

Physical composition analysis of household waste in Hanoi, Vietnam

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ABSTRACT

In order to improve municipal solid waste management (hereinafter referred to as “MSW”), it is crucial to identify the quality of municipal solid waste, of which households are a major source. The objective of this research is to clarify the proportion of recyclable and non-recyclable waste mixed in household waste in Hanoi, Vietnam. Household waste generated from 120 households in Dong Da district of Hanoi was sampled and sorted into 15 items for eight consecutive days from 26 July 2011. They also were provided questionnaire sheet to fill in information regarding age, job, monthly income and meals in a day. The result indicates that 37.2 g of recyclable waste (7.8%) and 435.8 g (92.2%) of non-recyclable waste per person per day were generated on average, 280.1 g or 59.1% of which was food waste, and 52.3 g or 11.0% of which was coal ash. Paper waste was generated as both recyclable and non-recyclable waste. Metal waste was generated mainly as recyclable waste (hereinafter referred to as “RW”). The current situation of recycling is greatly assisted by junk buyers or the informal sector, and the behavior of households, most of which have become familiar with keeping recyclable waste. However, it is necessary to discuss the sustainability of recycling systems in Hanoi taking into account the economic growth and changes in lifestyles.

KEYWORDS

municipal solid waste, collection amount, physical analysis, recyclable waste

INTRODUCTION

Hanoi, the capital of Vietnam has an area of 3,344,7km² and a population of 6,561,900 persons including urban city population of 2,709,900 people and suburban population of 3,852,000 people (statistics in 2011). In Hanoi there are 29 districts including 10 urban districts, 1 town and 18 suburban districts. Population density in urban area is 3,565 persons/ km². In addition there are hundred thousands of nonresidents and laborers from other provinces earning their living in Hanoi.

Currently, there are 5,371 tons of waste is generated in Hanoi that discharged from municipal sources, including households, restaurants, markets, and businesses. The increasing rate of waste volume collected in Hanoi is 10% per year due to the growing of population and economy. The quantity and quality of MSW generated in Hanoi have changed dramatically due to the large concentrated population, and the effects of lifestyle changes brought about by economic development. In order to propose the appropriately methods for MSW treatment for Hanoi city, it is necessary to investigate the characteristic of MSW in which the physical composition analysis is indispensable.

The objective of this study is to clarify the physical composition of MSW which was sampled from 120 households in Cat Linh ward, Hang Bot ward and Dich Vong ward in a study on July-August 2010. Sampling and analyzing of MSW and RW are implemented from 26 July to 2 August 2010 for 8 days in a row. The results of the survey were analyzed to determine the characteristic of MSW in Hanoi city in order to propose the appropriate methods for MSW treatment in the context of Hanoi city as a developing, urbanization, modernization city.

MSW collection and transportation process in Hanoi city

Every day, waste is collected by 240 liter containers which located in collecting points along streets and residential areas. For the lanes and alleys waste is collected by hand carts. Compactors are used for loading waste from containers or hand carts at the collecting points. After that waste is transported to the landfill site.

Generation amount and collection rate of MSW

According to the Department of Natural Resources and Environment of Hanoi People's Committee and Hanoi URENCO, the generated MSW amount in Hanoi is about 5,371 tons/day, in which 3,200 tons from urban area. The amount of MSW that collected and transported to the disposal areas is about 3,875 tons equal to 77% of total generation amount. In the inner city generally, the collection rate is from 70%. Particularly, at 4 old inner districts (Ba Dinh, Hoan Kiem, Hai Ba Trung, Dong Da), the collection rate is 100%, and 80-90% is for new districts such as Tay Ho, Cau Giay, Thanh Xuan, Hoang Mai, Long Bien and Ha Dong.

The process of MSW collection and transportation in Hanoi city is showed in figure 1:

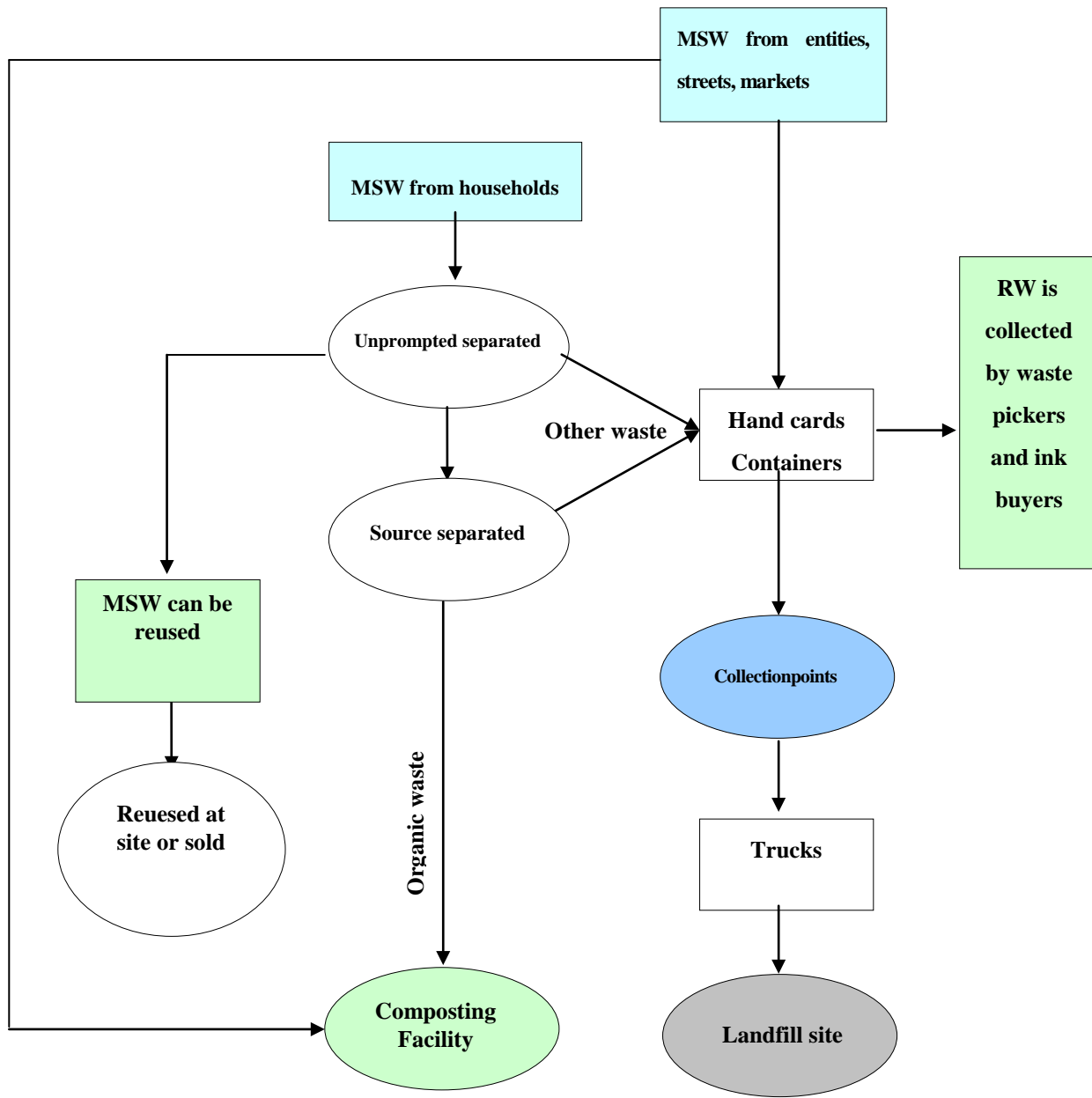


Fig.1. Process of MSW collection and transportation in Hanoi city

MATERIALS AND METHODS

120 households in Cat Linh, Hang Bot, and Dich Vong that belong to Dong Da district of Hanoi city were selected under the support of the local government (Ward People’s Committee). The households were requested for their cooperation with study team to supply samples of MSW and RW daily discharged. The list of the household with ID numbers was prepared in advance. Totally 20 plastic bags (20L) (10 for collecting kitchen waste and 10 for collecting other waste than food waste) per household were distributed to the households. The households also were strictly asked not to dispose of MSW in a handcart or not to give or sell RW to anyone during this study but to supply the study team all MSW and RW as the samples. 120 households were introduced and

explained by study team 2 days before the survey about: Categories of waste for source separation; Image color for each category; discharging time; Collecting time. At the same time with introduction and explanation, 120 questionnaires were distributed to 120 households. Households were asked to fill in the questionnaire with exactly information and turn back completed questionnaires on 2nd August in the morning. The content of questionnaire is shown in table 1.

Table 1: Question items for households:

Question items	
House information	Address
	Area (m ²)
	With or without the home help
Owner information	Name
	Age
	Job
	Monthly income
Daily meals during the survey	Have or don't have breakfast, lunch, dinner at home

At households, the residents stored and provided kitchen waste and other waste separately with different plastic bags from the day before. In the morning of next day, wastes are directly collected from households from 7-8 am.

The following table shows the source separation system for households:

Table 2: Source separation system for households

Source Separation	Food waste (Blue)	MSW other than food waste (white)
Category description	Seashells, egg shells, bones, fruit or vegetable peels including tea leaves which are residues after meals	Paper, plastic, textiles, and glass other than food waste which are not usually stored, given or sold but just disposed of, PET bottles, card boards, aluminum cans
Discharging tools	Plastic bags with blue sign	Plastic bags with white sign
Discharging time	7:00 am	7:00 am
Collection time	From the day before until 7:00 am of the day after	From the day before until 7:00 am of the day after
Collection frequency (Discharging frequency)	Every morning from 26 July to 2 August 2010	Every morning from 26 July to 2 August 2010
Type of collection transportation	Small truck	Semi-truck

After completion of sampling, the wastes were transported to Cau Dien Composting site by truck.

At the site, the weight of wastes was measured before sorting into categories. Sorting and weighting was completed every household in order to clarify the fluctuation of the physical composition of wastes among households. The wastes per household was sorted out on the trays and sorted into 16 categories as follow:

- (1) Salable paper, (2) Salable plastic, (3) Salable glass, (4) Salable metal, (5) Unsalable paper, (6) Unsalable plastic, (7) Unsalable glass, (8) Unsalable metal, (9) Wood, Plant, Garden, (10) Textiles, (11) Rubber, Leather, (12) Ceramics, (13) Coal ash, (14) Kitchen, (15) Others

RESULTS AND DISCUSSION

Physical Composition Analysis

The result shows that 37.2 g of recyclable waste (7.8%) and 435.8 g (92.2%) of non-recyclable waste per person per day were generated on average, 280.1 g or 59.1% of which was food waste, and 52.3 g or 11.0% of which was coal ash. Paper waste was generated as both recyclable and non-recyclable waste. Metal waste was generated mainly as recyclable waste. The current situation of recycling is greatly assisted by junk buyers or the informal sector, and the behavior of households, most of which have become familiar with keeping recyclable waste. A summary of the results is shown in Table 2.

Table 2: Physical composition of MSW in Hanoi city

Type	Category	Proportion (%) ^{*1}
Recyclable	Paper	3.2
	Plastic	2.8
	Glass	1.0
	Metal	0.8
Non recyclable	Paper	2.7
	Plastic	5.8
	Glass	1.4
	Metal	0.1
	Food	59.1
	Flower, garden	2.6
	Textiles	1.2
	Rubber, leather	0.5
	Ceramics	0.6
	Coal ash	11.0
	Others	7.0

The summary result of survey at the table 2 indicates that the highest proportion is food waste. Food waste can be reused for feeding animal or recycled to compost. The recyclable waste also has the a number of proportion in the total component. Now, in Hanoi, the recyclable waste is solved by informal sector with rudimental facilities. However, it is admitted that this informal sector has significant contribution to MSW management, economic growth as well as in waste reducing. Informal sector also can be considered as positive factor in our social apart from environmental pollution caused by their low technology for waste recycling. In Hanoi city now, the source separation has been carrying out in only 3 model areas, the result shows that it's very necessary to expand the source separation in all city to utilize the useful material such as food waste, RW among MSW as well as to reduce the land for dumping.

Questionnaire survey

114 questionnaires have returned from households (95%) and there were 06 households (5%) did not cooperate in filling in questionnaire. The returned questionnaires shows that households have difference personal and house information, but most of them have breakfast at home sometime and always have lunch and dinner at home. However, the frequency of having meals at home during the survey is not same among households. It means that the physical composition of waste among households is different.

CONCLUSIONS AND PERSPECTIVES

The physical composition of household waste in Hanoi city was defined. The food waste occupy more than a half of total proportion. The component of recyclable waste has a small proportion compare with non-recyclable waste per person per day were generated on average. The information from questionnaire returned from households indicates that there is a fluctuation of the physical composition of wastes among households due to the difference of living style among households.

The proportion of 15 categories that founded from this study may help the MSW manager to determine the method for MSW treatment in Hanoi city not only at the present but also in the future. The composting method or biogas as well as bio energy generating should be considered to take full advantage of high rate component of food waste.

It is also very necessary to maintain the sustainability of recycling systems in Hanoi taking into account the economic growth and changes in lifestyles through the portion of recyclable that shown from this study.

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Content

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- Objective of research
- Methodology
- Result and discussion
- Conclusion



Introduction of study area

HA NOI – CAPITAL OF VIETNAM



- Total area: 3.153,54 Km²
- Urban area: 185,7 km²
- Suburban area: 2.967,76 km²



Total population: 6.232.940

- In urban area: 2.136.500
- Suburban area: 4.096.440

Divided by:

- 10 urban districts
- 18 suburban districts
- 01 town



Xích lô



Traditional wear for women



Hanoi's special foods



Phở



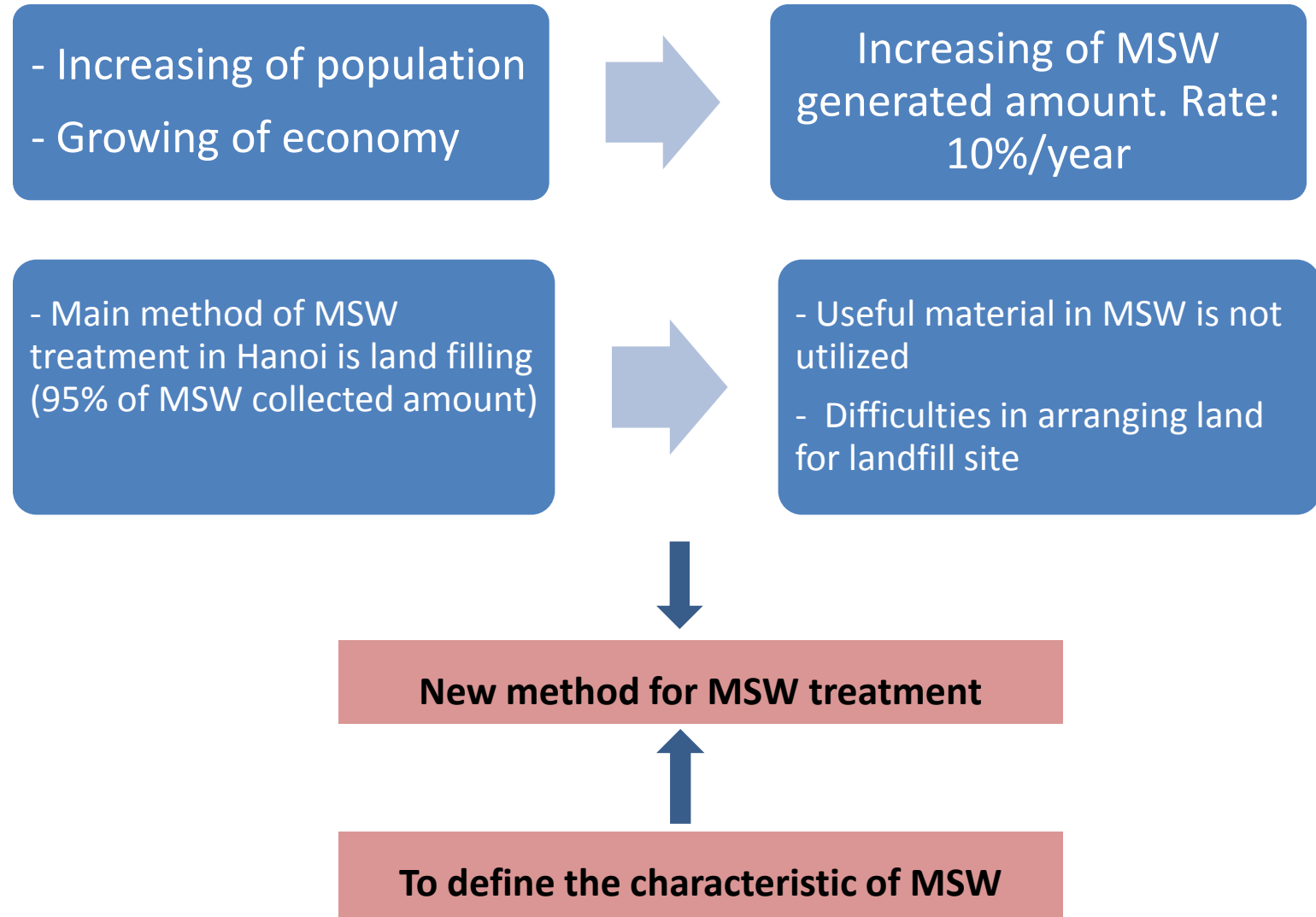
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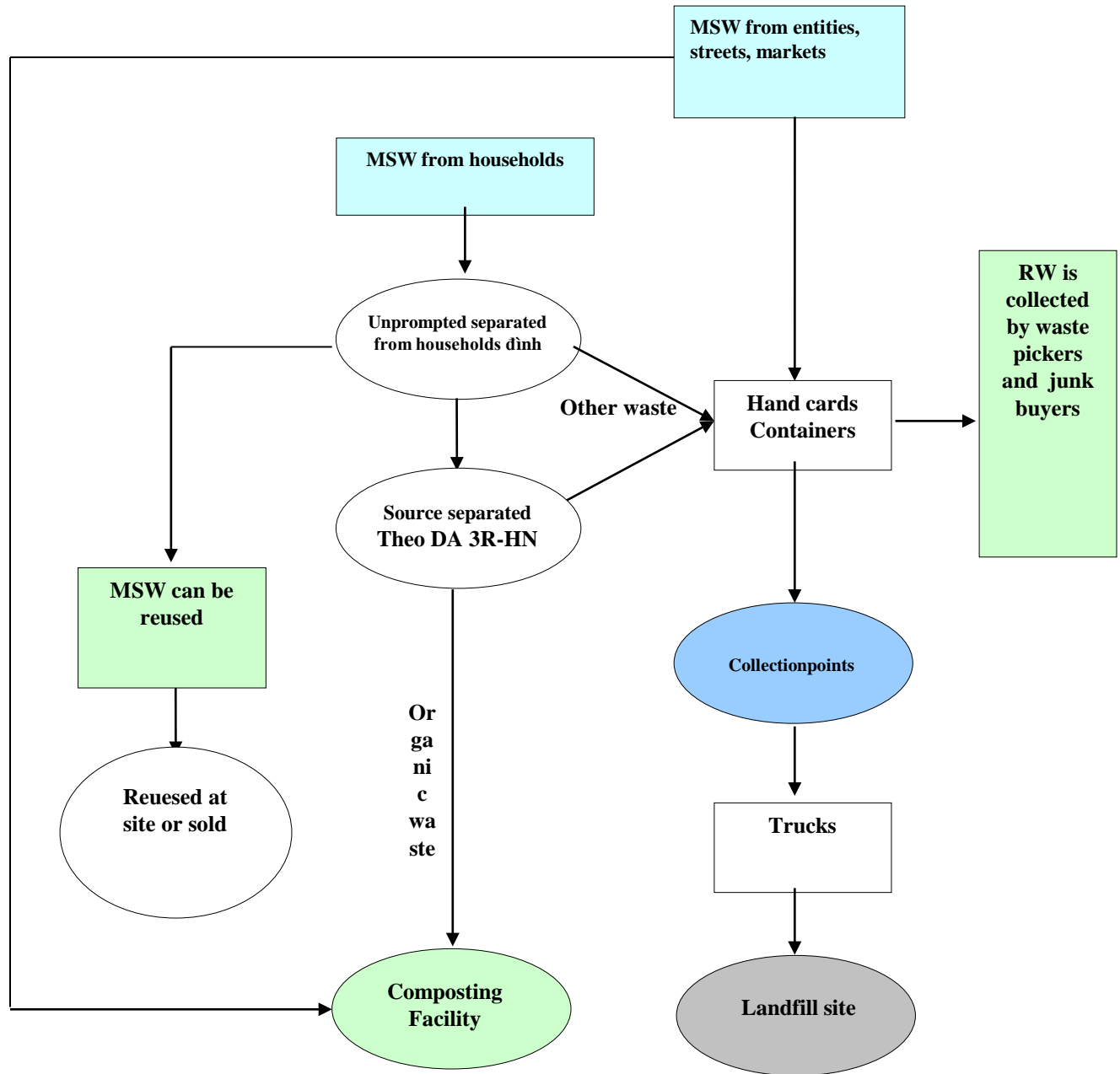
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MSW management situation in Hanoi city



Process of MSW collection and transportation in Hanoi city



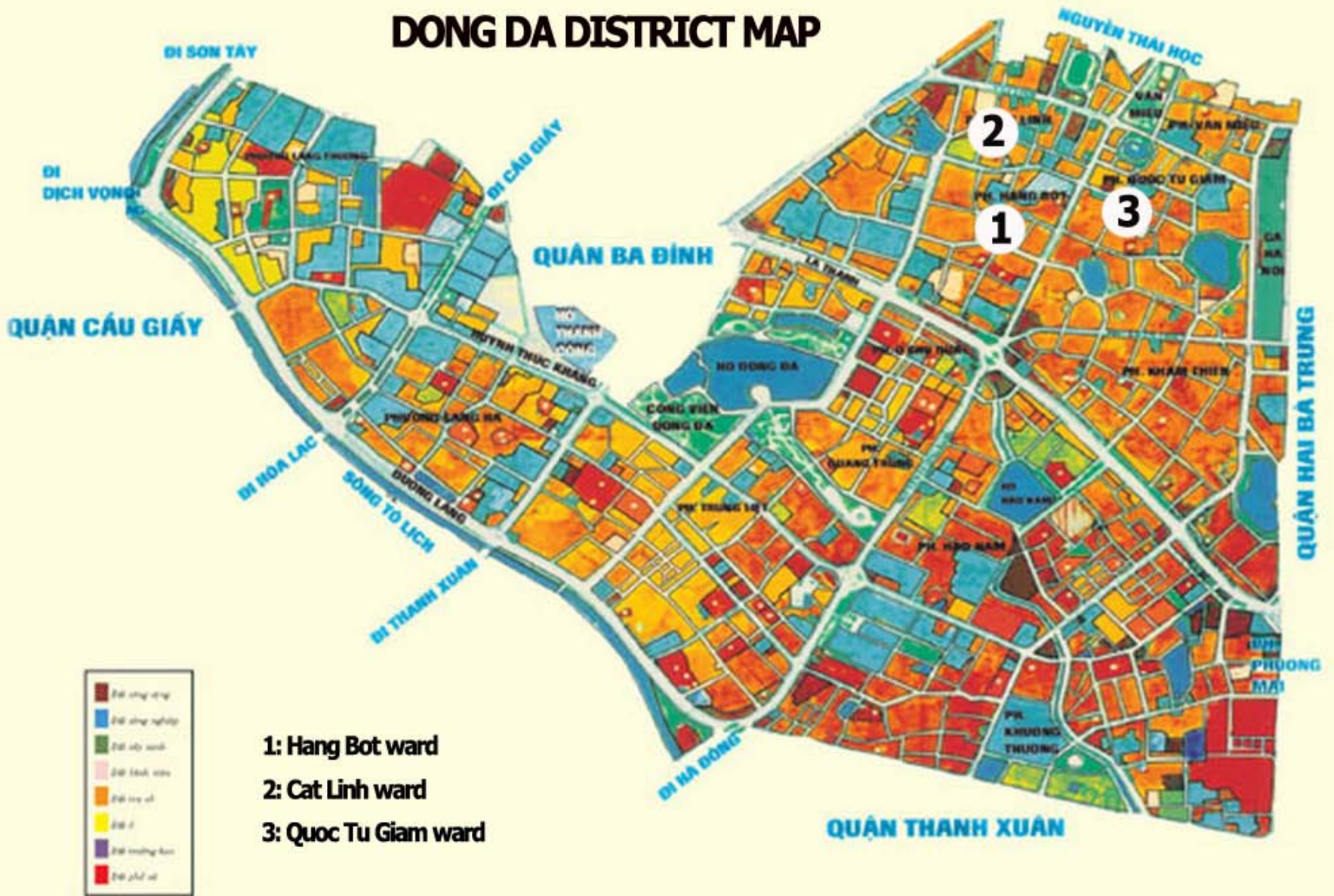
Objective of research

- To clarify the physical composition of MSW and recyclable waste discharged from representative households in Hanoi city, Vietnam

Time of research: 8 days from 26 July 2011 - 3rd August, 2011

Surveyed sites: 3 wards belong to Dong Da District

DONG DA DISTRICT MAP



Methodology

- 120 households: to supply samples of MSW and RW daily discharged
- 20 plastic bags (20L) (10 for collecting food waste and 10 for collecting other waste than food waste) per household were distributed to the households
- Households were asked to fill in the questionnaire with exactly information and turn back completed questionnaires on 2nd August in the morning

MSW categories

1	Salable paper	9	Wood, Plant, Garden
2	Salable plastic	10	Textiles,
3	Salable glass	11	Rubber, Leather
4	Salable metal	12	Ceramics
5	Unsalable paper	13	Coal ash,
6	Unsalable plastic	14	Kitchen
7	Unsalable glass	15	Others
8	Unsalable metal		

Source separation system for households

Source Separation	Food waste (Blue)	MSW other than food waste (white)
Category description	Seashells, egg shells, bones, fruit or vegetable peels including tea leaves which are residues after meals	Paper, plastic, textiles, and glass other than food waste which are not usually stored, given or sold but just disposed of, PET bottles, card boards, aluminum cans
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Type of collection transportation	Small truck	Small-truck

Questionnaire survey

Question items

House information

Address

Area (m²)

With or without the home help

Owner information

Name

Age

Job

Monthly income

Results of physical composition analysis

Type	Category	Proportion (%)
Recyclable (7.8%)	Paper	3.2
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	Glass	1.0
	Metal	0.8
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	Plastic	5.8
	Glass	1.4
	Metal	0.1
	Food	59.1
	Flower, garden	2.6
	Textiles	1.2
	Rubber, leather	0.5
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	Coal ash	11.0
	Others	7.0

Results of questionnaire survey

- 114 questionnaires have returned from households (95%) and there were 06 households (5%) did not cooperate in filling in questionnaire.
- The returned questionnaires shows that households have difference personal and house information, but most of them have breakfast at home sometime and always have lunch and dinner at home. However, the frequency of having meals at home during the survey is not same among households. It means that the physical composition of waste among households is different.

Discussion

- The result of physical composition analysis shows that It's very necessary to expand the source separation in all city to utilize the useful material such as food waste, RW among MSW as well as to reduce the land for dumping.
- The result of questionnaire survey shows that the physical composition of waste among households is different.

Conclusion

- The proportion of 15 categories that founded from this study may help the MSW manager to determine the method for MSW treatment in Hanoi city not only at the present but also in the future.
- The composting should be promoted; other method should be considered to take full advantage of high rate component of food waste.
- It is also very necessary to maintain the sustainability of recycling systems in Hanoi taking into account the economic growth and changes in lifestyles through the portion of recyclable that shown from this study.



Thank you for your attention!