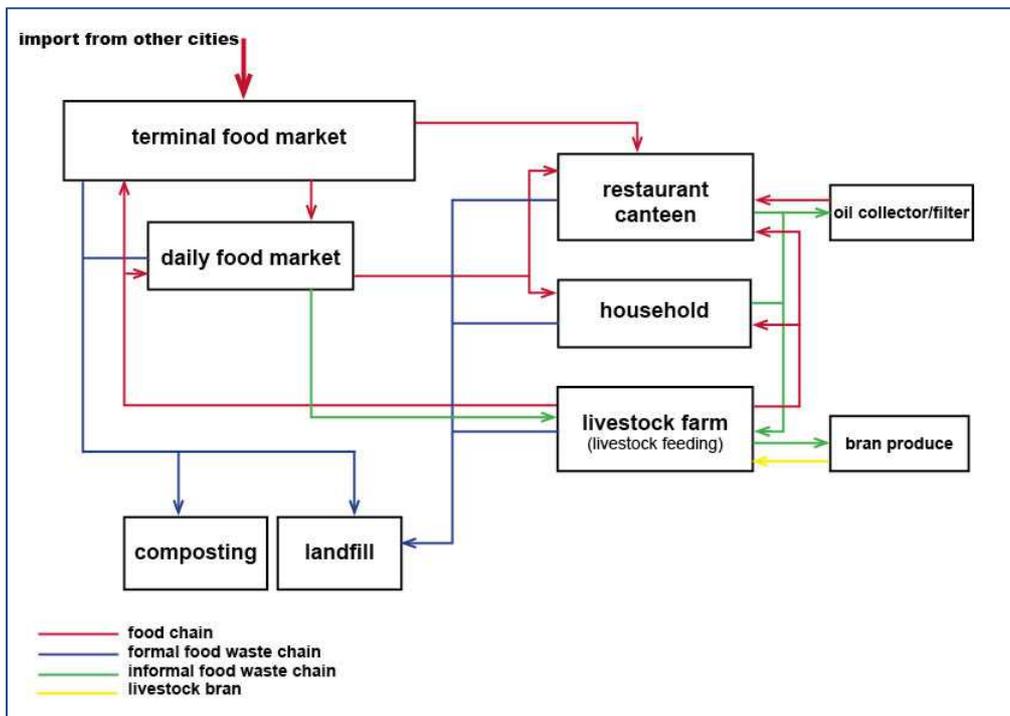


Logistic chain of food waste recycling in Hanoi Megalopolis



PHẠM Thị Thanh Hương

Hanoi, September 2016

Direction: Marie-Lan NGUYEN LEROY & Jean Daniel CERASO



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Report

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Introduction

Hanoi is a big city with an area of 3328.9 km² with a population of 7,500,000 people (2015) - (Source: <https://vi.wikipedia.org>). With a population of 2 nationwide, Hanoi is a big "source of food production waste". On the other hand, Hanoi urban composition varied is divided by the belt. These areas of urban are different, diverse functional activities and residential complex components. The collection and treatment of solid waste, including municipal waste, organic waste, is a challenge, is also a great potential for Hanoi. Especially, in the domestic waste, the food waste is big part, but there's never a specific research on this ingredient. Therefore, this study was conducted to understand the food waste chain in Hanoi.

Method

Objectives of the study:

To understand and describe the logistic chain of food waste recycling in Hanoi with different stakeholders involved (food waste collectors, URENCO street agents, private restaurants and the public canteens, households and the food merchants). From that, to understand and to generally assess the role of the participants in food waste collection and treatment.

Hypotheses

Following the research object, the study mentions 3 hypotheses:

- **Hypothesis 1:** (To understand the food waste producers): In Hanoi, there is a difference in the food waste treatment in the urban different areas with the different living habits, therefore food waste treatment is different. The areas has different properties are as follows: the old town area: the oldest living inhabitants, has become a regional trade and tourism. Urban residential area developed in the subsidy period, has already developed the new urban components now. Residential areas of urban fringe (peri-urban), gradually merged into Hanoi from 2008 up to present. First, the study will focus on areas with a high density urbanization, densely populated - meaning large source of food waste.
- **Hypothesis 2:** (to understand the food waste recycling chain): Beside the formal system of waste collection and treatment, the food waste is also collected by the informal collectors. The informal collectors have a system their own in division areas of collection, in profits, ect (ex; the case of Hồ Chí Minh city)
- **Hypothesis 3:** (to understand the food waste treatment, especially in the informal system) Food waste is collected separately by each component, based on the user's needs then. For example, the leftovers are for charity or poor, used as feed for livestock, frying oil is recycled into secondary frying oil, used as fertilizer, resale, ect.

Research sites

Follow the hypothesis 1, Hanoi has different urban areas, the study's held in the different characteristics. The study's essentially held in 03 district: Hoàn Kiếm, Đống Đa và Hà Đông, as following:

- **Hoan Kiem** is the city centre that has a high population and a diversity of activities therefore assemble a lot of food waste produce points with many types and scales (cơm bình dân, tourist restaurants, households, markets, v.v...)
- **Dong Da** is an old district of Hanoi that has a high population and the differences of food waste producers (wedding ceremony restaurant, the normal restaurants, and the cơm bình dân...), especially the differences in the living style (individual households and households in the Khu tập thể)
- **Ha Dong** is a new district of Hanoi that now is developing very fast with the new urban neighbourhoods which has been installed by the side of the old villages (agricultural or handicraft), therefore have a diversity of living style that be different from the living style at the districts in the city centre. On the other hand, it's also be an area which assemble many universities and the hospitals which has the public canteens.

For comparison, sometime the study's held in some case in the other districts, but not many.

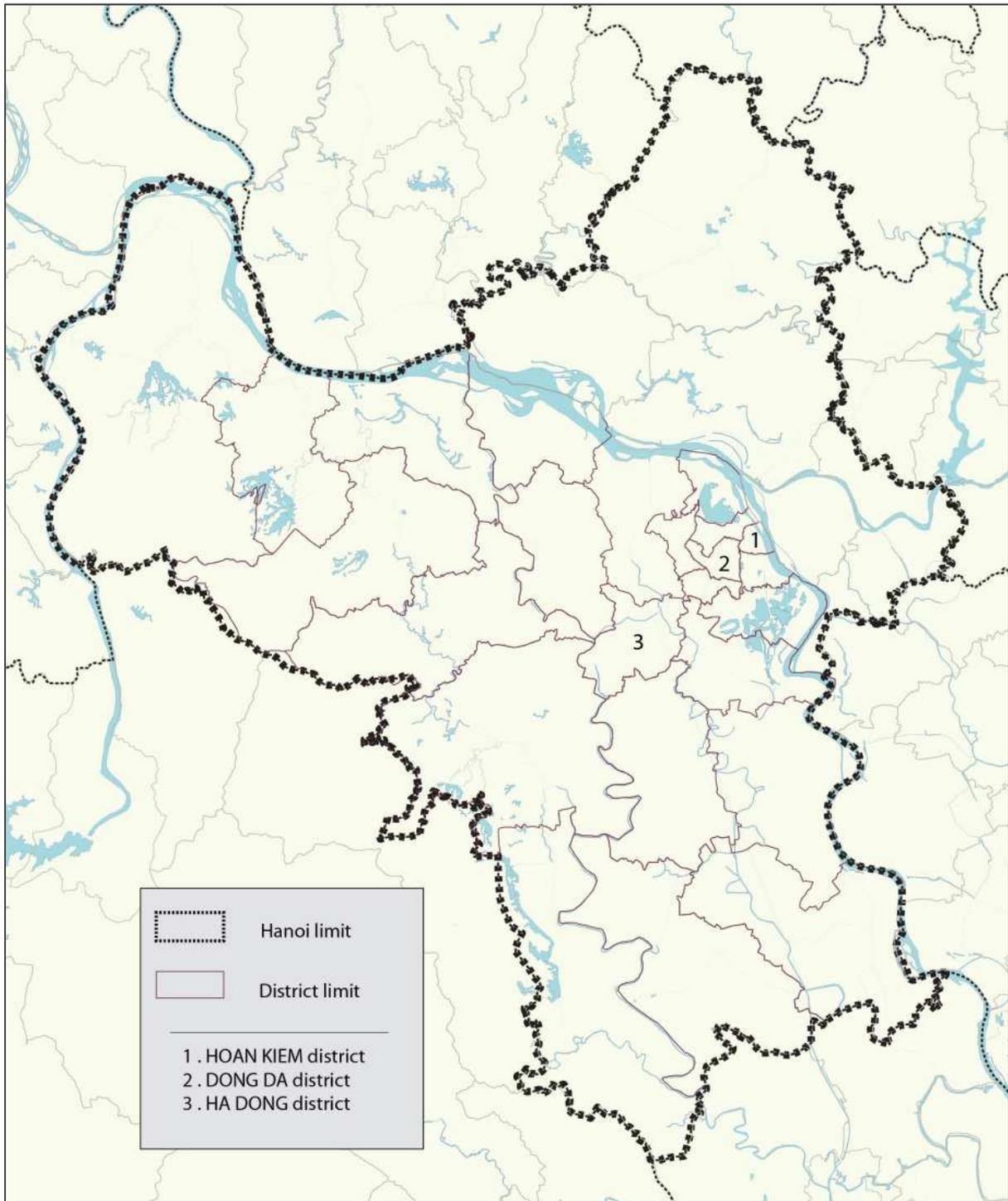


Figure1: Sites of study

Research method

Research carried out mainly conducted by the method of observation, study investigators in the field, combining interviews (interviews quick and in-depth interviews) and synthetic methods.

- **At the terminal food market:** the food waste is driven to the landfill or to the composting station. The part, which has a high organic content, is driven to the composting station. The rest is driven to the landfill. But sometime, because of the late or the breakdown of the small truck, or the control of each company, the waste is all piled in the big crane truck and transported to the landfill. Ex: In Long Biên terminal market: the waste in vegetable part is driven to Cầu Diễn composting station, and the rest is driven to Nam Sơn landfill (code: M1)

In Hoàng Văn Thái market, the waste is all driven to Nam Sơn landfill (code: M4)

- **At the daily food market:** Firstly, the informal collectors collect the useful part of food waste (fish and chicken bones, rest of meat, rest of vegetable...). These useful parts are raw, almost be collected for the fish, and rarely be collected a little for porks or chicken.

After, the formal collectors collect the rest of food waste with the other domestic waste. Although the useful food waste part is collected, but the waste in the daily food market still has a high organic content, therefore the waste here is driven to the composting station. But sometime, because of the late or the breakdown of the small truck, the waste is all piled in the big crane truck and transported to the landfill.

Ex: In Nam Đồng market, the waste is collected separately with the household waste, then driven to Cầu Diễn composting station by a small crane truck. The rest of waste is driven to Nam Sơn landfill by another big truck (code M6)

- **At the restaurant and canteen:** The little raw part is separate and kept after the preliminary-raw-treatment, then be given to the collector/"fish" farmer. Most of food waste in the restaurant and canteen are cooked, that be useful for feeding pork, therefore are collected by the collector/"pork" farmers. Some restaurants have the cooked oil that be collected to the oil collector or food waste/oil collector (the livestock farmer but also collects oil). After the collection the useful parts, the rest of food waste is thrown with the other waste and is collected by the formal collectors.

Ex: In the area around Cầu Gồ market, there are at least 2 collectors, 1 "pork" farmer (code: C2) and 1 "fish" farmer (code: C1)

- **At the household:** Almost food waste of the household is thrown away with the other waste and be collected by the formal collector. There are a few cases which have the households that keep the food waste for the informal collector.

Ex: Khu tập thể Nam Đồng (code: H1), khu tập thể Bộ Công An (collect point P5, code: C13), or the households in the Yên Xá village (code: H2)

- **At the livestock farm:** Almost food waste is for livestock feeding (feeding pork and "black" fish). The bones are separate and dry for selling to the livestock bran producers.

- **For the cooked oil:** is be filtered, be re-sold, then be re-used

2. The connection between the actors in food waste chain in Hanoi

a. Formal system

The work of the formal system bases on the waste treatment rules that controlled by the government.

- The grand waste producers that produce more than 1m³ of waste/day (the markets, the restaurants, the canteens) have to sign a contract with the environment company to negotiate the waste collection. This negotiation depends on the rule about food waste

collection and treatment that said the price waste collection and treatment are reckoned on the weight and the quantity of waste.

- The small waste producers (the households), the environment charge is 6.000vnd/per/month.

b. Informal system

The work of the informal system bases on the private negotiation between the food waste producers and the collectors, there is not a controller of this system. The informations in this system are communicated "from mouth to mouth". This negotiation depends on their relationship, on the quantity and quality of food waste. But there is not a standard price for all the cases, every negotiation are done relatively. It could be: the collectors buy the food waste, or take food waste for free but give feedback (wash production, the clean food from the field of collector). To start these kinds of businesses, once the producers find the collectors, or the collector comes and asks the producers.

3. The manner of collection and transport of the food waste in Hanoi

a. Formal manner

The formal collectors work 2-3 shift/day from around 18h-02h the next day. They collect the domestic waste from waste producers (market, restaurants, and households). The time to collect and transport the waste depends on the frequency of waste emission, and on the convenient traffic in the city (not rush hour, no interdict in some areas, ECT). Ex: The terminal market works in the night from 23h-06h, therefore, time to transport waste is from 8h-9h30'. Meanwhile, the daily food market and the household have waste emission around 11h-13h and 17h-19h30', therefore after that is the convenient time for waste collection.

b. Informal manner

The informal collectors collect food waste 1-3 times/day. This collection depends on the frequency of emission and the quantity of food waste. There is no rule of management.

Ex: Normaly, the collector collects the food waste 1-2 times/day after the meal serviced: one time collect a day for the small restaurant with few food waste, 2 times a day for the big restaurant with the quantities of food waste.

In case, the food waste quantity change suddenly, the collectors have to come for collection immediately. Or in case of the wedding restaurant and event organization hall, the food waste emission bases on the event, therefore, the time to collect food waste follows the changes.

The time to collect and transport the food waste also depends on the convenient traffic in the city (not rush hour, no interdict in some areas, ect). Ex: In the old quarter, the car and motor are interdict at the weekend, therefore, the collections have to change the time before or after the interdict hours.

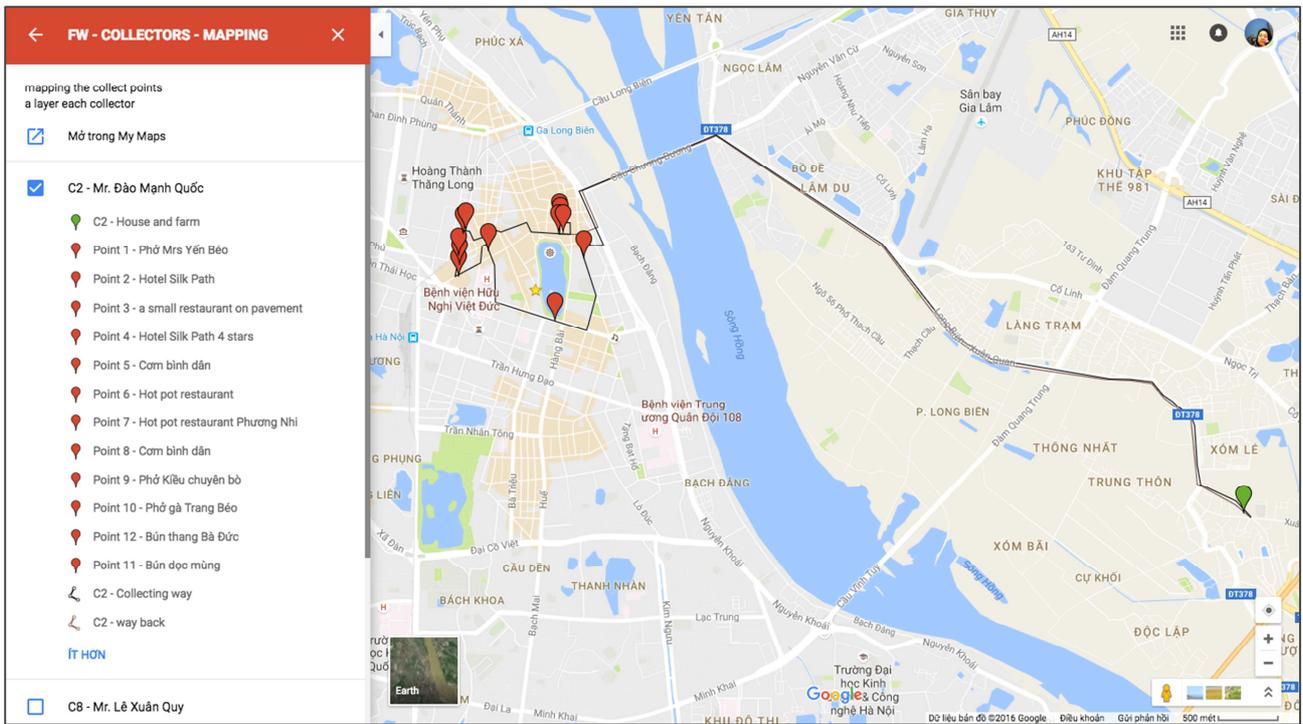


Photo 1: Mapping the food waste gather trip of Mr. Đào Mạnh Quốc (interview code: C2)

For more detail mapping, follow the google map link:

<https://www.google.com/maps/@20.9685935,105.7712347,12z/data=!4m2!6m1!1s1jh4s676QWQsH8NnMA8DYk5QAtrw>

4. The food waste consumption in Hanoi

a. Formal system

- Are buried in the landfill: with the other domestic waste. In Hanoi, the biggest landfill is Nam Son, actually almost domestic waste of Hanoi is buried there.

- Composting: The high organic proportion sources are the food markets. Actually, Hanoi has 02 composting places, are Kiều Kỳ and Cầu Diễn.

b. informal system

- Feeding the livestock:

	Livestock	Food needs	FW collection
1	Pork	Cooked food	Collect the cooked part from the restaurants, canteens and household where the food is almost cooked.
2	“Back” fishes	Raw meat – raw protein	Collect the raw part from the restaurants and the market merchant

3	“White” fishes	Grass and Vegetable	Almost doesn't collect
4	Chicken and duck	Vegetable	Almost doesn't collect

The raw part is collected by the “black fish” farmer. The cooked part is collected by the “pork” farmers. (the reason of food waste choice is explained in files code C1, C2)



Photo : Feeding pork at Mr.Chiến's farm - 28/05/2016, (code: C13)



Photo: Feeding “black” fish by fish bowel at Mr.Tường's farm - 09/06/2016 (code: C1)

- Filte cooked oil to the secondary oil and sell or reuse it: This research has not yet find out exactly what the secondary oil be used. But from some information, they are re-sold to the small and low price restaurants.



Photo: Cooked oil collector on his way – Khuất Duy Tiến str, 23/05/2016 (code: C18)



Photo: Collect and transport food waste and cooked oil – photo by Timothé Cantard

- A component of bran for livestock: grinds the bonnes to dust and blends with the other components to make the bran for the livestock.



Photo: Dry bonnes to sale on the dyke near by Mr. Quốc's farm - 23/05/2016 (interview code: C2)

5. Equipments for FW stock, collection, transportation and consumption

		Formal system	Informal system
1	FW collection	By the mobil-gather barrel with or without lid, the mobil-gather on bicycle, the mobil-gather electric vehicle and the small gather trucks	In the blue barrel or white bucket with lid
2	FW stockage	In the mobil-gather barrel with or without lid	In the blue barrel or white bucket with or without lid
3	FW transport	By the truck of many sizes	By motor, modified motor, "xe ba gác", bicycle, ect
4	FW consumption	Landfill or compost station	Livestock feeding

a. Formal system

- Collection and stockage:

- Mobil-gather barrel with lid: medium volume is 0,3m³ waste. There are 2 type of mobil-gather barrel that in 2 colors, yellow for inorganic waste and green for organic waste. But actually, the waste is mixed in the barrels.
- Mobil-gather barrel without lid: medium volume is 0,5 - 1m³ waste.



Photo : Mobil-gather waste in Vegetable part in Long Biên terminal market – 03/10/2016



Waste gather bicycle - Thái Thịnh str, Đống Đa district - 08/10/2016

Mobil-gather electric vehicle: for collection in the small streets and alleys

Small gather truck: This kind of gather vehicle asks the special crane truck to transfer waste.



*Photo : Small gather truck on Hoàng Tích Trí str,
Đống Đa district – 06/10/2016*

- Transport: typology of crane trucks:

+ Classification by cargo: big crane truck, medium crane truck, small crane truck



*Photo : Crane truck of 3,8 tons – Vegetable part
in Long Biên terminal marke, 03/10/2016*



*Photo : Crane truck of 7,5 tons – Long Biên
terminal market, 03/10/2016*

+ Classification by technic: there are 2 types: the old crane truck that match with transferation with the mobil-gather barrels, and the new crane truck that match with the small gather truck.



Photo : The old type truck that match with the old mobil-gather barrel on Tôn Thất Tùng str, Đống Đa district – 13/05/2016



Photo : The new type truck that match with small gather truck on Hoàng Tích Trí str, Đống Đa district – 06/10/2016

These informations of the waste formal system's equipment are base on the informations of URENCO collectors. URENCO is the biggest company in waste collection and treatment in Hanoi, which has a diversity and amelioration of equipment. The other companies are smaller and slower in equipment amelioration.

b. Informal system



Waste gather modified motor on Vũ Tông Phan str, Thanh Xuân district – 05/10/2016



The different food waste barrels in the truck of Mr. Quốc 23/05/2016 (Code: C2)

- Collection and stockage: By the blue barrel or white bucker with lid in many sizes. The barrels can be bought easily with many sizes, from 30 – 120 litres. The white buckets were the paint bucket in 20 litres, then be re-used.

- Transport:

+ Modified motors: can transfer maximum about 200 litres/trip

+ “xe ba gác” – the modified motors with a small hold behind

+ Bicycle: can transfer maximum 60 litres/trip

+ Truck: is the kind of 700kg truck (there’s only 1 exemple, interview code C2, the collector is transporter in the day, and he use his truck to collect food waste in the night)



Photo : Collect and transport food waste by modified motor – photo by Timothé Cantard



Collect and transport food waste by “xe ba gác” on Nguyễn Trãi str– 12/06/2016



Collect food waste by truck - 09/05/2016 (code: C2)



Photo : Collect and transport food waste by bicycle – photo by Timothé Cantard

- Consumption:

+ Feeding pork: Cook the food waste in the cooking pots that be modified from the iron barrels. Store the cooked food waste in the same blue barrels. Feed the pork by the buckets.



Photo : Feeding pork in Mr. Quốc's farm – 28/05/2016 (Code: C2)

+ Feeding pork: The raw food waste is stocked in the same barrels. Feed the “black” fish the raw food waste directly.

C. The actors in the food waste chain in Hanoi

1. Typology of food waste produce sources

To understand the food waste sources, their quantity, their components, and the food waste treatment by each source.

Food waste produce sources are:

- Market
- Restaurant
- Canteen
- Household
- Others

a. Market

Classification of food market

	Market	Characteristic	Note
1	Terminal food market	<ul style="list-style-type: none"> - Work 1time/day, from 11pm – 8am - FW are: the rotten vegetable, rotten fruit and rotten seafood. - FW treatment: The high organic fraction part is collected and driven to the composting station. The low organic fraction part is collected and driven to the landfill 	Import the food from the other cities, then distribute around Hanoi
2	Daily food market	<ul style="list-style-type: none"> - Work all day, with 2 peak hours: 6-11am, 15-19pm - FW are the leftover of food after preliminary-raw-treatment (leftover of vegetable, fish bowel, rotten fruit, ect...) - FW treatment: Almost is collected and treatment with the household waste 	Is the popular type of market
3	Super market	<ul style="list-style-type: none"> - Work all day - FW are: raw and cooked outdate food 	Haven't yet had information
4	"Frog" market	<ul style="list-style-type: none"> - Work all day, have the portability - FW is the leftover of food after preliminary-raw-treatment - FW treatment: Almost is collected and treatment with the household waste 	

- **FW components:** Almost is the raw and rotten food, the leftover of food after preliminary-raw-treatment. Be mixed with other solid waste (nylon bag, plastic pieces, paper, ECT). The food waste from the daily food markets is the most mixed with the other waste, because the waste from the household beside the market.
- **FW quantity:** The markets produce a quantity of FW, continuous operation. Of these, the largest FW emissions from the terminal food markets. However the number of daily food markets is much greater, the total volume is very large.
- **FW treatment:** Firstly, the usefull parts of food waste are collected by the informal collectors. Ex: fish and chiecken bowel, leftover of vegetable. The rest is collected by the formal collectors (URENCO, HTX Thành Công, workers of market...). The waste in the food markets has a high organic content; therefore the waste here is driven to the composting station.
- **FW treatment:** The markets don't have the especial funds for FW treatment. But they have a budget for cleaning. This budget's saved from the businesses in the market. This outlay depends on the FW quantity issued.

b. Restaurant

Classification of restaurant

Restaurant	Characteristic
1 Wedding ceremony restaurant or event organization hall <i>100-500 guests</i>	-The general quantity of FW depends on the event organized (ex: wedding season around September-November) - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) - FW collection: collect 1-2times/day, immediately after the events end (after the noon or night parties)
2 The big restaurant or event organization hall <i>100 - 200 guests</i>	-The general quantity of FW depends on the event organized - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) - FW collection: collect 1-3times/day: 6h-9h, 13h-15h, 22h-24h
3 The medium restaurant <i>50 -100 guests</i>	- FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) - FW collection: collect 1-3times/day: 6h-9h, 13h-15h, 22h-24h
4 The small restaurant <i>20 - 50 guests</i>	- FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) - FW collection: collect 1-3times/day: 6h-9h, 13h-15h, 22h-24h
5 The small kiosk <i>10 - 20 guests</i>	- FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is thrown away with the other waste or sold to an informal collector (“pork” farmer)

- **FW components:** Almost are the cooked food that are the leftover from the meals serviced, and a small part that is raw. Sometimes mingle the other waste like: nylon bag, plastic pieces,ect...
- **FW quantity:** The wedding ceremonies and the event organization hall, produce a big amount of food waste per event, but have intermittent operation which

depends on the calendar of events (usually seasonal, for example: the wedding season from September to November). Therefore, the average annual amount of production FW is so not too big. The medium restaurants work relatively constant and the amount of production FW is relatively steady. FW average volume in a great year is big. It is also a popular type of restaurant, so the total food waste volume is huge. The small restaurants and kiosks have a continuous operation, and average annual production is quite large. Although the volume of each FW produced volume of each one types is not very much, but this very common type, so the total volume of food waste of this types is huge.

- **FW treatment:** Almost sell the food waste to the collectors/farmers, with the prices are negotiate between the restaurant and the collector. Or give FW free but receive feedback (wash production, the clean food from the field of collector). Before the collection, FW is almost stored in the barrels covered by the lid. Rare restaurants do tri the FW. In addition, the luxury restaurants which have a rule of hygiene, not allowed to store the food waste in the restaurant, therefore, food waste is thrown away fastly with the other waste.
- **FW treatment outlay:** Almost the restaurants don't have to spend specialized money for food waste treatment, because the food waste is sold. On the other hand, the restaurants have to spend money for cost of hygiene, to the domestic waste collection and treatment. The cost's changement depends on the volume of waste emission and the regulation of government.

c. Canteen

This study has not yet done any long interview in the canteens. But, as observation and the semi-interviews, we could classify and indicate the basic characteristics of canteens and their food waste treatment.

There are 3 types of canteen: Canteen in the work place, canteen in the hospital and the canteen in the school.

Classification of canteen

	Canteen	Characteristic	Note
A	Canteen in the work place		
1	Canteen in the offices	<ul style="list-style-type: none"> - Serve the lunch for the officers - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) 	The offices and the factories work by the asminstratif hour and the shift.
2	Canteen in the factory	<ul style="list-style-type: none"> - Serve the lunch for the officers and the workers: Lunch for the officers. Lunch and dinner for the worker. - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) - FW collection: collect 1-2 times/day: 13h-15h, or 17h-20h 	
B	Canteen in the hospital		
1	Canteen for the patient and their families	<ul style="list-style-type: none"> - Normaly, is a canteen in common. Serve the lunch. 	Service breakfast and lunch
2	Canteen for the doctor and the officer	<ul style="list-style-type: none"> - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) 	
C	Canteen in the school		
1	Canteen for the pupil	<ul style="list-style-type: none"> - Normaly, is a canteen in common (except, in the kindergarten and primary school where the meals are served in the classroom space). Serve the lunch. 	The schools that have the canteen mainly are the kindergartens, the elementary schools and colleges.
2	Canteen for the teacher and officer	<ul style="list-style-type: none"> - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is sold to an informal collector (“pork” farmer) 	The secondary and the hight schools have the canteen just for the desserts, don’t serce the meals.

- **FW components:** Almost are the cooked parts– the leftover of the meals (rice, noodle, bread, ect). A few is the raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect).
- **FW quantity:** The canteens produce a big volume of food waste, sản xuất một khối lượng FW lớn, continuous operation (except in the school’s canteen because the impact of the summer holidays). The canteens of the factories are the largest volume food waste production (due to production workers serving in shifts, 2 meals / day. Ex: case of Mr. Chiến, code: C13)
- **FW treatment:** Almost sell the food waste to the collectors/farmers, with the prices are negotiate between the restaurant and the collector. Or give FW free but receive feedback (wash production, the clean food from the field of collector). Before the collection, FW is almost stored in the barrels covered by the lid.
- **FW treatment outlay:** Almost the restaurants don’t have to spend specialized money for food waste treatment, because the food waste is sold. On the other hand, the restaurants have to spend money for cost of hygiene, to the domestic waste collection and treatment. The cost’s changement depends on the volume of waste emission and the regulation of government.

d. Household

Classification of household

	Household	Characteristic	Note
A	Typology		
1	The tube houses	-Living combines merchant - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is thrown away with the other domestic waste	
2	Khu tập thể (the collective buiding)	- The appartements in height for living. The downstairs appartements for living combines merchant, include food merchant. - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is kept in a barrel in common for the farmer-collectors, or is thrown away with the other domestic waste	Before the <i>Đổi mới</i> , 1986, the households in <i>khu tập thể</i> did feeded the livestock long time ago
3	High building	- The appartements in height for living. - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect)- - FW is thrown away with the other domestic waste	

B	Location		
1	In the central area (in the limit of peripheral 1)	<ul style="list-style-type: none"> - Living combines merchant, include food merchant - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is thrown away with the other domestic waste, or thrown into the barrel of the collector which is left at the restaurants near by the houses. 	
2	Urbanization areas (between the limits of peripheral 1 and 2)	<ul style="list-style-type: none"> - Living combines merchant, include food merchant - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is thrown away with the other domestic waste, or thrown into the barrel of the collector which is left at the restaurants near by the houses. 	
3	The new developed area and peripheral urban areas (between the limits of peripheral 2 and 3,5)	<ul style="list-style-type: none"> - Living combines merchant, include food merchant - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is thrown away with the other domestic waste, or thrown into the barrel of the collector which is left at the restaurants near by the houses. 	
4	Rural areas	<ul style="list-style-type: none"> - Living combines farm - FW are: The raw part - the leftover of food after preliminary-raw-treatment (the rest of vegetable, fish, ect). And the cooked part – the leftover of the meals (rice, noodle, bread, ect) - FW is for feeding 	

- **FW quantity:** Normally, a household has a small food waste emission. But the number of the household is very big, therefore the total volume of food waste emission is very huge.
- **FW treatment:** Almost FW is thrown away with the other domestic waste. A few food waste is kept in a barrel in common for the farmer-collectors. A lot of households have the mind of save the food waste, but don't have the convenient situation to do that.

There are the households who had the habit of save the food waste and today still have the convenient position to do that, they still save the food waste for the farmer-collectors
 Ex: the households in the *khū tập thể*. Especially, the households in the peripheral areas or the rural areas, because there are still the space for livestock farming and the living isn't totally separate from the agricultural production.

e. Other FW produce sources

- **Bakeries** : the private food produce companies. Ex: Thu Hương bakery, Nguyễn Sơn bakery, Bánh mì master chef, Saint Honore,ect : This study hasn't yet done any long interview or research with this type of producer. But, as in the semi-interviews, the servers inform that: the food waste (the outdate food) is collected and driven to the produce workshops, but don't know what's next.

- **The great food producers:** Beer factory, candy factory, ect. This type of food waste producers is not in the notion of food waste that informed at the beginning of the report (is not a component of household waste), but still are a grand source of organic waste, that's still usefull. Ex: In Thái Bình town, a beer factory uses the beer residue for feeding porks.

2. Food waste collector and transporter

a. The formal collect-transporter

The formal collect-transporter street collectors are the workers of the environment companies of government or private: URENCO, *HTX Thành Công* – Cooperative Thành Công, *Công ty cổ phần Xanh* – Join-stock Xanh, Thăng Long, Sông Hồng, Tây Đô, Sinh Thái, collecting worker of market, ect. The work scopes are separate by the administrative limits, in the scal of district or ward. The separations are dicided by the contracts that be signed between the People committee of Hanoi and the companies after the biddings. Exemple1: 4 districts Hoàn Kiếm, Ba Đình, Đống Đa, Hai Bà Trưng are the work areas of URENCO. Exemple 2: In district Thanh Xuân, at least there are 2 compagnies work here: *HTX Thành Công* – Cooperative Thành Công and “*Công ty cổ phần Xanh*” – join-stock Xanh (for the detail follow the information in the interview code M6, M4)

In general, companies have a similar decentralization in management, of which related to garbage collection and transportation as follows:

- **Formal collector:** 10-15peoples/group. Work in shift, 03 shifts/day. Normally, a group collects waste in a ward.
- **Formal transporter:** They are the trucks with many sizes, are controlled by a steering committee. With each waste station, transfer the food waste 2-3times/day. Collects the domestic waste, include food waste.

In the study, there isn't any case that a formal collector is also a farmer-collector.

b. Informal collect-transporter

The informal food waste collectors are:

- Livestock farmer
- Oil collector
- Transporter

1. Livestock farmer

Livestock farmers are the owner of the small-scale farmings which have a the free operations. The FW volume collected depends on the produce size (the number of livestock).

In general, there are 4 types of livestock farmer: pork, fish and chicken or duck.

	Livestock	Food needs	FW collection
1	Pork	Cooked food and bran	Collect the cooked part from the restaurants, canteens and household where the food is almost cooked.
2	“Back” fishes	Raw meat – raw protein and bran	Collect the raw part from the restaurants and the market merchant
3	“White” fishes	Grass, vegetable and bran	Almost doesn't collect food waste
4	Chicken and duck	Vegetable and bran	Almost doesn't collect food waste

These livestock farmers collect 3 different types of FW. The different of collections base on the needs of livestock's food. Trong đó có loại chăn nuôi "white fish" and chicken don't collect FW, because can buy the low price bran or find enough food for livestock in their fields
These livestock farms are at the peripheral urban city of Hanoi, Nhưng livestock farm này chủ yếu ở các vùng ngoại thành Hanoi, even the farms in the other cities (Ex: the collector in Hưng Yên province, 20k from Hanoi – code: C3)

c. Oil collector

There are 2 types of oil collectors: specialize in oil collection, or be livestock farmer collector and collect oil just for some more money.

But both of 2 types collect cooked oil to sell to the people who filter the oil for re-using.

d. Transporter

In this study, there is not any food waste transporter

3. Food waste consumer

a. Formal consumer

They are the environment companies:

+ Agence of government: URENCO

+ Agence private companies or joint-stock: *HTX Thành Công* – cooperative Thành Công, *Cổ phần Xanh* – join-stock Green, Sông Hồng, Tây Đô, Thăng Long, Sinh Thái, ect...

Their works follow the control of government in waste collection and treatment. Actually, the waste treatment technics are burying in the landfill, composting and burning.

b. Informal consumer

- **Livestock farmers:** Feeding the livestock (pork and fish)

- **Oil filter produce:** The study hasn't yet found out exactly how the secondary oil is used, but likely to be sold to the small and low price restaurants.

- **The retail bran producers:** The study hasn't yet found out exactly how the livestock bran be made from the bones dust, but through the explaining of some livestock-collectors, the bones are be dried, be grinded to dust then be mixed with other bran components.

D. Conclusion

The food waste chain: There are formal system and informal system who collect and treat the food waste. There is not any real considerable “relationship” in food waste collection and treatment between 2 systems. But the works of these 2 systems are quite fluent, and help each other anyway.

The informal system: They are the the retail livestock farmers who live at the peripheral and rural areas of Hanoi. There isn't any “boss” of controler who control the informal system. The informations in the informal system are informed “from mouth to mouth”. The collectors and the producers do the negotiations by themselves.

To be dependent on them, a huge volume of food waste is collected and consumed. These collection and consumption do not only make use of food (like a habit of vietnamese), but also decrease the waste emission – that's now be the burden on the overloaded waste treatment formal system.

The food waste is also a cheaper and good quality food for the livestock, that help the retail farmer in saving the money. But on the other hand, because of the diversity of the food waste source, the quality of livestock food is not guaranteed.

The future of food waste collection and treatment in Hanoi: The food waste collection and consumption are very important in the work of the detail farmings which is a important role in the subtainable development of the city . With the speedy urbanization, the rural spaces in Hanoi are decreased fastly, additonaly the agricultural activities in generally, and the livestock farms in detaily are not be organized in a reasonable way. Therefore, need the researchs to help the organization of control them well.

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Annex

Annex 1: Livestock feeding needs

Feeding needs of fish	
“Black fish”	-need much protein
<i>non scales fish</i>	- stronger, can live in the small, “dirty” ponds
“White fish”	- eat tiny shirmp, vegetable
<i>Scales fish</i>	- just live in the large clear ponds
Feeding needs of pork	
Industrial breeding	To breed a pig from 10 to 20-22kg: bran special type (cám sữa)
<i>Use the commercial product</i>	To breed a pig from 20kg to 20-40kg: bran type 1
<i>(industrial bran)</i>	To breed a pig from 40kg to 70kg: bran type 2
	To breed a pig from 70kg to 150kg: bran type 3
Traditional breeding	To breed a pig from 10 to 30kg: bran special type (cám sữa)
<i>Use the fw and a little commercial product</i>	To breed a pig from 30 to 150kg: food from fw+ the rest of vegetable
<i>(industrial bran)</i>	

Annex 2: Google mapping link

<https://www.google.com/maps/@20.9685935,105.7712347,12z/data=!4m2!6m1!1s1jh4s676QWQsH8NnMA8DYk5QAtrw>