from the streets and from households where waste was not brought to the waste banks. These people had official personal documents; therefore, it was much easier to integrate them. However, their salary sometimes does not reach the income that they had during waste picking, secure income, favorable judgment, and further advantages of an official job worth them to be employed. Unfortunately, based on the experiences of Ellen De Wilde there are waste pickers who do not have official personal documents in which cases waste banks cannot employ them.

	Bank Sampah Induk Gesit												
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score	
Score	10	10	5	5	5	0	5	5	10	0	55	100	

Table 7 Scorecard Bank Sampah Induk Gesit

5.1.4 Bank Sampah ASRI

The interview in Bank Sampah Asri was taken on 18.07.2019 in East Jakarta, with Ms. Tere, the leader of the waste bank, who works voluntarily. The waste bank was established in 2011 by UNILEVER, but no further support was provided neither from companies nor from the government.

Customers have to bring their waste directly to the waste bank. They accept biodegradable and dry recyclable waste, which devises as follows: 70% biodegradable and 30% dry recyclable. The appraisement of the quantity per week of the collected waste is 300-400 kg dry recyclable, of which approximately 40 kg is plastic. The number of constant visitors is estimated to be 350 entirely diverse people. Housewives, cleaning ladies, small shop owners, informal sector, and students all use the opportunities that Bank Sampah Asri gives them.

Savings are recorded in the bank book, and people can take their money whenever they want, there are no strict rules. However, mostly the inhabitants like to take out their money around Ramadan or at the beginning of primary school. People do not have to separate their dry recyclable waste, but in this case, they do not do get a lower price for them: 1kg unseparated dry recyclable material values 900 IDR (approx. 0.06 EUR), 1 kg separated plastic is 1,000 IDR (approx. 0.06 EUR), and the highest plastic price is 3,900 IDR/kg (approx 0.25 EUR/kg) which is given for the PET bottles without cup and label. Bank Sampah Asri sells further their valuable material to the central East Jakarta Waste Bank for the reason that they offer higher prices than the companies who treat the waste directly. The profit for Bank Sampah Asri is 500 IDR (approx. 0.03 EUR/kg) for 1 kg of valuable material. The waste is transferred to the central waste bank every three weeks.

On Table 8 it is visible the strength of Bank Sampah Asri: 'Motivating locals to use the waste bank system'. The waste bank offers an educational program not just about waste management but also about food security; people can learn how to compost at their houses and plant their food. The program has high social, health, and environmental impact, since in Jakarta, it is costly to get fresh vegetables and fruits, and they have to be transferred in long distances. The waste bank has won a competition with the program and got several prizes from the Bank of Indonesia.

Bank Sampah Asri has customers from the informal sector, but unfortunately, here is no possibility to integrate them, because they cannot offer payment for their employees.

				E	ank Sampah ASI	રા				
Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste	Recycling rate of the waste bank	Summa of the reached score
	the local	.,	wasto	management				hanks system		

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Table 8 Scorecard Bank Sampah ASRI

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5.1.5 Bank Sampah Kerabat Pulo Kambing

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On the 05.08.2019, the interview with Vera Nofita was taken in Bank Sampah Kerabat Pulo Kambing, in East Jakarta. The waste bank has been operating since 2014. One of the biggest supporters of the organization is the company Lois Jeans; they get monetary help from them. Equipment like the bank book is coming from the Indonesian mining company Antam, and a truck was given by the bank BNI. The government expresses its appreciation for their job, mostly with certificates.

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Schools and neighboring associations usually bring their waste, but it is open for everybody. Altogether 20 people are working there voluntarily. Among them, 18 are women, since women empowerment is a critical objective of the organization.

Year by year, the collection of the dry recyclable waste amount is growing. In 2016 the collected material was more than 5,100 kg; in 2017, it reached 19,000 kg, and in 2018 it increased to 23,990 kg. Today the number of customers is more than 800.

The prices for the most common recyclable waste are diverse between 300-8,000 Rp per kg and the plastic between 500-7,000 IDR (approx. 0.03-0.45 EUR/kg). Every

Maximum

score

0

delivered waste is recorded into the bank book, and customers can get their money whenever they want it; there is no ruled period for withdrawing. The operational costs are covered by the profit, which is 500 IDR (approx. 0.03 EUR) on top of the price of every received kilogram. Whenever the processing factory requests an order, the waste bank puts together a bulk accordingly and carry it directly to the facility.

Bank Sampah Kerabat Pulo Kambing offers additional programs, events, and workshops. They are producing several different goods, for instance, bags, toys, small furniture for selling. They also teach people how to create them. Educational presentations are offered for local people, companies, and tourists as well. From August 2019, a new program has started; Bank Sampah Kerabat Pulo Kambing is officially a tourist destination. The program consists of a tour around the Bank Sampah Kerabat Pulo Kambing, small presentations about their work, and a short workshop where the tourists can create their objects from waste. The price of the excursion changes between 35,000-150,000 IDR / person (approximately 2.25-9.64 EUR). There is an additional option to buy from the products made by the waste bank.

Table 9 shows the results of the score card. Banks Sampah Pulon Kambing is one of the observed waste bank that has a strong relationship with a company, therefore they have a sustainable financial situation.

Even though the waste bank has quite a reasonable business concept, and the number of customers is continuously growing, they are still suffering from the attitude of the residents. The lack of inhabitants' knowledge makes their job much more difficult. It is hard to explain why waste separation is essential. Furthermore, in many cases, people do not understand that the waste generated by themselves will not disappear, and it can cause huge problems.

					Bank Sam	pah Kerabat Pul	o Kambing					
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score
Score	10	5	5	5	5	0	10	0	0	0	40	100

Table 9 Scorecard Bank Sampah Kerabat Pulon Kambing

5.1.6 Bank Sampah Tri Alam Lestari

In South Jakarta, there are about 500 waste banks, with the support of the central waste bank. For example, every school has to have a waste bank in the institution. There are excellent connections between the businesses, organizations; therefore, the collection of recyclable materials and the awareness of people are continuously increasing. The prosperous cooperation results in considerable successes in the area. This improvement is due to the leadership of South Jakarta, the local communities, and the activity of the central waste bank.

In Bank Sampah Tri Alam Lestari, South Jakarta, the interview was taken on 05.08.2019 with Tri Sugiarti. The waste bank has been operating since 2014, and their main profile is manufacturing valuable products from waste. There is some support from the government, for instance, the bank book, balance, equipment, and the central waste bank transfer the valuable materials from them.

About 80 customers bring their recyclable waste to the bank even from other districts, every Saturday. The estimations for the collected waste are 500 kg per week, and from this amount, 400 kg is plastic. They accept dry recyclable waste and if the clients separate it like PET bottles without label and cup the material worth more. "Dirty" (with cup and label) PET bottles cost 2,000 IDR (approx. 0.13 EUR) per kg while the clean ones are 6,000 IDR (approx. 0.39 EUR) per kg. Bank Sampah Tri Alam Lestari sells the material to the main waste bank with approximately 15% profit. Furthermore, they generate some profit also from the goods that they produce and sell. However, the money barely covers its operational costs.

People can take their money in cash or withdraw it from their accounts whenever they want. There are other opportunities to get or save some extra money. BNI, an Indonesian bank, allows people to open a bank account with a tiny amount of money without any fee. If people are customers of the Bank Sampah Tri Alam, they can use the money from valuable material to get electricity or internet credits cheaper.

As table 10 shows the two strengths of Bank Sampah Tri Alam are 'Motivating locals to use the waste bank system', and professional knowledge of the staff. The main focus of the waste bank is to encourage people to make income from their waste instead of throwing them away. Ms. Sugiarti is an acknowledged person in waste management in Indonesia; therefore, she spreads her knowledge also on events organized by the government, and the residents follow her. She has cleaned their neighborhood, part of the river from waste, and organized the waste bank without any help. Her mission is to teach people to respect the environment, and to create a livable life in Jakarta even in poorer districts.

Table 10 Scorecard Bank Sampah Tri Alam Lestari

					Bank S	ampah Tri Alam	Lestari				i	
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score
Score	0	10	10	5	5	0	0	0	0	0	30	110

5.2 Bali

5.2.1 UNIT Pelaksana Teknis Laboratorium Lingkungan - Laboratory of environment office of Denpasar government

Bank Sampah BWL

On 09.04.2019, an interview was done with Ketut Made, the executive manager of the Laboratory of environment office in Denpasar, the capital city of Bali.

The daily amount of solid waste collected in the city is estimated at 750 kg, which is distributed in 70% biodegradable and 30% dry recyclable. In 2019, 100 waste banks were counted in Denpasar, which is mostly supported by the local government. They do not get any help from the Ministry of Environment and Forestry. One of the obligations of Denpasar is to organize or support all together 255 waste banks form their budget, till 2020.

The local government leads three waste banks and cooperates with several community associations who bring their collected dry recyclable material to the central waste bank. First, there are educational events in the community houses to teach people how to separate their waste and why it is crucial, and then people can bring their valuable material on the given day to the neighborhood community house. After a specific time, the central waste bank led by the government collects the separated materials from the associations.

The three waste banks accumulate about 16 tons of dry recyclable waste per month. The customers are mostly students and their parents who can bring valuable materials once per month. People have their bank book, and they can save or get the money immediately for the brought waste. Several prices are depending on the type of material. The clean PET bottle worth more, 2,500 IDR (approx. 0.16 EUR) per kg, compared to the dirty one, which is 1,000 IDR (approx. 0.16 EUR) per kg.

Table 11 shows the results of the score card, and shows that the strengths of the waste bank are the accessibility of the waste banks and the sufficient opportunities for citizens to drop of their material. The three waste banks are operating in schools; therefore it is easy to reach the students and their parents get the information straight from the school. The opening hours are fixed as well, as mostly students and teachers work there.

Unfortunately, the local government is facing several problems like the lack of awareness of people. They cannot finance further projects till 2020. The other problem is that the traders always change the price of the materials, but they cannot do the same with the customers.

There was no possibility of getting information about the integration of the informal sector through waste banks because the manager had no authorization to share information about this issue.

	Bank Sampah BWL												
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score	
Score	10	5	5	10	0	0	5	0	0	0	35	100	

Table 11 Scorecard Bank Sampah BWL

5.2.2 Bank Sampah Abukasa

Bank Sampah Abukasa is located in Denpasar. The interview was taken with Mr. Nyoman Astawa, the owner of the waste bank. It is a family-led business, besides Mr. Astawa, the family members are working there, but sometimes they are hiring extra employees for specific orders. It has been operating since 2011.

The waste bank is supported through CSR programs by Pertamina, an Indonesian gasoline company, and by the Dutch airline company, KLM. KLM buys the products manufactured by the waste bank. Furthermore, they accept all dry recyclable waste. Workers first separate the materials, then wash it, and ultimately shred them. After the process, the crushed particles are sent to Java Island for further treatment.

Approximately 1 ton of dry recyclable waste comes into the waste bank every month. The customers are from the neighborhood, three community associations and waste pickers bring the collected waste there. The site is open every day; people can weigh their waste by themselves too.

The diversification of the materials is mostly like 50% plastic, 30% paper, and 20% metal. 1 kg unseparated waste worth 1,000 IDR (approx. 0.06 EUR/kg). The price of plastic, depending on the type, is moving between 2,000-6,000 IDR (0.13-0.39 EUR/kg) per kg.

Table 12 shows the result of the scorecard in the case of Bank Sampah Abukasa. From the observed organizations this waste bank is the only one, who offers door-to-door collection for some customers. Mr. Astawa has a three-wheel auto-rickshaw to collect waste from further districts. However, the collection demand in the neighborhood exceeds the capacity of the vehicle.

In addition to waste collection, the bank sampah also deals with educational programs and workshops for children and adults too. There are educational events in the community hall led by Mr. Astawa.

Bank Sampah Abukasa could be categorized as a profitable business. However, there is no opportunity to hire employees for permanent jobs. Therefore, they cannot provide solution for the integration of the informal sector.

Table 12 Scorecard Bank Sampah Abukasa

	Bank Sampah Abukasa												
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score	
Score	0	5	5	0	0	0	5	10	0	0	25	100	

5.2.3 EcoBali Recycling

EcoBali is small entrepreneurship located in Bandung. The interview was taken on 22.07.2019 with Sahiri Loing, who is responsible for communication.

The business stands on several pillars, namely they run an Ecostore, offer sustainable waste management for companies (collection, separation of waste), consulting, education. Therefore the business is suitable to maintain the waste bank. It was established in 2006, under the Pemberdayaan Kesejahteraan Keluarga – Family Welfare Program, led by a group of women. The organization is collaborating with the Environmental agency in Bandung regency, and it aims to reduce waste by 30% until 2025.

Besides their profit, they get further support from the Environmental Agency, such as bank books, calculators, scales, and trucks. Integration of the informal sector is also a big issue, and thirty-five people work in the waste bank where waste pickers get a part-time job a fixed salary, equipment, and protective gear.

Dry recyclable waste is acceptable, which does not have to be separated, but the price depends on it. The tariff of plastic moves between 300–2,500 IDR (approx. 0.02-0.16 EUR) per kg. The waste bank separates the material into 40 categories. The average

collected amount monthly is between 500-2,500 kg. The most common material is plastic, followed by paper and metal. After the waste is separated, it goes to the central waste bank organized by the Environmental Agency.

Table 13 shows the result of the score card at EcoBali Recycling. The site is easily accessible, and they have several channels, where locals get the information of the waste bank and events.

There is a close relationship between EcoBali and the government. Before they involve a new community association, educational programs are held in the community house to teach people how to deal with their waste and the opportunity to increase their income. The role of the community leader (in Bali called 'Banjar') to spread the information is crucial. Even though the waste bank is thriving and getting bigger and bigger, it is still a massive problem in Bali to encourage people to separate their waste.

Furthermore, their financial situation is also quite strong, because of their wide range of services.

						EcoBali Recyclin	5					
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score
Score	10	10	5	5	10	0	10	0	0	0	50	10

Table 13 Scorecard EcoBali Recycling

5.3 Lombok

5.3.1 Bank Sampah NTB Mandiri

Bank Sampah NTB Mandiri is located in Lombok, at the small island next to Bali. The interview was taken on 31.03.2019 with the founder of the waste bank, Aisyah Odist. She started to organize waste management activates in 2011 before she tried to reach out to inhabitants with a campaign to clean their environment. Unfortunately, her presentations were not successful enough; that is why she came to the idea to invest in a waste bank. Now nine people are working there; all of them were unemployed or disabled.

The waste bank does not get support from the government, but they are working together with the bank Mandiri and with the electricity company. Ms. Odist increases further the profit by manufacturing products from waste and also collaborates with designers so they can sell them to Europe, Australia, and Japan.

The system in Bank Sampah NTB Mandiri differs from the others. They accept separated, cleaned dry waste, but not the usual ones, the ones that other waste banks cannot use. For instance, the labels from the PET bottles, the plastic bags, straws. All these unusable wastes are redesigned and transformed into valuable new products, which are sellable. This waste bank does not work together with further recycling facilities or central waste banks; they do not sell their materials.

People get 1,000 IDR (approx. 0.06 EUR) for 100 pieces of plastic (e.g., 100 pieces of snack packages). It is recorded into their bank book, and after three months, it is

possible to withdraw the money. There is an opportunity if the customers want to save their money and withdraw it after a year, around Ramadan, the waste bank donates them extra food and a 10% bonus. There are approximately 150 families who bring their materials to the waste bank. One family brings about 2,5kg plastic waste there per month. It is opened from Monday to Saturday, from 9 am to 4 pm.

Table 14 shows the results of the scorecard at Bank Sampah NTB Mandiri. The waste bank has two outstanding strengths, such as 'Motivating locals to use the waste banks system' and 'Sustainable financial situation'.

Ms. Odist organized a unique brand just for the products, named EcoCraft Lombok. The most important tool for them is marketing. She is cooperating with travel agencies, cruises, hotels, and designers who help in the invention of more than 250 goods.

Furthermore, about 80% of the profit goes to EcoSchool Lombok, which was established in 2019, where environmental education is got into the spotlight. The school offers a program for pupils on the weekends. There are four different programs in focus:

- a green and healthy campaign in schools
- eco education 3R concept
- disaster education "How can you save yourself?"
- volunteer exchange

Table 14 Scorecard Bank Sampah NTB Mandiri

	Bank Sampah NTB Mandiri												
	Accessibility of the waste bank for local people	Dissemination of the importance of waste separation in the local community	Motivating locals to use the waste bank system	Sufficient opportunities for citizens to drop off recyclable waste	Professional knowledge of the staff about waste management	Proportionate density of waste banks	Sustainable financial situation	Current level of door-to-door collection	Informal sector integration into the formal system through waste banks system	Recycling rate of the waste bank	Summa of the reached score	Maximum score	
Score	5	10	10	5	5	0	10	0	0	0	45	110	

5.4 Summary of the research results

The efficiency of waste banks was investigated based on the collected plastic waste quantity, the number of customers who are regular visitors and the price of the different plastic wastes. Furthermore, the results of the compiled score card was evaluated.

Table 15 shows the volume of the gathered plastic waste in the ten very different waste banks in three different areas in Indonesia. The number of customers in some cases is very high, but the collected waste does not correlate to it. For instance, in Bank Sampah Kerabat Pulo Kambing the number of constant customers is 800, but the collected dry recyclable waste is only 2,000 kg per month compared to another example in Bank Sampah Tri Alam where 80 people are visiting the site with the same gathered dry recyclable waste amount. The reason can be that some of the waste banks have their educational events and workshops, and many customers visit them only with that purpose. Some of the organizations focus more on these opportunities. In that case, these visitors are recorded as customers as well. The educational events help to increase the awareness of waste pollution and separation, and to see the

advantages of the 3 R concept (Reduce, Reuse, Recycle). For instance, at many waste banks, they do not accept organic waste, but they teach people how to compost at home. In another case, in poorer districts the inhabitants collect valuable materials from other households and they bring the material; ergo the waste bank records a smaller number of visitors.

In the central waste banks, the number of customers has no relevance, since their partners are the smaller Bank Sampah-s. In other cases, there are no official data for the number of visitors because they get the money immediately in cash for valuable materials, or they could not provide information about it for other reasons.

Bank Sampah NTB Mandiri is a particular case among the investigated waste banks. The focus is mainly on products that can be created from waste, and can be sold immediately (for example bag from snack packages). Furthermore, they accept only particular types of waste. In this case, the volume of dry recyclable waste collected is equal to the quantity of collected plastic waste.

The recycling rates of the waste banks were calculated based on the size of the neighborhood involved. Through the field interviews the waste banks estimated, that most of them serves a neighborhood with around 50,000 or more people. The central waste bank is exceptional, because they collect the material from other waste banks in the district. Furthermore, Bank Sampah Tri Alam is located in an area with approximately 10,000 inhabitants. Recycling rate shows how effective the waste bank is in their neighborhood. In most cases it shows similar result as the country average recycling rate, around 0.1- 0.2.

Waste Banks	Collected total recycable waste volume /month (kg)	Collected plastic waste volume /month (kg)	Collected plastic waste percentage of the total recycable waste (%)	Number of customers	Recycling rate
BS Vida Bekasi	1,200	286	24	135	0.12
BS Ciliber	500	300	60	100	0.04
				*central	*central waste
BS Induk Gesit	8,000	2,400	30	waste bank	bank
BS ASRI	1,400	120	8.5	350	0.13
BS Kerabat					
Pulo Kambing	2,000	300	15	800	0.19
BS Tri Alam	2,000	1,600	80	80	0.97
BS BWL	5,333	800	15	no data	0.52
BS Abukasa	1,000	500	50	120	0.10
EcoBali Recycling	500-2,500	75-375	15	no data	0.12
BS NTB Mandiri	375	375	100	150	0.04

Table 15 The quantity of the collected recyclable wastes, plastic waste, and their percentage, number of customers in the interviewed waste banks, recycling rate for the neighborhood

*Central waste bank collects waste from smaller waste banks in the neighborhood

Recyclables collected (or received), kg/month

On table 16, the plastic prizes offered by the different waste banks and the revenues are shown. 1 Euro worth approximately 15,580 Indonesian Rupiah. (European Central Bank, 2019) The revenue is one of the most critical factors of success. Some waste banks get support from the government or different companies, but mostly have to stand on their legs, means that they have to cover all their expenses themselves.

Even though the prices vary on a wide range, they all correlate; the cheapest and the most expensive materials are always the same. The most valuable material was the clean PET bottle: 8,000 IDR/kg (approx. 50 EUR/t). Clean PET bottle means the label and the plastic cup are removed from the bottle. PET bottle with cup and label was reached the price of 2,500 IDR/kg (approx. 160 EUR/t). The least valuable materials (250-800 IDR/kg, approx. 20-50 EUR/t) were mostly packaging and plastic bags.

There are some waste banks where plastic waste is not part of the main profile. For instance, in Bank Sampah Abukasa, their primary focus is on cardboards and paper. Alternatively, as it was mentioned before in Bank Sampah NTB Mandiri, the focus is on the materials which are common in other waste banks like the packaging of snacks and instant coffees, and the organic waste gets a big emphasis.

Some waste banks did not want to share the information about the revenues they generate or the prices of the valuable material they sell, like Bank Sampah Vida Bekasi or EcoBali Recycling. In another case, Bank Sampah BWL could not summarize their financial gain because the prizes are continuously changing.

Prices IDR/kg					Waste	Banks				
	BS Vida Bekasi	BS Ciliber	BS Induk Gesit	BS ASRI	BS Kerabat Pulo Kambing	BS Tri Alam	BS BWL	BS Abukasa	EcoBali Recycling	BS NTB Mandiri
Mixed inorganic										
waste	200	-	-	900		-	-	1,000	-	-
Mixed Plastic		500	-	1,000	-	-	-	1,000	800	-
Clean PET bottle	5,800	2,750	7,000	8,008	7,000	6,000	2,500	3,000	3,000	-
PET bottle with										
label and cup	-	750	4,000	4,664	3,800	2,000	1,000	1,500	1,800	-
Plastic bucket	1,300	2,000	1,500	2,024	1,500	1,000	700	1,200	1,000	-
Colored PP	2,520	-	4,000	-	-	-	-	-	2,500	-
Bottle cup LD	4,200	5,000	5,500	5,896	5,500	3,500	-	-	2,500	-
Bottle cup HD	-	3,000	3,200	4,840	3,200	2,000	-	-	2,500	-
HDPE	4,300	2,500	2,000	-	2,000	1,000	-	-	2,500	-
Plastic bags	_	500	500		500	500	500	250	800	* 1,000/ 100 pieces
PE	1,500	1,200	1,500	1,900	1,000	2,500	2,500	1,200	2,500	-
Plastic package mixed (100										
pieces)	-	-	-	-	600	-	300	-	-	1,000
Plastic package one type (100										
pieces)	-	-	-	-	-	-	1,000	-	-	1,200
Acryl	-	6,500	3,000	-	3,000	2,000	-	-	-	-
Profit	no data	200	no data	500	500	15%	500	20%	no data	approx.30%

Table 16 Prices of the different plastic types and the profit realized after 1kg sold waste in the objected waste banks.

5.4.1 The operation of the waste banks

The operational system was quite similar at all investigated waste banks. Customers are informed about waste banks via internet, brochures or through events held in the local town hall. After that, they can bring their valuable waste to the waste bank or a community place. Mostly dry recyclable waste is accepted, but there are few places where organic waste also has value. The dry recyclable waste does not have to be separated in most cases, but then it worth less. The waste brought in is recorded into the customers' bank book. The method and the frequency of the payment depend on the waste bank.

5.4.2 Material flow

In most cases, the waste banks only separate further the waste, but they do not clean or treat it. The valuable material is sold further to central waste banks, recycling facilities, or to the final purchaser like UNILEVER. It is widespread that waste banks produce objects from the materials to increase their value. The objects are sold at events and markets.

5.4.3 Finances

During the field interviews, it came clear that most of the waste banks are not profitable. It is tough to keep up operations, even when the employees, in most cases, work voluntarily. The prices of the valuable recyclable materials are quite low, and change frequently. In many cases, the waste banks do not make a knowledgeable profit from the materials. The waste banks have to give a motivating price for their customers. The waste banks work well when they have support from companies, or they stand on more pillars; for instance, offering a collection system for businesses like in EcoBali. On the one hand, the government has ambitious goals to implement the '3R' concept through the waste banks; on the other hand, their financial support is minimal.

5.4.4 Assessment

Table 17 Shows the summary of the compiled score card. The targets identification was based on the European Commission recommendation for civic amenity sites. Each waste bank has achieved a score in the specified target. The received scores were summarized for each targets. The results highlight the weakness and strength of the waste banks system based on the observed waste banks.

Overall, the results show the identified issues, which barrier their efficient operation. Only three of the targets achieved more than 50% of the total score. Dissemination of the importance of waste separation in the local community (score: 75), Motivating locals to use the waste bank system (score: 65), Accessibility of the waste bank for local people (score: 60).

The waste banks have a critical mission, which is education. At all waste banks, there are events and programs to deepen the awareness of people about waste management. There are also opportunities to learn how to make money from the material, and with that, increase the income. In many cases, waste banks focus not only on waste reduction and recycling but on further environmental and social issues too. For instance, food security, environment protection, water protection, and cutting poverty are essential tasks. However, the rising of awareness is one of the most important aim of all the waste banks, it came as a huge issue through every interview.

All of the observed waste banks offer money for the valuable material. It is a very important motivation tool, since people can raise their income with the collection and separation of their wastes. It depends on the individual waste bank, how they give the money, but in many cases there was also an opportunity for the customers to save their money.

Mostly the accessibility of the sites was connected to the development level of the waste banks. In some cases, there was information provided and it was easy to reach the waste bank, but in some other cases a guide was needed to find the waste bank and the provided information was poor.

Two areas: "Sufficient opportunities for citizens to drop off recyclable waste" and "Professional knowledge of the staff about waste management" achieved 45 points. These targets can be categorized as human resources related issues. To complete the category "Informal sector integration into the formal system through waste banks system target" should be added, which is one of the weaknesses of the system.

In Indonesia, it is prevalent that women stay at home after their marriage, and they are responsible for the children and the housework. This is the reason why they are the

typical customers and often the employees of these organizations and entrepreneurship. In most cases the workers, even the manager works voluntarily. There is a strong correlation between the availability of volunteers, and the unsatisfactory opening hours.

In most cases, it is tough to integrate the informal sector by hiring them because people work there voluntarily. During the field visits, there were only two precedents where the waste bank had the appropriate circumstances to employ waste pickers (score: 15). Another issue is the lack of official personal documents of the informal sector. There are people in Indonesia who do not have any official documents, and these people often work as waste pickers. In order to employ those people, the government has to act. Unfortunately, during the field interviews, the government did not want to share information about this issue.

Only two waste banks offer door-to-door collection, but not regularly. Usually, waste banks do not have big collection vehicles like trucks, and they use handcarts. The inhabitants have to bring their material to the site, and it is quite rare that the employees of the waste bank collect the waste from the households. The central waste banks collect the separated material from the smaller waste banks, and they bring it to the final user. In all cases, the trucks were granted by the government or by companies.

During the field interviews, it became clear that most of the waste banks are not profitable. It is tough to maintain operation, especially when the employees, in most cases, work voluntarily. The prices of the valuable recyclable materials are quite low, and change frequently. In many cases waste banks do not make significant profit from the materials, while the waste banks have to give a motivating price for their customers to keep them.

The waste banks work well when they have support from companies, or they stand on more pillars; for instance, offering a collection system for businesses like in EcoBali. The opportunity to get support from profit-oriented companies seemed rare, the waste banks achieved 50 points in the target "Sustainable income from the collaboration with profit-oriented partners".

On the one hand, the government has ambitious goals to implement the '3R' concept through the waste banks; on the other hand, their financial support is minimal.

Finally, the two weakest targets were the "Proportionate density of waste banks" and the "Recycling rate of the waste bank", which correlate strongly with each other. All of the observed waste banks are in areas with more than 50,000 inhabitants. However, it shows the inhabitants are more than the ideal 1,000 people per waste bank, the waste banks do not have even 1,000 of people as customer. It shows that the observed issues need to be take into consideration as a complex issue.

			Waste banks										
		BS Vida Bekasi	BS Ciliber	BS Induk Gesit	BS ASRI	BS Kerabat Pulo Cambing	BS Tri Alam	BS BWL	BS Abukasa	Ecobali Recycling	BS NTB Mandiri	Summa of the reached score	Maximum score
	Accessibility of the waste bank for local people	10	0	10	5	10	0	10	0	10	5	60	100
	Dissemination of the importance of waste separation in the local community	5	5	10	10	5	10	5	5	10	10	75	100
	Motivating locals to use the waste bank system	10	5	5	5	5	10	5	5	5	10	65	100
	Sufficient opportunities for citizens to drop off recyclable waste	0	5	5	5	5	5	10	0	5	5	45	100
gets	Professional knowledge of the staff about waste management	10	0	5	5	5	5	0	0	10	5	45	100
Tar	Proportionate density of waste banks	0	0	0	0	0	0	0	0	0	0	0	100
	Sustainable financial situation	5	0	5	0	10	0	5	5	10	10	50	100
	Current level of door-to- door collection	0	0	5	0	0	0	0	10	0	0	15	100
	Informal sector integration into the formal system through waste banks system	0	0	10	5	0	0	0	0	0	0	15	100
	Recycling rate of the waste bank	0	0	0	0	0	0	0	0	0	0	0	100
	Summa	40	15	55	35	40	30	35	25	50	45		

Table 17 Achieved scores for each targets, by the observed waste banks

The results of the scorecard reflect on the efficiency of the waste banks. During the research, it was realized that the aspects listed above are the critical factors of success, but they need to be analyzed in a system since efficiency cannot be described by only one of them. The scorecard was created to make the performance of the waste banks more transparent and comparable.

The two most efficient waste banks were Bank Sampah Induk Gesit (score:55), and Ecobali Recycling (Score:50). Both of them are very strong in education, they are easily accessible, and the employees are not just volunteers. However, they reached only half of the total score. The least efficient waste bank was Bank Sampah Ciliber (Score:15). The waste bank has neither sustainable income nor strong cooperation with the government and companies. It is even hard to access the site.

The waste banks could not reach any score in two targets. One is independent of the operation of the waste bank, namely "Proportionate density of waste banks". Waste banks cannot control this target. The other target is mostly the result of the other targets, namely the "Recycling rate of the waste bank". All other targets have a score of ten from at least one waste bank. It means that even in this small group, every member has useful knowledge that could be shared. If they could share their knowledge, 80 points would be reachable instead of the recent maximum. All waste banks have strengths and weaknesses, which could be equated with cooperation. Therefore the efficiency of the individual waste bank could be increased.

6. Plastic waste in the European Union

In 2017 in the European Union 487 kg/cap/yr of MSW were generated (Eurostat statistics, 2019). In 2016 the total yearly waste generation was 392 million tons (Kaza et. al, 2018) out of which 27.1 million tons of plastic waste were collected in the EU-28 countries, Norway and Switzerland., which is referred to Europe. From this amount, 41.6% was incinerated, 31.1% was recycled, and 27.3% was landfilled (Plastic Europe, 2018). Although it was the first year when the amount of plastic waste going to recycling was higher than to landfilling, the potential is still huge for recycling and the reuse of end-of-life plastic compared to the efficiency of other dry recyclable waste like paper, glass, and metal (European Commission, 2018). According to Plastic Europe (2018), in 2016, from the separated plastic, 63% was treated inside, and 37% outside the European Union.

The Circular Economy Package (European Commission, 2018) requires increasing recovery targets for all materials, including plastics. (Deloitte Sustainability, 2017) The proportion of recycled plastics is targeted to reach 55% by 2025. (Deloitte Sustainability, 2017)

6.1 European laws

Several European regulations and directives govern waste management, the former applies automatically to each EU member, while the latter has to be implemented individually by each Member State. The Waste Framework Directive (2008/98 EC) is the legal framework it defines the main concepts of waste, describes a five-step waste hierarchy, and contains vital provisions of the National Waste Disposal Act. The Directive was amended by Directive (EU) 2018/851 which includes several targets and provisions to be achieved by the Member states, for instance:

- Set up a collection system for at least paper, plastic, metal and glass by 2015

- Preparation of the reuse and recycling level of minimum 50% of paper, metal, plastic and glass of the households, by 2020

- The level of preparation has to be increased of MW to 55% by 2025, 60%, by 2035 (European Environment Agency, 2019)

The Extended Producer Responsibility policy is applicable to many product among other packaging material. According to the OECD definition, EPR is "an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle". EPR signifies that producers are responsible for the collection of used products, sorting and treating for their final recycling. (European Commission, 2014)

6.2 Plastics waste processing in the EU

Each member state has a unique recycling chain, which is based on the same regulatory principles. A typical structure of the recycling chain is presented in Figure 6. A European plastic recycling chain contains the following steps of collection, sorting, reprocessing, the recycled material is inserted back into the manufacturing process. (Deloitte Sustainability, 2017)



Figure 6 Plastic packaging recycling in the EU (Deloitte Sustainability, 2017)

The first step of plastic recycling is the **collection**. In Europe, there is a wide diversity of collection systems; different countries and regions use different means for collection. Collection systems by separation:

- Separate collection of recyclables as mono material (e.g., Austria, Germany)
- The combined collection of recyclables with further processing at materials recycling facility one bin for dry recyclables, for instance, metal with plastic (e.g., France, UK)

Table 18 shows the different collection types appear in the EU, divided into countries. There are three main categories, namely:

- Door-to-door collection, waste is collected at the place of generation The recyclable waste separation depends on the waste management system. It can be single fraction, co- mingled (plastic, metal together), 3 fractions go together (plastic, metal, glass) or all recyclable fraction go into one waste bin.
- Bring-point systems, households transfer the waste to recycling banks (collection containers for paper, glass, metals, etc.), civic amenity sites (take over bulky waste, construction waste, hazardous household waste, waste electrical and electronic equipment)
- Deposit, bottles sold with refundable deposits, redeemable upon return of the bottle. High quality and quantity of recycling plastic waste can be achieved most effectively by inserting a refund on different items, which motivates people to return them. For instance, Germany uses a deposit on one-way PET bottles. (Deloitte Sustainability, 2017)

Table 18 An overview about the collection methods for the different kind of recyclable waste in the EU 28. Even though the collections methods differ on a relatively wide scale country by country, all members states collect all kind of recyclable wastes. (European Commission, 2015)

Collection type	Paper	Glass	Plastic	Metal	Bio- waste
	AT, BE, BG, CY, DE,	BG, FI, LU, LV,	AT, LV, NL, DK	FI, NL, DK	AT, BE, CZ, DE,
Door-to-door (single	DK, FI, HU, IT, LU,	NL, SI, MT			FI, EE, IT, HU,
Taction	LV, NL, SI, UK				LU, NL, SI, SE,
					IE, UK
Co-mingled …plastic + metal			BE, BG, FR, IT, HU	CY, DE, , LU, SI	
3 fractions	RO, MT: paper, glass	plastic, meta	al, UK: plast	ic, metal,	
all in one bin	EL, IE: paper, gla	ss, plastic, n	netal		
	CZ, EE, ES, FR, HR,	AT, BE, DK, CY	SE	AT, EE, SE	ES
	LT, PT, PL, SE, SK	CZ, DE, EE, ES,	ES, HR, L (all plastic one contair	T, PT, PL /metal in ner)	
Bring points		FR, HR, IT, HU,			
		LT, PT, PL, RO,			
		SE, SK			
	Primary collection	n: CZ (metal	waste), SK	(metal and	bio-waste),
Civic amenity sites	Addition collection	n of all waste	streams: al	l countries	
	PL: rare distributi	on of civic an	nenity sites		

However, table 19 highlights that the collected mass of plastic waste varies substantially based on the implemented collection system. The most effective way to

collect plastic waste is the door to door single fraction method, where is reaching up to 32 kg/cap/yr.

Table 19 Average and the highest quantity of collected plastic waste through the different waste collection schemes in the EU-28 capital cities (European Commission, 2015)

	Door-to-door (single fraction)	Door-to-door (Co-mingled) Bring point plastic+metal		Civic amenity sites
Plastic waste	9 kg/cap Highest: 32	6 kg/cap Highest: 12	7 kg/cap Highest: 26	1 kg/cap

The second step of plastic recycling is **sorting.** Plastic is sorted by colors and types of material. It can be manual, automatized, or the combination of the two.

The third step is **reprocessing.** Plastic waste can be either mechanically or chemically recycled. Mechanically material is reprocessed by melting, grinding, palletizing, and extrusion. It can be recycled chemically by chemical depolymerization, or by thermal cracking, or by catalyst conversion.

Figure 7 shows the types of plastic waste generated in the EU in 2015. Packaging is the largest share, with 59% of the total plastic waste, which is often single-use plastic products. (European Commission, 2018) As the first step to repel single-use plastics, in 2019 the European Parliament has approved a law called 'Single Use Plastic Directive', Directive (EU) 2019/904 to ban single-use plastic by 2021 in the EU. (EUR-Lex, 2019; C.B. Wahlén, 2019) The directive submits more responsibility for plastic producers and new recycling objectives for the EU members.



Figure 7 EU Plastic waste generation in 2015

Even though a well-structured recycle chain is implemented, as a summary of figure 7, it is clear that one of the most determining waste management issue in Europe is the oversized plastic packaging production.

In the European Strategy for Plastics in a Circular Economy adopted on January 2018, reuse and recycle of plastics are highly emphasized. This strategy supports the aim of plastic products to be manufactured with more sustainable materials and designed more sustainably (e.g., repairable). (European Commission, 2019)

Two countries were investigated deeper in the EU from the perspective of plastic recycling, a Western European country, Germany, and a central-eastern European, Hungary.

6.3 Plastic waste management and generation in Germany

Germany is located in central-western Europa, with an estimated population of almost 83 million. (2019) and with 357,386 km2 land area. According to the study of the World Bank report in 2018, Germany is classified as a high-income country, based upon the waste composition is divided as follows: 32% Organic, 25% Paper, 13% Plastic, 6% Metal, 4% Glass, 36% other.

Table 20 shows the generated MSW and the recycled amount of MSW from 2014 to 2017. According to the data from the European Commission in 2017, the waste generation per capita was estimated to 631 kg out of which in 2015, the estimated plastic packaging waste generation was 38 kg per capita. In 2014 and 2015 about 47% of the generated plastic packaging waste was recycled, the recycling rate is increasing but relatively slowly, in 2016 and 2017, 48% was recycled. The reason is because the generated plastic packaging waste is continuously rising too. (Eurostat, 2020)

	Generated Municipal Solid Waste (million tons)	Generated Municipal Solid Waste (kg/cap/yr)	Recycled MSW (million tons)	Share of recycled MSW in the total amount of MSW
2014	51.100	625	33.522	66%
2015	51.600	631	34.417	67%
2016	52.100	634	34.959	67%
2017	51.800	627	34.810	67%

Table 20 Generated and Recycled MSW, Recycling rate in Germany from 2014-2017

(Eurostat, 2020; UN, 2019)

The Act on Waste Management contains the following regulations for waste management:

6.3.1 German Federal law

The first national waste disposal act, the Abfallbeseitigungsgesetz (AbfG), was introduced in 1972. The Waste Management Act (KrWG), which is the current primary waste disposal statute in Germany, incorporates the main structural elements of the Kreislaufwirtschafts- und Abfallgesetz (KrW-/AbfG). Specific types of waste (end-of-life vehicles, used batteries, and end-of-life electronic and electrical devices) are governed by specific regulations such as the ELV regulation (AltfahrzeugV), Law on batteries (BatterieG) and by the Laws on electrical and electronic equipment (ElektroG). (Umwelt Bundesamt, 2014)

State law of federal states

The Waste Management Act (KrWG) also varies based on the waste management acts of the states (Bundesländer). Nevertheless, under the German Constitution, the federal government is responsible for regulating waste management (Article 74(1)(24)), and the regional states only have jurisdiction over those manners of waste disposal, which are not regulated by federal law. Therefore, state laws most commonly address implementation related matters such as determining which entities are subject to waste disposal obligations, the authorizing bodies for waste disposal matters, and municipal waste disposal ordinances. (Umwelt Bundesamt, 2014)

Municipal waste law

The following aspects of household waste collection and recovery at the municipal level are ruled by municipal authorizations: usage and integration into the public system, and municipal waste fees.

6.3.2 Packaging collection in Germany

Packaging material collection is crucial part of the EPR (Extended Producer Responsibility). In Germany the obliged producers have to register their packaging with a compliance scheme and pay a fee by material and quantity. Afterwards, the fee for recycling is an internalized cost of the product, which is paid by the customer. The industry has 100% responsibility and control of cost. The fee is used for collecting, recycling, and disposing of packaging waste.

Organizations responsible for waste management collect the packaging, sort them, and recycle or recover the materials. (Watkins et al., 2017)

Der Grüne Punkt Duales System

The main idea of the system is that the consumer who sees the logo knows that the producer contributes to the cost of recovery and recycling (Watkins et al., 2017). A "dual disposal system" has been established for packaging waste in parallel to the public-sector waste disposal system. It delivers a nationwide collection of waste packaging and provides raw materials from them. All light weight packaging, such as plastic, aluminum, tin cans, is placed in yellow bags or containers by residents. Then it is collected by companies and brought to sorting facilities, where the packaging is sorted for recycling. It is separated in the following types: tinplate, aluminum, and the various types of plastic (PE, PP, PET, PS). There are types of packaging which require return deposit. Reusable beverage containers stay in the circulation until the packaging company retires them, because of damage. The refund system of returning the materials supports the recycling of non-reusable plastic beverage containers. (Umwelt Bundesamt, 2020)

6. 4 Plastic waste generation, and management in Hungary

Hungary is located in central-eastern Europa with an estimated population of 9.7 million. (2019) and with 93,030 km² land area. According to a report of the Ministry of Agriculture (2015), the municipal solid waste composition in Hungary is divided as follows: 23% Organic, 14.5% Plastic, 13% Paper, 2% Metal, 3.5% Glass, 44% other. (European Commission, 2015)

In 2017 about 32% of the generated plastic packaging waste was recycled.

	Generated Municipal Solid Waste (million tons)	Generated Municipal Solid Waste (kg/cap/yr)	Recycled MSW (million tons)	Share of recycled MSW in the total amount of MSW
2014	3.712	379	1.159	31%
2015	3.710	379	1.194	32%
2016	3.734	383	1.292	35%
2017	3.752	386	1.319	35%

Table 21 shows the generated and the recycled amount of MSW from 2014 to 2017.

(Eurostat, 2019; UN 2019)

The generated MSW is slowly but continuously rising; however, in the meantime, the recycling rate was also improved. In 2017 35% of the total MSW was recycled. (Statista, 2019) According to the data from the European Commission in 2017, the waste generation per capita was estimated to be 385 kg out of which in 2015, 31 kg was packaging plastic (Eurostat, 2018). In 2017 about 32% of the generated plastic waste was recycled in the country.

In line with the national waste management plan, waste management is ruled and overviewed by the Environmental Development division of Agriculture Ministry (FM). There are Deputy State Secretaries who are in charge of waste management on a country level. These Secretaries develop regulations and general strategies through parliamentary submissions.

6.4.1 Relevant Waste Regulations in Hungary

Hungary had started to establish measures aimed at aligning national legislation with the European ones as they adopted the Act on Waste Management in 2000 (Act XLIII of 2000). Currently, the following rules and regulations are in place related to waste management:

The Act on Waste (Act CLXXXVof 2012)

The aim of the new Act of Waste was mainly to adopt the Waste Framework Directive regulations and concepts such as life-cycle thinking, re-use, and preparing for re-use, extended producer responsibility, precaution, and prevention into national law. In line with the new Act, separate waste collection become mandatory from 2015. Apart from including the obligations of the WFD, the new Act on Waste was introduced to provide the municipalities and other local entities greater responsibility for waste management. (European Commission, 2015)

The Act on Environmental Protection (Act LIII of 1995/2015)

"This particular law defines the responsibilities for the effects produced on the environment and aims to harmonize State activities with the requirements of environmental protection. It implements six Directives. The Directives implemented in the law are not related to the treatment of MSW in particular but are important when it comes to environmental protection in waste-related activities." (European Commission, 2015)

The Environmental Product Fee Act (Act LVI of 1995)

The Environmental Product Fee Act (Act LVI of 1995) is another improvement to strengthen the relevance of waste management. This initiative had introduced the environmental product fee, which had to be paid by the producers of specific waste streams such as batteries, packaging, and tires. Under the Product Fee Law minimum of 7 % of the collected fee must be allocated for environmental awareness-raising. (European Commission, 2015)

6.4.2 Waste Collection in Hungary

The operation of collecting and treating municipal waste is led by waste-collecting companies that can be public, semi-public, or private. Since 2015 compulsory door-to-door separate collection had to be introduced by public service providers for paper, plastic, metal, and green waste. (European Commission, 2015)

In Hungary, there are several types of collection and separation based on the type of waste. Plastic and metal packaging is collected in co-mingled door-to-door system. Residents have to separate and collect their plastic (PE, PP, PET), tinplate, and aluminum packaging into the yellow bins. (European Commission, 2015)

The separate collection of packaging waste is financed through the EPR-system since 1995, and is thus based on the extra fees for certain products paid by the customers. Therefore, there is no extra charge for the service of the separate collection. ÖKO-Pannon has been working as a consultant company providing services in connection with environmental product charge and Green Dot trademark. (European Commission, 2019).

7. Comparison

Table 22 Recycling rate of MSW, in total, by the waste banks, by the informal sector, and the recycling rate factor of plastic waste in Indonesia, EU, Hungary and Germany. Furthermore the average income in the informal sector and formal waste sector are also added to the table. Source: 1 European Environment Agency, 2017; 2 World Bank report, 2018; 3 Based on data Nugroho, 2019 and interview results; 4 Putri et al., 2018; 5 Sasaki et al., 2013; 6 Statista, 2019

	Total Recycling rate of MSW	Recycling rate of MSW, by waste bank	Recycling rate of MSW, by informal sector	Recycling rate of plastic waste	Average income of informal sector (USD/month)	Average income in formal waste sector in Indonesia (USD/month)
Indonesia	~ 20%²	0.2% ³	15% ²	24% ⁴ (Jakarta,2018)	216 ⁵	180 ⁶
European Union	46% (2017) ¹	-	-	42% (2017) ¹	-	-
Hungary	35% (2017) ¹	-	-	32% (2017) ¹	-	-
Germany	67% (2017) ¹	-	-	48% (2017) ¹	-	-

Table 22 shows the total recycling rate of MSW, the recycling rate of plastic waste in Indonesia, EU, Hungary and Germany, based on literature. Furthermore, the recycling rate especially for the waste banks, the average income of informal sector, and in the formal waste sector.

The recycling rate of MSW by waste banks is estimated through a calculation. The interviews showed the average recyclable materials collected by one waste bank is 20.4 t/yr. The estimation of the registered waste banks, according to the study of Nugroho, 2019 in 2016, was 5,200. It is assumed that the average recyclable waste is the same around the country. The recyclable waste amount per waste bank is multiplied by the number of existing waste banks, it means the total recyclables collected by the waste banks in Indonesia is 0.106 million t/yr. According to the research of the Ministry of Environment and Forestry of the Republic of Indonesia, the estimated MSW generation was 65 million t/year in 2018. To get the recycling rate of the waste banks, the collected recyclables was divided by the total generated MSW in the country, the result is 0.2%.

Total recycling rate of MSW

Remarkably, Germany has a quite high MSW recycling rate with 67%, Hungary as only 35%, which is lower than the average EU recycling rate with 46%. The MSW recycling

rate in Indonesia is only 20%, from which the highest part, 15% is collected through the informal sector. In the current situation, the waste banks, with their frequency and efficiency, only contribute 0.2% of the recycling rate.

Plastic recycling rate

In case of plastic recycling rates Germany is also outstanding with 48%, and Hungary with a 32% fall behind the average EU result, of 42%. In Indonesia, it is 24%, which could be recognized quite high compared to the overall recycling rate. The reason could be that the plastic material has a high value.

Informal sector

The income of a worker in the informal sector and a former employee in waste management were compared. Data shows that the waste pickers earn about 20% more than the workers in the formal waste management in Indonesia (Statista, 2019).

Collection system

In the EU countries, especially in the two investigated, there are collection systems for the residual and the recyclable waste. The collection scheme depends on the country and often in the province as well.

In Germany and Hungary, there are single door to door collection for paper, and comingled for metal and plastic, both of them show quite high efficiency. The single door to door collection average in the EU is 9 kg/cap, and the co-mingled is 6kg/cap. (European Commission, 2015) There are public, semi-public, and private companies that are responsible for the collection.

In Indonesia, only 47% of the total population is served with collection service, the rest generated MSW is mostly treated unofficially by burning and dumping into rivers, and the ocean. (Lestari et al., 2019) For formal recycling, the waste banks are responsible, where inhabitants have to bring their waste to the sites; furthermore, there is another system, the informal one, where waste pickers collect the waste from the streets, households, landfills, etc.

8. Best practices

The results of the score card, and the distinguished issues waste banks are suffering from show that improvements are needed both at government level, and at the individual waste bank level. The developments can be top down (it means a more expensive, system approach, in developed countries mostly governmental initiatives), and bottom up (cheaper, easily achievable steps at local level for communities) change. For the revealed issues, best practices can be recommended from places where recycling is working more efficiently, such as EU countries, or Thailand where there are good examples on how to operate successful waste banks.

8.1 Lack of awareness about the existence of waste banks

There is limited information among local communities about the existence, location, and available services of waste banks. Furthermore, waste banks are often placed at remote locations, which are hard to be approached by public transport and scooters.

Grassroot action

There is a good example in Thailand for bottom up approach. There are two types of waste banks in Thailand. One of them is the 'School Garbage Bank' operates in schools, where students and teachers organize the sites. Schools are easily reachable public places, where everybody is allowed to bring in valuable material. With the help of the children many residential get information about the opportunity to bring the separately collected waste and make some financial benefit from it. (World Bank, 2003)

Top-down approach

Hungary can provide a top down best practice. FKF Nonprofit Zrt., one of the largest waste management and street cleansing company in Hungary operates the civic amenity sites in Budapest and in the agglomeration. There are different types of sites, some of them accept all the recyclable, hazardous and compostable waste,. All the regarding information about the address, the acceptable material, opening hours etc. can be found on webpages. Furthermore, the company continuously provides information of the existing sites and expanding services through brochures, posters and advertisements. Therefore, residents are well-informed about the opportunities that they are available to use. (FKF, 2016)

8.2 Dissemination of the importance of waste separation in the local community

The importance of waste collection and separation is almost unheard among the lowest income families in Indonesia. In many places, people are not aware of the consequences of unmanaged and inappropriate treatment of waste. Due to the fast invasion of plastics, which has a substantially different environmental footprint than ordinary organic waste, the inhabitants are lack of information about the long-term effects of open dumping and burning of waste. Even though waste banks provide education about appropriate waste separation and collection, they can only disseminate information to a small number of people.

Grassroot action

To spread the knowledge and reach as many people as possible, the initiative, where the waste banks appear in schools is a very successful practice. In the Thai school waste banks students are directly involved in the waste collection and separation, besides educational programs are offered for them. Children can spread the information in a broader circle and improve their family's knowledge. (World Bank, 2003)

Top-down approach

The EU manages a successful initiative to raise awareness. The "European Week for Waste Reduction," program encourages all Europeans to carry out awareness-raising actions about sustainable resource and waste management during a single week in November with the mobilization of different stakeholders. Public authorities, businesses, institutions, associations, and others can join the program and improve the awareness-raising and register as Project developers. Their informative actions must be registered in pre-defined categories, such as 'raising public awareness,' 'better production.' Outstanding actions are appreciated by the annual European Waste Reduction Award. In Indonesia, similar gamified events could be initiated by the central government based on this particular European example. (https://www.ewwr.eu/)

Another good systemic initiative from Portugal is "Eu Nao Faco Lixo" – "I don't create rubbish!". The Inter-municipal Waste Management Organization of Porto (LIPOR) created a website "Eu nao faço lixo" as a part of its efforts to raise the awareness of waste prevention. It is offering practical guidance on waste reducing, separation, and engaging activities for youth. The interactive portal contains ten commandments of waste prevention suggested by LIPOR, highlighting ten key actions that are easy to implement and effective, games and waste simulating tools, useful ideas on how to reduce waste in your house, office, on holidays, at events, etc. (European Commission, 2019)

8.3 None persistent opening hours

Opening hours are often not known or frequently changed. In consequence, local community members cannot bring their materials, and they lose their motivation. Voluntary workers prioritize their paid jobs, which undermines the possibility of creating reliable and suitable opening hours for potential customers.

Grassroot action

As a local example for the solution of the wider availability of a site is the service of Humusz Szövetség. In Hungary one of the biggest waste management NGO is Humusz Szövetség provides community compost spot in their backyard. The site is open every week day form 8 am to 5 pm while their office is also open. Inhabitants from the neighborhood can bring their organic waste whenever they want during the opening hours. Furthermore, the NGO accumulates and communicates on their website other possibilities for compost collection in Budapest. (Humusz Szövetség, 2018)

Another good practice is the 'School waste bank initiative' in Thailand. Students have the opportunity to bring their separated recyclable waste to the waste bank on every school day. The opening hours are fixed and children can easily bring the valuable material when they go to school. (World Bank, 2003)

Top-down approach

Strict opening hours can be defined on country level as well. According to the ordinance of the European Commission civic amenity sites, which operates in a similar way as waste banks, the opening hours should offer sufficient opportunities for residential to drop off the different waste fractions. The opening hours meet the need of the citizens. For example in a German village the opening hours of the civic amenity site are adapted to daylight and season. For instance, there are extended opening hours in November to increase the reception of green cuttings. (European Commission)

8.4 Lack of professional knowledge about waste management

Managers and employees of waste banks are volunteers from the community who try to act and change their polluted environment. Subsequently, the motivation is always given, unlike waste management and business acumen. To spread the missing knowledge waste management and prevention related events, conferences, workshops could be organized nationwide in Indonesia. In these events, the different stakeholders should participate like researchers, governmental representatives, management of waste banks, etc. to share the different views and point out the existing issues hindering successful waste management in Indonesia.

Grassroot action

The practice of the Hungarian NGO, Humusz Szövetség could be used to educate the employees of waste banks. Accredited Workshops are held for teachers in high schools by HUMUSZ NGO. (Budapest, Hungary) The topic of the workshops is: Theoretical and Practical Problems and Possibilities of Educational Tasks Related to Knowledge of Waste Management and Consumer Society. During the workshops, the participants are introduced to waste management, issues, prevention, recycling possibilities, etc. The managers of different waste banks could organize educational events not only for inhabitants, but for each other as well, where they can share their knowledge and experiences. (Humusz Szövetség, 2020)

Top-down approach

On systemic level there are several conferences, workshops, where professionals can share their knowledge about waste management. The Indonesian government could hold similar events for waste banks, like the followings:

- 10th International Conference on Waste Management and the Environment 2020 (Madrid, Spain) The conference provides an occasion for the exchange of scientific information and publication on the current situation of waste management between professionals, researchers, government departments and local authorities. (WESSEX Institute, 2020)

- Plastic Free World Conference Expo. (Cologne, Germany) New Materials Innovations, Technologies & Circular Economy Solutions To End Waste Plastic Aim is to reduce plastic consumption, find and source highly sustainable alternative bio-based materials, and create a more circular economy throughout the supply chain. (Trans-Global, 2020)

In addition, without reliable data sets, it is challenging to organize a nationwide adequately sized and operated waste bank network. Deep understanding of the sector and developing a network of waste banks are only feasible if reliable and systemic insights are available.

Grassroot action

Waste banks should have continuous and accurate data management. Bank Sampah Induk Gesit, and EcoBali Recyling have an employee who is responsible for the data collection. They also provide information and available data for government.

Top-down approach

On systemic level, the Indonesian government should claim for the date from the waste banks, and then provide statistical information. Like in the European Union, the Eurostat statistical office provides high-quality statistics for Europe, including data about waste management. Data is collected by the statistical authorities of the Member States. They verify and analyze national data and send them to Eurostat. Eurostat's role is to consolidate and present the data sets in a comprehensible way. (European Commission, 2020)

8.5 Unproportionate density of waste banks

In order to achieve the ultimate goal of the government, when there is one Bank Sampah per every thousand people, new waste banks need to be established in a systematic way. Currently, in some cases, people must bring their recyclable waste to remote districts; in contrast, there are communities where waste banks are directly competing against each other. Hence, the projected waste banks need to be planned based on the demand for valuable recycling materials.

Grassroot actions

As a possibility to increase the number of waste banks without expensive investment, the 'School garbage banks' in Thailand are good examples. The waste banks do not need special maintenance. In these waste banks students and teachers are responsible for managing the incoming waste. Schools are public places easily reachable even on foot, so more resident could bring their separated waste in. Establishing waste banks in schools or public places can easily increase the amount of waste banks. (World Bank, 2003)

Top-down approach

At systematic level, the EU has strict rules how densely should a civic amenity site set up. European Commission report of amenity sites conclude the main principles with which the sites have to meet. Every local authority needs at least one site, that has to supply 100.000 inhabitants, but as a benchmark of excellence for municipalities with at least 1.000 residents, at least one civic amenity site in their territory is needed. Furthermore, in the EU, amenity sites for recyclable waste collection operate beside the door-to-door waste collection system. (European Commission) In Budapest the FKF the Nonprofit Zrt., besides the door-to-door collection of plastic, metal, paper and residual waste, they provide through the bring point system 122 public sites around Budapest, where residents can bring their glass, metal, plastic, and paper waste for free, and 17 civic amenity sites. (FKF, 2020)

8.6 Sustainable income from the collaboration with the profit oriented partner (including direct support)

Grassroot action

Wongpanit Co. Ltd, Garbage Recycle Plant is best practice on how to develop business network. Wongpanit is the largest recycling separation plant in Thailand and it established the first waste bank that encouraged people to separate their waste. The company developed its network to more than branches in Thailand and other countries. It has been able to create a strong relationship with waste pickers, buyers, franchising partners, waste banks and schools. It has a strong market hold, therefore Wongpanit is capable to ensure fix prices for the valuable materials for waste banks. (Paritatamby & Tanaka, 2014)

Top-down approach

On a systemic level to increase and stabilize the prices of recyclable materials in 2012, the Hungarian Government established a policy about packaging fee. The first domestic distributor is liable for a product fee based on the amount of used packaging material. In the case of products produced abroad, the importer company is responsible for the charge, i.e., the company which imports, and sells the product in Hungary for the first time. 7% of the collected tax is directly used for awareness-raising while the rest is used to cover the waste management cost of the generated packaging material. (European Commission, 2015)

Another best practice the Germany deposit system, has been operating since 2003. The distributors of non-refillable beverage packaging are obligated to charge the customer a deposit of at least 0.25 Euro. The deposit has to be charged by each distributor until transfer to the final consumer. All distributors have to take back the returned one-way beverage containers of such material-type (glass, metal, plastic) and refund the deposit. The refundable packaging is marked. The system has a high success; only an estimation of 1-3% of non-reusable beverage packaging is not returned. (The Guardian, 2018)

8.7 Door to door collection schemes

Door to door collection schemes shows the highest results capture rates and yields of recyclables. Collection costs for such schemes might be higher; however, capture rates and revenues are also higher, and rejection rates and treatment costs are lower.

Grassroot activities

On local level in Indonesia and Thailand as well the informal sector is responsible for the collection of valuable materials from households and bring them straight to the recycling facilities. The recyclable waste is collected by human or animal power; therefore, it is more economical and less harm to the environment. (Scheinberg, 2010)

Top-down approach

On systemic level in the EU the door-to-door collection is a well-functioning structure. In 2013, Berlin was one of the first German federal states who had introduced a waste separation strategy, with a single recycling bin for light packaging together with similar materials. Light packaging/non-packaging material of the same type (plastic, metal, or composite materials). 100% of the households are covered with a door-to-door comingled collection. The frequency of waste transportation is weekly or bi-weekly, which is free of charge service since the cost is included in the residual waste collection fee. Therefore, inhabitants are much more motivated in the separation of their waste. (European Commission, 2015)

8.8 Informal sector integration into the formal system through waste banks system

Expect a couple of examples, employees at the inspected waste banks are voluntary workers. These micro organizations do not have sufficient financial resources to hire paid employees. Hence, there isn't a realistic possibility to integrate the informal sector into these waste banks. The informal sector is one of the most important stakeholders in Indonesia's solid waste recycling; approximately 15% of the generated MSW is recycled in this sector. Their carbon footprint is significantly lower due to the use of human or animal propelled vehicles. In many cases, workers from the informal sector have much more knowledge about waste separation techniques than the current manager of waste banks; hence it is essential to utilize their knowledge. From the cooperation of the informal and formal sectors, all the stakeholders would benefit; therefore, it is a prerequisite that the local governments much support cooperation.

Grassroot actions

On local level Bank Sampah Induk Gesit, the central waste bank in South Jakarta is a good practice for implementation of informal waste pickers to the formal waste management system. The waste bank has the financial background to employ workers for salary. The employees are hired from the informal sector. The employees used to be customers of the waste banks. They picked waste from the streets and from households where waste was not brought to the waste banks. They have a deep knowledge about valuable materials, therefore it makes advantage for the waste banks to work with them. However, their salary sometimes does not reach the income that they had during waste picking. Secure income, favorable judgment, and further advantages of an official job worth them to be part of the formal waste management system.

Top-down approach

On the systemic level as a good practice to integrate the informal sector to the waste management system there was a Central European project, called: 'Formalization of informal sector activities in collection'. The main objective of the project was to clear formalization ideas how to reach legal compliance of the informal actors. The Austrian-Hungarian idea concerned on the implementation of a re-usable item collectors association (ISHS). The aim was to provide training for the collectors and to improve legal compliance. A business plan was developed for a cross-border socio-economic enterprise, Work Integration Social Enterprise (WISE) with the aim to collect used goods and repair them in Hungary. The business plan comprises a description of the business idea, a market description and marketing, costs and financing and implementation plan. A final conference was held in Budapest, in 2012, presenting the results of the project regarding the significance of informal activities, the importance of re-use and examples from Europe. The focus of the conference was to drive together NGOs, associations and representatives of informal waste collectors, mainly from Eastern Europe. The initial step was taken to establish a European Waste Pickers Association. (keep.eu, 2020)

9. Conclusion

The Indonesian central government has launched a plan to reduce plastic waste by 70% by the end of 2025. (UN, 2017) Part of this complex initiative is to foster the establishment of waste banks throughout the country per thousand people. If this target of the government is realized solely through waste banks, the recycling rate in the country would reach more than 15%. Besides, the currently most effectively functioning recycling sector, the informal sector could be integrated into the waste bank network. So far, it is unclear how much progress has been made. During the field interviews, the most crucial operational and systematic errors were identified, which impede the efficiency of waste banks, including the recycling rate and the possibility to integrate the informal sector.

Waste banks in Indonesia originally are informal-community based organizations where people can bring their valuable recyclable waste, and increase their income. The Ministry of Environment promotes waste banks as a strategic program, as a part of their 3 R strategy. There is no door-to-door collection for recyclable waste, and waste banks are the reception point where people bring in their recyclable waste. Municipal communities can establish waste banks, and the aim of the Ministry is the increase of the number. Unfortunately, waste banks suffer from several shortcomings, the density is very low, therefore they do not reaches the goals of the Ministry.

In Thailand the first waste banks were established. Waste banks which are in cooperation with the recycling company Wongpanit work efficiently. The success thanked for the sustainable acquisition of the valuable material, by the waste recycling plant. This is an example of use of the market power of the formal private sector to

integrate the community. Such a partnership with the formal private sector improves the informal sector's linkages to the industrial value chain.

The cultural, geographical, economic differences should be taken into consideration when different best practices are implemented into the system in Indonesia. Furthermore, a crucial point of the successful waste management system is the cooperation between the stakeholders and the support of each other.

The aim of the study was to identify the issues that inhibit the efficient operation of waste banks and through them to strengthen the recycling rate in Indonesia.

In the current situation, waste banks cover only 0.2% of the total recycling rate. However, there are potentials to increase the recycling rate significantly through waste banks. There are two primary components of the improvement; first is the appropriate density of waste banks. Therefore, furthermore in-depth researches is needed to identify the exact number of operating waste banks, secondly the improvement of the waste bank efficiency. Furthermore, a reliable data source is a critical point of successful improvement.

The informal sector plays a considerable role in recycling success in Indonesia. Estimation of 15% of the recycled materials connected to their active participation. In the current situation, it is rarely possible to integrate the waste pickers into the formal sector through the waste bank system. The main interfering reason is the financial issues of waste banks. From the interviewed Bank Sampah-s in eight out of ten, the employees work voluntary and suffering from further financial problems. However, the employment of the informal sector could cause even economic benefits; for instance, their knowledge and experiences in waste separation, trading can raise the waste banks' profit; with their door-to-door collection can new customers be involved.

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11. Appendix

11.1 Interview questionnaire

- 1. How is the waste bank working?
 - People can bring their own recycling material?
 - How do they receive financial compensation?
 - How do the waste banks collect waste? (Often people don't bring their recyclable materials directly to the waste bank but for example to the "Banjar" who is a leader of a community and he has a community house where there are opportunities for different occasions e.g. collecting valuable recycling materials.)
- 2. When did the waste bank start its operation?
- 3. What kind of waste do you accept?
- 4. Should be the different types of waste separated?
- 5. Material stream: How do you treat the waste? What is happening with the waste after it is brought to the waste bank?
- 6. How much waste is brought to the waste bank daily?
- 7. How much is plastic from this amount?
- 8. How many people deliver their material to the waste bank per day? How much waste is delivered typically by a person?
- 9. Who are the customers? Households? Businesses? Informal sector?
- 10. How do people know about the waste bank?
- 11. Who is leading the waste bank? Is it led by the government or NGO or is it a private for-profit organization?
- 12. How are the costs covered?
- 13. Is there any support from the government or from somewhere else?
- 14. Do you cooperate with the government or with any other public body?
- 15. How many people are working here?
- 16. What are the roles of the people exactly?
- 17. For who does the waste bank sell the valuable materials?
- 18. What are the prices of the waste?
 - How much does the waste bank give for the valuable materials to the customers?
 - How much does the waste bank receive for the valuable materials?
- 19. What are the main problems?

11.2 Field interview pictures

Picture 1 - Bank Sampah Tri Alam



Picture 3 - Bank Book of Bank Sampah Tri Alam



Picture 5 - Bank Sampah Kerabat Pulo Kambing







Picture 4 - Bank Sampah Kerabat Pulo Kambing



Picture 6 - Products made of waste in Bank Sampah Kerabat Pulo Kambing



Picture 7 - EcoBali Waste Bank



Picture 9 - Bank Sampah ASRI



Picture 11 - Residual waste container, polluted canal, West Jakarta



ecoBali RECYCLING

Picture 8- EcoBali Educational Center



Picture 10 - Collected PET bottles in Bank Sampah Abukasa



Picture 12 - Open dumping- West Jakarta



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12. Affirmation

I certify, that the master's thesis was written by me, not using sources and tools other than quoted and without use of any other illegitimate support.

Furthermore, I confirm that I have not submitted this master's thesis either nationally or internationally in any form.

Budapest, 24.04.2020, Annamária Domonyik, BSc.