

## 2-9 Partnership Project of Solid Waste Management in Bandung Indonesia

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### Abstract

Bandung in Indonesia is the capital of West Java province in Indonesia, the country's third largest city, and second largest metropolitan area in Indonesia, with 7.4 million in 2007. The current landfill is temporal use and the remaining lifetime of the landfill is several years, therefore the shortage of landfill space is a large problem. The local government is evaluating incineration as well as promoting the reduction of solid waste generation. In this project, we consider the best way to reduce landfill waste by systematical combination of reduce, reuse and recycle activities. Not only survey of the waste stream but also design the appropriate solid waste management system is performed. In this year, we conducted an exchange program to understand mutual SWM and to discuss on the subject to be solved. The waste collection system in the residential area was focused in the first stage of this project. In this paper, we report the situation of solid waste management in Bandung and discuss the waste collection system.

**Keywords:** Solid waste management, waste segregated collection system, Bandung in Indonesia

### Outline

The aim of this project is to reduce landfill waste from view point of 3R. Through survey and analysis of the waste stream from waste generation, collection, transport, and disposal, appropriate solid waste management (SWM) is considered.

Prof. Damanhuri and related professors in Institute of Technology Bandung (ITB) are counterpart of our team in Okayama University (OU). This year, I visited ITB twice with a student and prof. Damanhuri visited OU twice and lecturer Dr. Chauel stayed in OU for three months. We had many opportunities to discuss and exchange ideas of SWM research not only with professors in ITB but also government officers of Bandung city. Moreover, students had a good experience of watching current status of solid waste problem in Indonesia.

Through discussion and site visitation, I recognized that one of the important points we must pay attention to is waste collection. Segregated waste collection is not adopted by residents but many scavengers engage in separating waste in transfer station and landfill site. Sorting of waste in

household and separate collection might make the stream of the waste smoothly and efficiently. We need to analyze the waste generation mechanism, design the waste collection/recycling/transport procedure and evaluate its efficiency.

In this report, I describe the outcome of exchange program and discussion of research idea.

### **Exchange program**

#### 1) Meeting with students of ITB and governmental officers of Bandung

Members of OU visited the Institute of Technology Bandung (ITB) on 18 June, 2010. Dr. Enri Damanhuri and his research staff as well as the dean of the department welcomed us.



Picture 1. Group photo taken at the environmental engineering building.



Picture 2. Group photo taken with the dean of department



Picture 3. Group photo of research meeting in the Prof. Damanhuri's laboratory

In this meeting, I gave an introduction of the partnership project, the aim and concept, currently individual projects which are going on, the coverage of Asian countries, among others. In exchange, the government officer of Bandung presented the solid waste management outline. Waste treatment is composting and landfilling in spite that a large amount of solid waste generates in

Bandung every day, however, it is difficult to construct a new landfill. Since the landfill used is only temporal, it will be necessary to build a new one soon.

## 2) Visit and observation of waste collection, transport, landfill and recycling

During the visit we watched the situation of waste discharge in Bandung city. Picture 1 shows a scene in front of a market in the morning of Bandung city. A large amount of waste were gathered and put into a big container but it overflowed. In Indonesia, people have as custom buying foods for breakfast and other meals early in the morning. So, not only market waste but also resident's waste were discarded. It gave us an impression of messy.

Picture 2 is a collection truck picking up the restaurant waste in the morning. The food waste in the plastic bin was collected, shop by shop.



Picture 1. Market place in the morning



Picture 2. Waste collection at a restaurant in the morning

In the residential area, the community consisted of about 20 houses, and it employs a personal garbage collector to make collect the household waste. The garbage collector stops each house in that community and picks up any waste by a “Henka” cart shown in Picture 3. Waste is taken to a regional transfer station of Bandung city.

In the transfer station, a licensed scavenger extracts and segregates the recyclable waste from the mingled waste and puts into a plastic bag by waste category. Picture 4 shows a scene where a worker is separating the waste in the Henka cart, and plastic bags of recyclable waste are stacked in Picture 5. The residuals generated from extraction process are gathered in a container, and it is taken to a landfill by truck at night, landfill is located more than 40 km away from the city. The recyclable materials are sold to a recycling company.



Picture 3. The front of “Henka”.



Picture 4. Segregation of recyclable matters in a transfer station



Picture 5. Stacked plastic bags recyclable waste.

On the way to the landfill site we watched scavengers segregating cartons in plastics waste bags taken by container trucks. They open the plastic bag, sort the materials, and pack up manually. The plastic bag of waste is also packed up after washing and drying.



Picture 6. Plastic bags dumped to the private waste collection site.



Picture 7. Manual separation of carton package from others.



Picture 8. Segregated recyclable plastic bags washed

Constructing new landfill around Bandung city is very difficult due to residents' opposition, being similar to Japan. The road distance from the center of Bandung city to Sari Mukit landfill is 44.4 km (Picture 11). Transportation of waste by heavy truck through heavy traffic jam (Picture 9) and on unpaved roads (Picture 10) takes long traveling time. Besides, arrow road (one line per one side) causes traffic jams. For this reason, waste transportation is not effective.

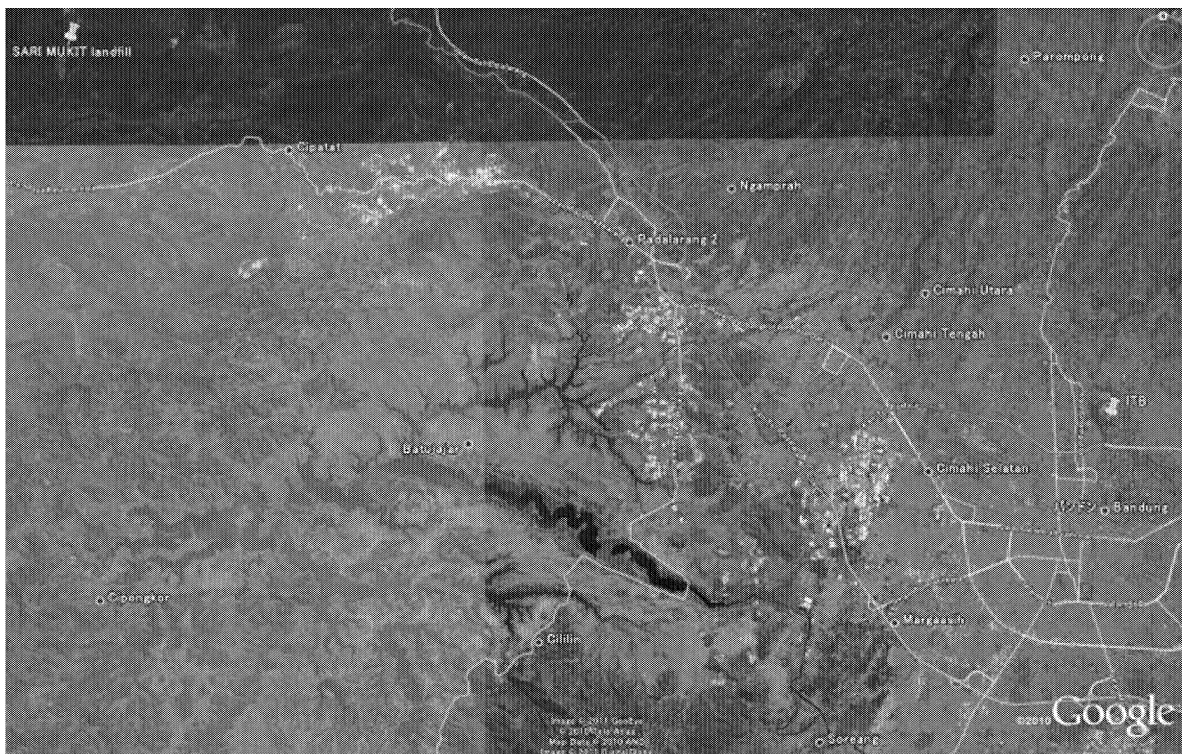




Picture 10 Traffic jams

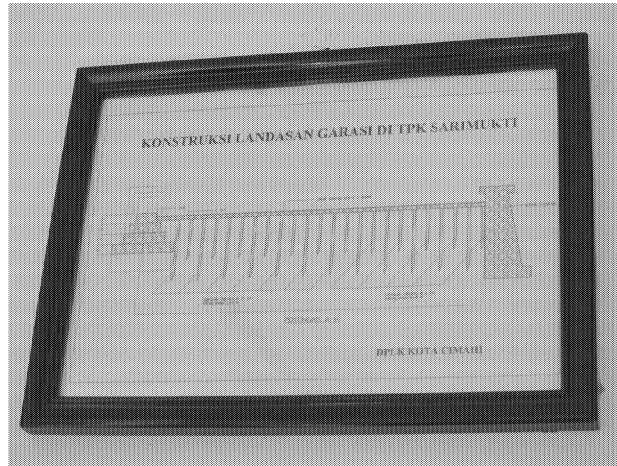


Picture 9. Muddy road



Picture 11 Route between center of Bandung city and landfill (example)

During our visit to TPK SARI MUKTI landfill, we had a hearing with the landfill manager and took a site visiting round.

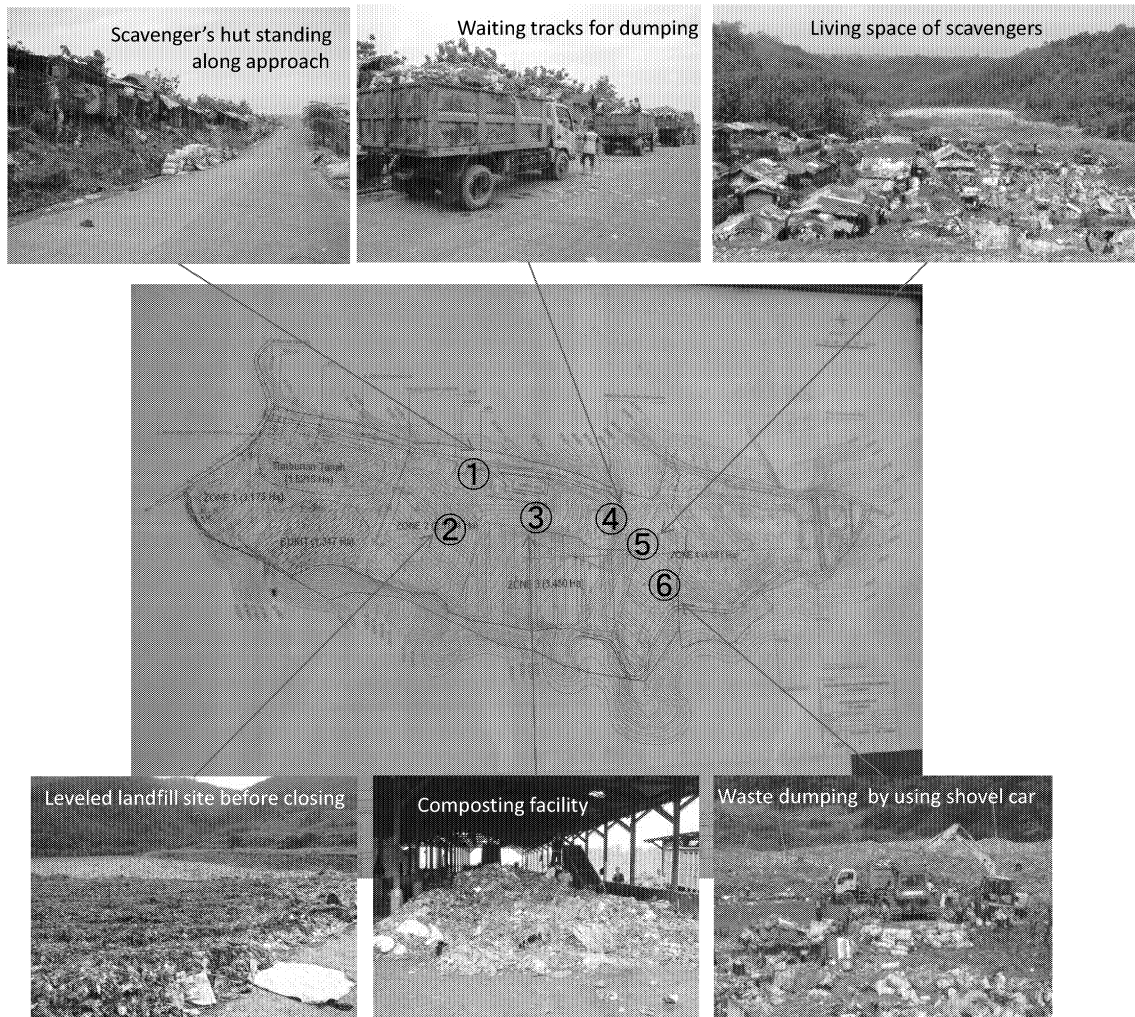


Picture 12 Basic structure of the sanitary landfill, TPK SARI MUKIT.



Picture 13. Hearing to the manager of the landfill

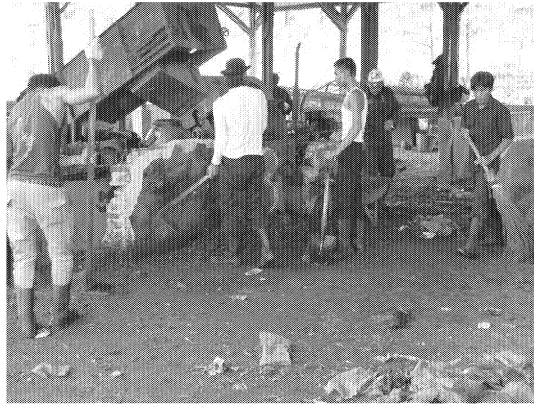
Picture 14 shows the map and picture of the landfill. In the entrance of the landfill at upper left of the map, trucks must be weighed. However the scale but the scalar was broken at that time. The road has a slope angle down to the valley and there were many scavengers' poor houses beside it (see ①). There are 4 yards of landfill and stage (see ②) was already closed and covered. In the middle altitude, there was a composting facility (see ③). Since the present dumping yard is the bottom one, the transportation trucks waited for the dumping time in a line on the road, and being crowded (see ④). In the bottom yard, many scavengers houses (see ⑤). There are many scavengers gather soon at the place where the truck dumped the waste. (see ⑥)



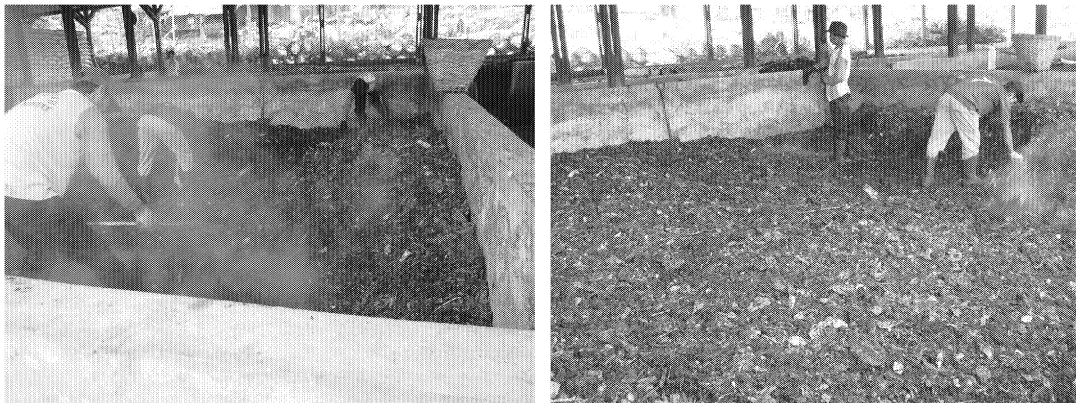
Picture 14. Landfill map and the view

Picture 15 shows the composting facility. Mainly market food waste was moved to the composting facility. A worker was mixing the food waste manually once per week while the steam was generating from the hot material of composting. Sorting powered by wind separated plastics from other materials.





Picture 15 Composting facility (1)

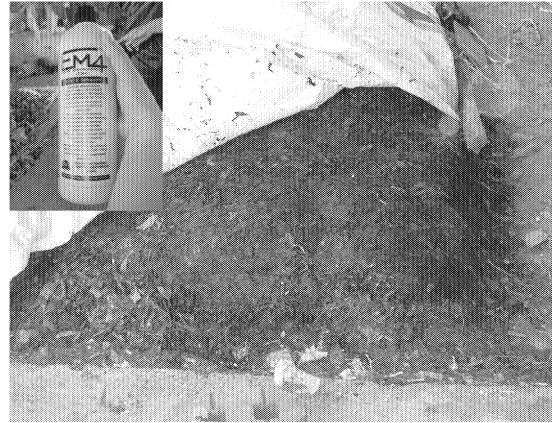


Picture 16 Composting facility (2)

At final, we visited the pilot plant of composting in transfer station. As new idea for recycling, local authority is starting pilot study of composting in transfer station. In order to reduce the volume of waste transported to landfill, the city of Bandung examined the possibility of composting in the transfer station. The simple composting process is firstly chipping the garden waste with a machine, adding an enzyme as digestion accelerator, and mixing manually everyday. So, organic compounds reached a good degree of fermentation a week later.



Picture 17 Chipping by machine



Picture 18 Level of fermentation after 8 days

### 3) Visiting researcher from ITB

From the beginning of October to the end of December, Dr. Chauel, a lecturer of ITB, visited Okayama University Waste Management Center, supported by Indonesia government. Dr. Chauel studied on the applicability of recycling law based on the concept of EPR for reduction of plastic waste, and discussed with us in SWMC. Also, our project invited him to the technical tour to Kita-Kyusyu Eco-town. He was interested in the experimental research on landfilling by Fukuoka University, and also was impressed by the recycling center of E-waste and bio diesel fuel (BDF) production.



Picture 19 Travel by Shin-kansen



Picture 20 Explanation and discussion in  
Fukukoka Univ. Institute for  
Recycling Env. Control System



Picture 21. Landfill experimental facility      Picture 22. Visit to Kitakyu-syu Eco-town

## Results and Discussion

In current waste collection and treatment system, resident do not need to segregate waste because scavenger goes to each house to pick all waste up (Fig.1). Due to the low labor cost, it is possible to segregate waste in the transfer station by manual operation. From the view point of accuracy in waste separation, it is not effective to separate the mingled waste but effective to separate at source. Therefore, sorting waste in the household and collecting separately by the sorted waste is recommended (Fig.2). For instance, concrete waste segregation categories are steel and aluminum cans, glass bottle, PET bottle, other plastic, papers and card boards, cloths, and others. In Japan, these waste categories are popular as the waste collection categories designated by local authority. Of course, the increase of collection frequency makes collection labor and employ. It might be possible to transfer the recyclable waste to recycling company directly. In transfer station, the waste of food category collected should be raw material for in situ composting process. Scavengers who are affected by loss of the segregation job in transfer station will be able to engage in the work for composting. Education and enlightenment of the waste segregation in household for residential people is mandatory. Looking at the Japanese case, hundreds of briefing session to get across the significance and actual discharging manner to the residents must be hold.

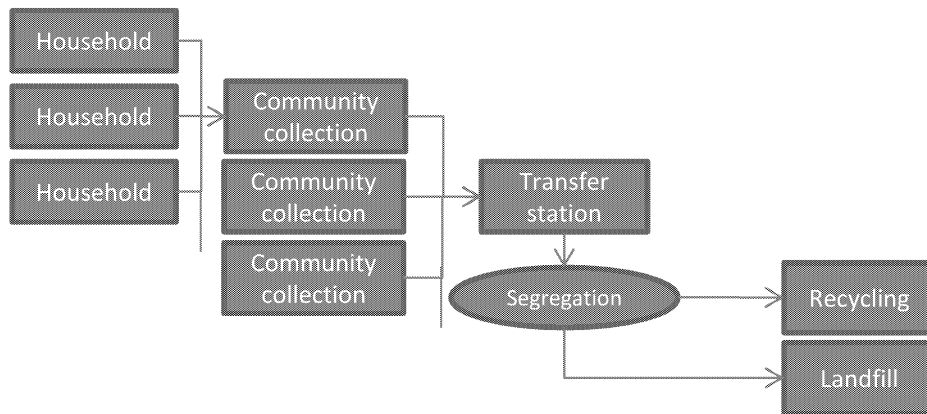


Fig. 1 Current waste collection and treatment system

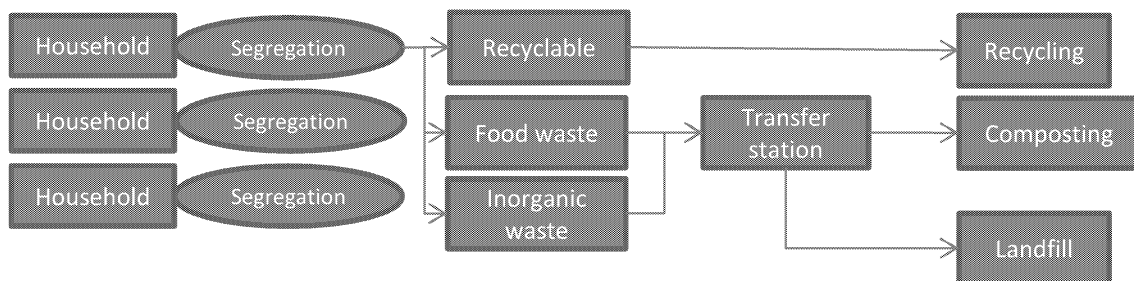


Fig.2 New waste collection and treatment system

## Research Planning

At the first stage of this project, we focus on the system composed of waste sorting in household, separate collection, composting in transfer station, waste transportation to landfill. We work on making a scenario of segregated collection system based on the statistic data of waste generation from household and understanding the current community collection system by using “Henca” cart, and calculate the efficiency of the collection system from view point of time, cost, energy and environmental burden.

In the year 2011, officers of Okayama city government will take part in our project. The officers and the OU team will visit Bandung city and will discuss and exchange ideas with the ITB team and officers of Bandung city about the waste collection system and treatment system, especially, the political strategy to promote 3R.