

**Disparities on Waste Sorting in Shanghai and  
Potential Amendments to the Waste Sorting Guidelines**

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## **Abstract**

Urban fringe areas in Shanghai faces more challenges on waste management comparing to downtown areas because it has higher population density of migrant workers and severer issue on underprovided infrastructure. The establishment of the Waste Sorting Guidelines, the first binding legislation on waste sorting in China, on July 1<sup>st</sup>, 2019 could potentially worsen such challenges since the legislation makes it more difficult for people to dump domestic waste and produces an unprecedented amount of wet waste. This paper investigated how the disparities on waste sorting between downtown and urban fringe areas in Shanghai were affected by the Waste Sorting Guidelines. Through field observations and interviews with government officials and employees in two towns in downtown areas and two in urban fringe areas, the paper found that urban fringe areas did fall short on the sanitation conditions of new waste dumping spots and quality of new supplementary facilities designated by the Waste Sorting Guidelines. Apart from the disparities, common government efforts on making the legislation more humanized were also present in all researched towns. As for how much wet waste could be processed, however, the paper was not able to produce a comprehensive result since interview with government officials and employees yielded contradictory results. Based on these results, the paper gave suggestions on how lower government branches in urban fringe areas could improve their implementation of the Waste Sorting Guidelines through redistributing management efforts and combining power and resources. Given the early enactment of the Waste Sorting Guidelines in Shanghai, these results and suggestions could inspire the design of similar policies across China in the future.

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## **Introduction**

After more than 20 years of education and non-binding suggestions on waste sorting, on July 1, 2019, the first binding legislation on waste sorting in China was established. It designates four waste categories: dry, wet, recyclable, and hazardous, and set up prescriptive regulations that are clearer and stricter than most of the existing waste sorting legislation in China. (Kuo, 2019) There are, however, clues already indicating that this legislation may produce undesirable side effects, particularly in the urban fringe areas of Shanghai. The reason is urban fringe areas in Shanghai face more challenges on waste sorting than other areas of Shanghai. Such disparity is caused primarily by the overdependence on low-end businesses and under-provided infrastructure in these areas, which lead to more frequent littering and a weaker ability to deal with waste. In the meantime, the Waste Sorting Guidelines replaces existing trash cans with new ones that meet the new regulation and alters the old waste processing procedure. Unfortunately, these measures are causing negative side effects to the sanitary condition of the city, and it is reasonable to deduce that such side effect will have heavier impact on urban fringe areas than other areas in Shanghai based on the existing challenges these areas are facing. This paper will answer the question of how the Waste Sorting Guidelines affected downtown and urban fringe areas differently in terms of residents' waste disposal and waste processing. To answer this, it will first study the issue of waste sorting disparities in urban fringe areas of Shanghai, then investigate the different impact of Waste Sorting Guidelines between the urban fringe areas and other areas, and finally give suggestions for further implementation of the policy.

## **Background**

**Broad context: Why Shanghai's urban fringe areas face more challenges with waste disposal**

The term “urban fringe areas” is defined as the areas that mostly consist of agricultural lands but are under urban influence, usually characterized by sporadically distributed small commercial complexes.

There are two major reasons Shanghai’s urban fringe areas face more challenges to garbage recycling than the urban center and rural areas. The first one is the sheer number of low income migrant population living in urban fringe areas, and the second one is the underprovided infrastructure in these areas.

For the first reason, according to a 2015 census carried out by Shanghai Municipal Statistics Bureau, six districts of Shanghai consisting largely of urban fringe areas have the highest percentage of migrant workers. (Zhu, 2011) (360doc, 2018) (Figure 1) The reason for the concentration of low-income migrant workers in urban fringe areas is the relocation of labor-intensive industries. (Zhou 2015) As downtown areas in Shanghai experienced the earliest urbanization process, the land and labor price in downtown areas also increased, pushing industries with high demand on land and labor, such as manufacturing, away to urban fringe areas. The job opportunities of these industries and the cheaper land attract low-income populations. (Zhou, 2015) Many of these low-income groups come from other less developed provinces in China since they are attracted by a relatively higher wage level in Shanghai. (Lin, 2016) As a result, the low income migrant population becomes a large proportion of workers and residents in the urban fringe areas of Shanghai. The issue is that the low income level inevitably leads to waste production that is harder to regulate because of the persistent high demand on cheap privately constructed housing and low-end businesses, such as small restaurants and salons. For housing, 68% of migrant population in Huaxin Town (located in district 2, Qingpu District in Figure 1), a typical urban fringe town in Shanghai, are living in privately constructed housing units. (Zou, 2010) Because of the low amount of rent from the low income tenants, the providers of these units usually cut their



population density and low city-hukou ownership rate. Nevertheless, the mismatch occurs in urban fringe areas with high population density and low city-hukou ownership ratio, where the sheer percentage of migrant population in these areas are not considered when infrastructure projects are designed. For example, Huaxin Town, in 2014, its town-level disposing center can dispose about 120 tons of garbage daily. (Li, 2014) However, assuming one person can produce 1 kg of domestic waste daily, the approximate 200,000 population in Huaxin Town will produce 200 tons of garbage per day. Consequently, lots of domestic garbage are disposed unregulated, forming scattered waste-piling fields and making waste management more difficult.

### **Political Background: Potential problems of the Waste Sorting Guidelines**

Formally implemented on July 1, 2019, the Shanghai Waste Sorting Guidelines is a set of city-level government regulations designed to sort garbage into dry waste, wet waste, recyclable waste, and hazardous waste in order to improve the efficiency of garbage disposal. (Bendibao, 2019) Under this Guidelines, any garbage recycling site that does not fit the regulations (designated garbage types, e.g.) in the Guidelines will be rebuilt, and most of the scattered garbage cans originally placed in communities will be withdrawn. Moreover, many communities are setting up a fixed time for garbage dumping as required by the Guidelines, meaning that the available periods for residents to dump their household garbage is sharply shortened. The number of measures in this Guidelines are more than any laws or regulations of the same type in China, so are they implemented more strictly. (Jiang, 2019) Potentially, however, this policy may generate two major problems.

One is that these measures, especially the two mentioned above, make it more difficult for individual households and small businesses to dump their waste: they will have less cans and time to dump garbage. Although there are announcements from the Shanghai Municipal People's Congress that in areas with lower household density, the time slots for



garbage dumping can be prolonged or cancelled (Yu, 2019), there is little literature that mentions how such practices will cover urban fringe areas.

The other issue is related to the unprecedented amount of wet waste. As a category within the Guidelines, 97.9% of this type of waste is composed of kitchen waste. (Xi, 2020) Due to the government's insufficient estimation of the amount of wet waste, the garbage disposal plants (both incineration and land fill) cannot handle all the wet waste produced. Therefore, the city incorporated on-site disposal, which means some of the wet waste produced will be land filled near where it is produced. The problem is that in urban fringe areas where the sanitation level is undermined partially because of undisposed domestic waste, whether this method will exacerbate or mollify the circumstance is unknown. Given that there are four new garbage disposal plants under construction that are estimated to be completed by the end of 2020, the varieties lie within how easy it is for urban fringe areas to access these plants, both operational and under construction.

## **Literature Review**

In this section, I will give a deeper look at the literature regarding the Waste Sorting Guidelines and urban fringe areas of Shanghai. To understand the potential impact of the regulation on Shanghai's urban fringe areas, studies elaborating Shanghai's urban fringe areas are essential to understand the characteristics they have that makes them vulnerable to the regulation. It is also necessary to look at studies evaluating how the regulation is implemented and suggesting how it should be developed.

### **Urban Fringe Areas in Shanghai: Where and What's Wrong**

Around 2010, articles discussing Shanghai's urbanization started to focus on the city's urban fringe areas mainly because the rapid increase of migrant workers deciding to live in Shanghai at that time. As of the definition of urban fringe areas, multiple articles resonate on

the point to define urban fringe areas from land use and relative geological location approaches. Juan, Wu and Xiaoyuan, Zou all define urban fringe areas as the areas mixed with urbanized lands and rural lands that are usually located next to the outer edge of continuous urbanized lands. (Wu, 2013) (Zou, 2010) What is missing in the literature, however, is a clear map of Shanghai that can clearly indicate where these areas are. A potential way to compensate for this shortage of information is to use the case study in Zou's article as a template to identify urban fringe areas (Zou, 2010). Zou uses Huaxin Town as an example of urban fringe areas and suggests that Huaxin Town attracts many migrant workers because of easier commutes to factories and lower housing prices and thus the town starts urbanization; but the town also maintains its rural features because city infrastructures have not yet followed population growth. Nonetheless, with this case, how broad the definition can be applied is still unknown.

Several articles contain census and explanations of where migrant workers live, which eventually lead to the answer- urban fringe areas. Therefore, one important indicator of urban fringe areas is identified: the population density of migrant workers. To identify urban fringe areas, we can now follow this clue and rely on a census and an article, both sharing the finding that Pudong, Minhang, Songjiang, and Qinqu District (district is the administrative region below city in China) are found to be mostly populated by migrant workers. (Zhu, 2011) (360doc, 2018) Besides backing up the definition of urban fringe areas, Zhu's article also points out a problem in these areas: poor living conditions. The author attributes this partially to the city government's failure to provide sufficient infrastructure. This point is made more explicitly in Jinwen Li's article and Xiaoyuan Zou's article, where they both suggest that the government's provision of public services is based on the number of hukou households in an area. Since migrant workers don't have their hukou in Shanghai, the city government failed to provide sufficient infrastructure based on the actual population. Then,

the underprovided garbage disposal services, such as the maintenance of disposal sites, hinder the sanitation conditions of urban fringe areas. In addition, Zhu, Zou and Li also tend to be in line with each other on another issue of Shanghai's urban fringe areas: high demand on low-end businesses in these areas. (Zhu, 2011) (Zou, 2010) (Li, 2014) While Li and Zhu only offer a slight touch on the point, Zou explains it in depth: it is the low income level of migrant workers that produces a persisting high demand on low-end businesses such as small restaurants and salons. Many of these businesses are running without proper licenses, which leaves their negative externalities, like disposal of kitchen waste, unregulated.

In short, the literature revealed that the underprovided waste-related infrastructure and kitchen waste disposal of highly demanded low-end businesses are two problems in urban fringe areas of Shanghai. The next section discusses how these two problems are reflected in the critiques of other literatures on the Waste Sorting Guidelines, and what suggestions has been proposed to tackle these problems respectively.

### **Issue of the Waste Sorting Guidelines: Underprovided Infrastructure**

The first area of critique, which is that the Waste Sorting Guidelines will further reduce the waste-related infrastructures that are already underprovided, is reflected mainly in news articles, both written by pro-government media in China and foreign media that are rather neutral to the Chinese government. These articles point out consistently that such reduction makes personal garbage disposal less convenient. In detail, a 2019 news article published on *The Guardian* indicated that since the time available for garbage disposal is shortened and available disposal sites are reduced by the Waste Sorting Guidelines, there are severe complaints from residents in Shanghai on such inconvenience. (Kuo, 2019) Another news article published on *Shanghai Morning Post*, a pro-government media, is more general in the same vein but points out that some complaints are coming from volunteers that are supervising the waste sorting process because of their heavy workload, which is caused by

the surge of people looking for garbage disposal during the shortened time period available. (Yu, 2019)

Although few academic articles mention this point directly, Li and Yang indirectly reveals that low-income residents in Shanghai are more reluctant to put their individual effort into cooperating with the Waste Sorting Guidelines. (Li and Yang, 2020) Since a high population of low income residents is a characteristic of urban fringe areas, as discussed in the last section, this article helps to narrow the critique of personal waste disposal inconvenience down to urban fringe areas of Shanghai.

Suggestions on addressing this issue focus on government effort to encourage incentive based self-supervision on waste disposal in order to make better use of the new waste disposal facilities. One article written by Lu and Roman approaches self-supervision through a community scope. In detail, the authors suggest that the town governments should introduce programs that train volunteers based on the unique condition of each town, instead of letting the city government assign universal missions to all volunteers in Shanghai to help supervise waste sorting. (Lu and Sidortsov, 2019) As examples in this article indicate, efficient waste sorting volunteering in urban towns should focus on educational community meetings and the use of peer-pressure effects; while in rural areas, volunteering should focus more on establishing more lucid signs and consider landfilling some of the organic waste in agricultural lands nearby. Although this article does not mention urban fringe areas directly, changing the volunteering style is a possible method to address the complaints from volunteers on heavy workload mentioned in the Shanghai Morning Post article.

Another article approaches the incentive based self-supervision mechanism through an individual scope. It proposes to expand the current “Green Account” system, which gives users points based on the number of times he/she sorts waste correctly. Users may redeem the points for gifts. The author suggests that a credit system can be added to the current “Green

Account” system, which can make the correct or incorrect sorting behaviors cumulative. For example, if one does not sort his/her wastes five times in a row, the value of gifts he/she can get through points in a given time will be limited. (Chen, 2019) This article also finds that a successful improvement of the “Green Account” needs an efficient volunteering system, which might require the methods mentioned in Lu and Roman’s literature above.

What is missing in these suggestions, however, are ways to physically improve the condition of waste processing facilities.

### **Issues of the Waste Sorting Guidelines: Inadequately Processed Wet Waste**

The second area of critique of the Waste Sorting Guidelines is a high amount of wet waste that surpassed the estimation of the city government. This critique is relevant to the issue of high amount of kitchen waste disposal from highly demanded low-end businesses because an article by Hui Xi shows that 97.9% of this type of waste is composed of kitchen waste. (Xi, 2020) And according to Zou’s article, restaurants are a major type of low-end business in urban fringe areas. (Zou, 2010) Xi’s article lays out its critique on the high amount of wet waste, suggesting that some domestic kitchen wastes have to be piled near where they are produced because the amount of wet waste was underestimated by the city government when designing the regulation. (Xi, 2020) Moreover, the author further explains that waste processing plants, both landfill and incineration, cannot handle all the wet waste produced.

Besides the wet waste issue, Xi’s article also provides a brief overview of the construction plan of more processing plants city-wide. The construction plan is specified in another article written by Jiang, who lists the location of these processing plants. (Jiang, 2019) Jiang’s article also criticizes that wet waste in Shanghai is not processed properly, but he attributes this issue to the poor management of waste processing plants. Specifically, he states that wet waste processing plants, especially landfill plants designed for compost, does

not have a universal standard at city-level to standardize their techniques and products. This results in difficulties for government supervision and low market participation.

A third article published in *Environmental Science and Pollution Research* agrees with the critique of capacity, stating that the current capacity of kitchen waste treatment is inadequate. (Xiao, Dong, Geng, Medel-Jimenez, Pan, and Wu, 2020) Furthermore, this article suggests that such underestimation also appears on recyclable waste, another waste type designated by the Waste Sorting Guidelines.

Only one articles focuses on solving the problem of insufficient capacity of processing plants. This literature suggests the optimal position of waste recycling centers and transfer stations, which also develops the construction plan mentioned above in Xi's article. (Lyu, Dong, Geng, and Li, 2020) Specifically, this article maps the predictions of the amount of recyclable waste produced by towns. The finding is that the towns that will be characterized as urban fringe areas using the definition in the first section also have the highest predicted amount of recyclable waste. As a result, the recycling centers with the biggest capacity are also suggested by the article to be built in these regions. Given that this article includes organic waste as a type of recyclable waste, the suggestion serves finely for solving the plant insufficiency problem.

### **Literature Review Conclusion**

To sum up, there is consensus in the literature on defining urban fringe area as areas mixed with urbanized lands and rural lands that are usually located next to the outer edge of continuous urbanized lands. Research analyzing the problems of Shanghai's urban fringe areas has two major focuses: government's failure to provide enough public services and negative externalities of low-end businesses. As for how the Waste Sorting Guidelines is implemented, the literature is relatively reserved perhaps because the regulation's designed purpose needed more time to emerge. Instead, they provide clear critiques on two major

points: inconvenience for individuals to dispose waste and low capacity of existing wet waste disposal system. Suggestions to improve the guidelines are limited in number and do not merge with each other much, but they do point out various directions to address the critiques mentioned above, including optimizing the location of waste-related facilities and establishing more efficient volunteering patterns.

Nonetheless, a major gap among the literature is a clear link between urban fringe areas and the Waste Sorting Guidelines. It can be deduced that urban fringe areas are vulnerable to the downsides of the regulation, but few studies explicitly mention how does the implementation of the regulation look like in Shanghai's urban fringe areas. Some do not distinguish different types of areas when describing how the regulation is carried out, and the ones that do classify areas roughly as urban and rural, neglect the uniqueness of the areas in-between. Relatively minor weaknesses of these literatures include the lack of a mapped definition of urban fringe areas in Shanghai and limited, unmatched suggestions for the regulation.

## **Methods**

To answer the question of how the Waste Sorting Guidelines affected downtown and urban fringe areas differently in terms of residents' waste disposal and waste processing, this research compared the two areas on their performance of implementing this policy. Specifically, the research assessed the condition of garbage cans for the waste disposal perspective and the processing methods for the waste processing perspective.

### **Geological regions of research**

The research focused on towns (zhen) in Shanghai, which were a type of administrative regions in China (administrative hierarchies in China roughly follows province-city-district-town-residential committees). This level of research is chosen because

a town is small enough to carry out in-depth research, and big enough for the result to be representative.

The research had chosen four towns, with two from urban fringe districts and two from downtown districts. The choice was based on the definition mentioned in the background section. All areas of research were applied to the research in these towns, and the results of them were compared to generate conclusions.

### **Research Questions**

1. What is the condition of garbage cans? The criteria include sanitation, distribution, and whether they are modified to fit the new guidelines.
2. Are there problems of exposed garbage piling sites of these areas, as well as the lack of formal landfill plants? If so, how are the new garbage cans and/or recycling sites tackling these problems.

### **Methods for the first area of research**

For sanitary condition and the models (new or old) of the cans, the research method was field research. Firstly, field research of the garbage cans' sanitary condition included direct visual observation. Specifically, whether the cans lacked regular cleaning, emptying, and fixing were checked. The purpose was to find out if the garbage cans received proper maintenance. Secondly, the models of the cans were observed. The purpose of observing whether the garbage cans were modified was to generate a rough impression about the implementation of the new Guidelines. It was combined with interviews shown below to make the results more accurate. Overall, by studying the status of garbage cans, the research found out, in different districts of Shanghai, whether the city government had spent enough effort to ensure a thorough and well-considered implementation of the Waste Sorting Guidelines. To make the criteria clearer, if many garbage bins are not modified to fit the Guidelines, it meant the Guidelines is not implemented thoroughly; if many garbage bins are



broken or dirty, it meant the implementation is ill-considered because it left behind environmental problems. Learning about models of the cans could serve as the basis of the entire research since to study the impact of the Waste Sorting Guidelines, the research needs to first check how it is implemented. Sanitary conditions of the cans, on the other hand, could help the research assess the potential side effect of the Waste Sorting Guidelines.

For studying distribution, the method was primarily interview with the local governments, in this case, the town level government. The purpose of studying the distribution of garbage bins was to reveal how convenient it is for residents to dispose their waste. Interview questions included:

1. What is the number of public trash cans provided?
2. What is the ratio when the number is divided by the number of households?
3. How is the number and distribution pattern of trash cans designed?
4. To what percentage are the public trash cans modified to meet the requirement of the new guidelines?
5. Are households, companies and factories provided new garbage cans so that they can sort their waste more easily?

### **Methods for the second area of research**

For the distribution of both landfill plants and exposed garbage piling sites, this research focused on interviews. The interviews with the local government were qualitative and quantitative, and focused on the current number, distribution, and construction plan of waste processing plants (landfill and incineration). Contents from the interviews also included the number and frequency and garbage truck services, and how much of the waste, especially under-estimated wet waste, could be covered by such services. The purpose of the interviews was to find out if exposed garbage piling sites, a problem identified in the background section, were being replaced by cleaner waste processing plants under the

situation where the amount of wet waste was underestimated.

Interview questions within this area included:

1. What are the current number, distribution, and construction plan of waste landfill plants?
2. How is the garbage truck services designed?
3. What percentage of wet waste were covered by garbage transportation services?

## Findings and Analysis

To answer the question of how the Waste Sorting Guidelines affected downtown and urban fringe areas differently in terms of residents' waste disposal and waste processing, the research was composed of field observations on waste-related facilities and interviews with local government officials and employees. The findings are demonstrated below:

### I. Summary of samples:

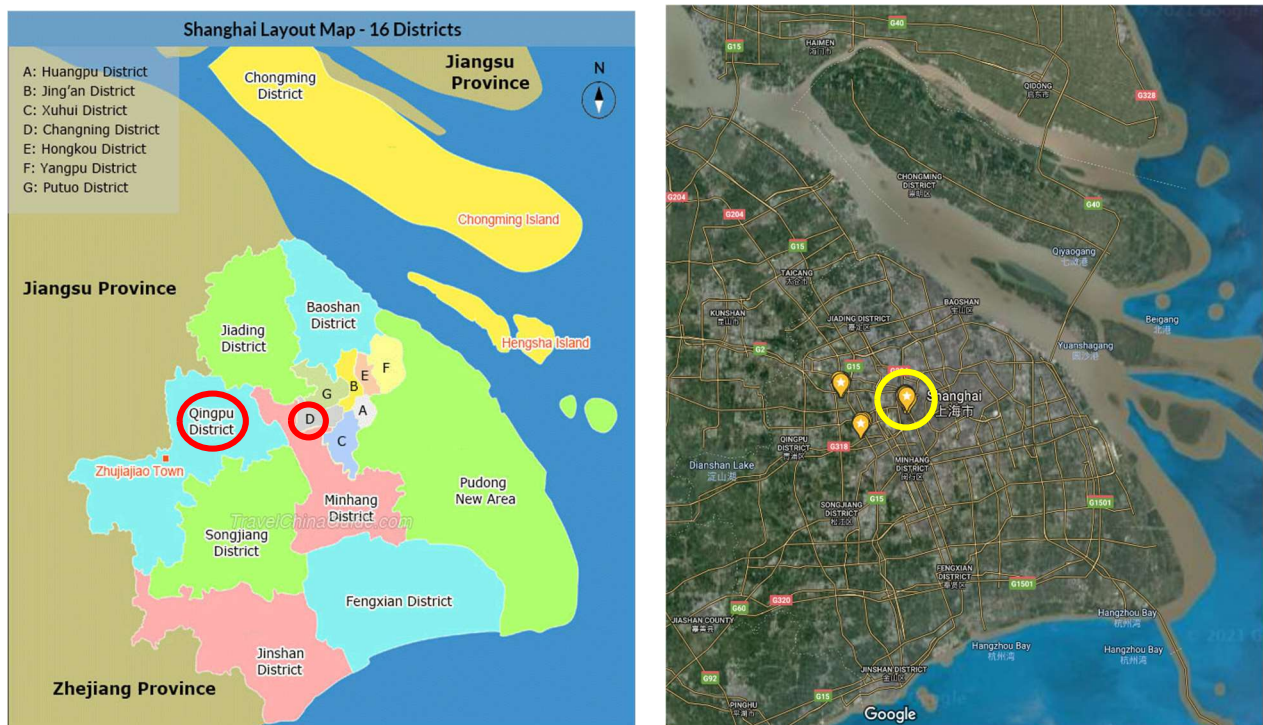


Figure 1 (Right): Districts where researched sites locate, circled in red

Figure 2 (Left): Four researched towns highlighted in yellow markings. Note that there are two towns being close to each other in the yellow circle

The research took place in four towns in Shanghai. Two of them locate in Changning

district, a downtown district, which are Xinjing Town and Beixinjing Town respectively. Two of them locate in Qingpu District, a district with both urban fringe and rural areas. Both are in the urban fringe areas in Qingpu District, which are Huaxin Town and Xujing Town respectively. As for the sample size, a total of 27 housing estates or communities were researched, with 12 of them in the downtown area and 15 of them in the urban fringe area.

## **II. Findings and analysis for research area 1**

Garbage cans are a type of core facility the government provided to implement the Waste Sorting Guidelines. A set of four garbage cans (dry, wet, recyclable, and hazardous) has a common design across the entire Shanghai city. However, there are also supplementary facilities, such as sinks for hand cleaning, cabins to hold the garbage cans, and on-site recycling equipment. The offering of these facilities varies across the city because they are designed and distributed differently by each town-level government, and sometimes by the residential committees of each housing estates. Therefore, aside from maintenance of the cans themselves, the facilities were also a profound factor leading to different conditions of garbage cans between downtown and urban fringe areas in Shanghai.

Overall, the garbage cans and their associated facilities of urban fringe areas in Shanghai are relatively inferior comparing to those in downtown areas. This disparity is most present in terms of sanitation conditions and the quality of supplementary facilities. Nevertheless, the downtown and urban fringe areas did share two common strengths: a thorough coverage of new garbage cans under the Waste Sorting Guidelines and a reasonable elasticity when mandating time slots for waste dumping.

### **1. Disparities:**

#### **a. Less sanitized dumping spots in urban fringe areas:**

Unclean garbage cans were present in both downtown areas and urban fringe areas. Garbage cans are more sanitized in downtown areas than in urban fringe areas overall

because of the following two reasons: more reasonable dumping behaviors and better management on garbage cans in downtown areas.

For the first reason, the research had spotted significantly higher cases of littering behaviors in urban fringe areas than in downtown areas. Littering in this case referred to residents putting their domestic waste bags outside of garbage cans (usually next to the cabins for holding the garbage cans), which undermined the sanitation condition of garbage cans directly. Four out of the fifteen housing estates located in urban fringe areas had this littering phenomenon, (Figure 3) while only one out of the twelve housing estates in downtown areas had the phenomenon. A government official from Xujing Residential Committee Party Branch responded to the interview question “Were there any complaints from residents when implementing the Waste Sorting Guidelines?” by saying “Yes, there is quite a bit about littering. In the past one and a half years, residents often complained about, sometimes report to us, that some other residents, usually the worker tenants, are leaving their domestic trash next to the trash cans, not in them.” Both interviewed government officials from the downtown areas, on the other hand, did not mention littering behaviors when responding to the same question.



Figure 3: The four littering cases in urban fringe areas

With that being said, construction waste, a type of waste that was not regulated by the Waste Sorting Guidelines, occurs more often in downtown areas. Over the 12 downtown housing estate covered in the research, two had the construction waste piling phenomenon, while none of the 15 housing estates in urban fringe areas had such phenomenon. Figure 3 shows the two garbage can cabins in the estate that had signs on their outer walls saying: “temporary construction waste piling site”, and how the construction waste was piled openly next to the cabins. Since people used the cabins designed for the Waste Sorting Guidelines as piling sites for construction waste, this littering phenomenon might be a form of the policy’s negative impact on downtown areas.



Figure 4: Construction waste piled next to the garbage can cabins in Hongyuan Yicun  
The circled sign says “temporary construction waste piling site”

For the second reason, four of the researched housing estates in urban fringe areas had their garbage dumping spots (either cabins or groups of garbage cans) available outside of their designed time slots. Since no supervising personnel was assigned to these spots when it was not during the designated time slots, waste in those garbage cans would stay in there with the lids opened until the next time slot, which made the waste more likely to pollute the surroundings. By contrast, all researched housing estates in the downtown area locked up their garbage cans in cabins at the dumping spots when it was not the available time slot. Nevertheless, some housing estates in both downtown and urban fringe areas had special spots for mistimed dumping, which will be mentioned in the section about common strengths.

The following figure offers a comparison between two dumping spots in the urban fringe area and downtown respectively. (Figure 5) Both photos were taken around 10:30 am. On the left, the spot in urban fringe area had a sign saying its available time slots were 6:00 to 8:00, 12:00 to 14:00, and 18:00 to 20:00, while the garbage cans were still available for dumping at 10:30. On the right, the spot in downtown had its sign saying the time slots were 7:00 to 10:00 and 17:00 to 20:00, and the garbage cans were locked in the cabin at 10:30.



Figure 5: A spot in urban fringe area (left) and a spot in downtown (right)

### -Analysis

Although the littering of construction wastes was more severe in downtown areas, the sanitation challenge of garbage cans in downtown areas was still lighter than that in urban fringe areas because constructions as sources of waste would most likely end easier and more quickly than individuals. The reason was that construction projects would naturally end, while individual littering would need countermeasures to be stopped. Based on the findings, littering was the main factor undermining the sanitary condition of garbage bins in housing estates, and the major potential cause of littering was the poor management from local governments. The issue of poor management can be explained from behavior management and facility management, in both which governments in urban fringe areas were doing poorer than those in downtown areas.

Behavior management means how the government restrains littering directly through

education and supervision mechanisms. While these means were used by governments from both types of areas based on the interviews, governments in urban fringe areas were facing more challenges. The official from Xujing Town stated that since the establishment of the Waste Sorting Guidelines in 2019, the local management bureau constantly received reports from residents saying that people were littering, and they often referred to migrant worker tenants. Regulations like fines were implemented, but it was extremely hard to catch a violation, and the government at most times could only tell the landlord to persuade their tenants. Both officials from Xinjing and Beixinjing Town also said that fines and mutual supervision among residents were means implemented to keep the garbage cans clean. However, they said that although littering was present in 2019, because residents were not familiar with the restricted time slots, the habit of following the time slots was formed during 2020 and littering was hardly seen. The poorer performance of the government from the urban fringe area could be attributed to its inability to adjust its management methods to serve its more complex demographic structure, comparing to that of downtown. Housing estates in urban fringe areas had greater percentage of migrant workers, and their relatively weaker personal bond with local people, especially the landlords and government officials, may undermine the effectiveness of persuasion and direct government educations like distributing brochures.

Facility management, on the other hand, refers to how the government manage the garbage cans themselves so that they are less likely to pollute or be polluted. As mentioned, many garbage cans were still available for dumping when it was not the time slot in urban fringe areas. This issue reflected the insufficient amount of management effort of urban fringe town governments. Specifically, the problem was either no personnel was assigned to move those garbage cans, or no places was assigned to hold the cans outside of the time slots, or both. The lack of funding or effective feedback mechanisms were potential causes.

## **b. Inferior supplementary facilities in urban fringe areas**

Most common supplementary facilities include sinks for hand cleaning, cabins to hold the garbage cans, on-site recycling equipment, and resting spaces for volunteers. Overall, such facilities in downtown areas are better in terms of design than their counterparts in urban fringe areas.

On-site recycling equipment was only spotted in one housing estate, which was in the downtown. It was a compose equipment, a facility served for initial degradation of wet waste. Since the equipment was not widely applied, it can be deduced that its function was less needed by the implementation of the Waste Sorting Guidelines compared to that of other facilities.

For the other three types of common supplementary facilities, the research discovered overwhelming advantages in downtown housing estates compared to urban fringe ones. Cabins, cleaning equipment, and resting spaces were all had better design in housing estates in downtown areas than in urban fringe areas. More specific summary of the findings in different housing estates is presented through the different statuses and the charts listed below. The statues are listed from the least to the most favorable. In the chart, since the number of dumping spots vary from every housing estate, percentages are used to show the statuses of the supplementary facilities.

Statuses for cabins: None, Unenclosed, Enclosed;

Statuses of hand cleaning equipment: None, Water tap only, Water tap and sink;

Statuses of resting spaces for volunteers: None, Chair only, Lounge.



Chart 1: Statuses of Supplementary Facilities in Downtown Housing Estates

Name of housing estates	Percentage of cabins with status:			Percentage of cleaning equipment with status:			Percentage of resting spaces with status:		
	None	Unenclosed	Enclosed	None	Water tap only	Water tap and sink	None	Chair only	Lounge
Bixia Units			100%			100%			100%
Hongkan g Garden 3 <sup>rd</sup> phase			100%			100%			100%
Hongyuan Bacun			100%			100%		33%	66%
Hongyuan Yicun			100%			100%	33%		66%
Jianhe Jiayuan			100%			100%	50%	50%	
Jinju Units			100%	25%		75%		50%	50%
Jinzhong Units			100%			100%			100%
No.200 Qingchi Road			100%			100%			100%
Xinjing Liucun			100%			100%	100%		
Xinjing Qicun			100%			100%	66%	33%	
Xinjing Wucun			100%			100%			100%
Xinjing Yicun			100%			100%	50%		50%

Chart 2: Statuses of Supplementary Facilities in Urban Fringe Housing Estates

Name of housing estates	Percentage of cabins with status:			Percentage of cleaning equipment with status:			Percentage of resting spaces with status:		
	None	Unenclosed	Enclosed	None	Waste tap only	Unenclosed	None	Chair only	Lounge
Gongyuan Units		100%		100%			100%		
Guanghong Apartments		66%	33%	100%			100%		
Guanghong	66%	33%		100%			100%		

Xinyuan									
Huagang Units		66%	33%	100%			100%		
No.353 Huaxin Street	50%	25%	25%	100%			100%		
Huajia Cun		75%	25%	50%	50%			100%	
Xijiao Yiqu		100%			100%			100%	
Xijiao Meiguiwan Garden	100%			50%	50%		100%		
Xijiao Meideyuan	66%		33%	33%	66%		100%		
Xiyuan Xincun		100%		100%			100%		
No.495 North Xinfeng Road		100%		100%			100%		
Xinhongqiao Mingzhu Garden		100%				100%	100%		
Zhaodi Linglongxuan		100%				100%	100%		

Chart 1 includes housing estates located in downtown areas, while chart 2 includes those in urban fringe areas. These charts in total include 25 of the researched housing estates, excluding two from urban fringe areas since the research was incomplete due to obstructions from local security personnel. As mentioned, all researched housing estates in urban fringe areas fall short on all three types of supplementary facilities comparing to their counterparts in downtown areas.

In addition, the styles of supplementary facilities also vary across the same urban fringe town more than across a downtown town. (Figure 6) Although this may not affect the condition of garbage cans directly, it may indicate the different funding method in the two types of areas regarding waste sorting. In downtown, the standard of supplementary facilities

had uniform designs, so they were more likely funded by the town government; whereas in urban fringe areas where the standards are different, the facilities are more likely to be funded separately by the residential committee of each housing estate.



Figure 6: Comparison of supplementary facility styles. The upper row is two dumping spots of two different housing estates in Xujing Town. The lower row is two in Xinjing Town.

### -Analysis

For the consequences of having poorer supplementary facilities, unenclosed cabin or no cabin for garbage cans increased the possibility for the cans to contaminate the surroundings, as well as diminish the sanitary condition of the cans during wet weathers. Without hand cleaning equipment, volunteers might not be able to wash their hands in time after working, which posts threat to their health. With water taps only, water fallen onto the ground would increase the contamination risk from the garbage cans, since it can possibly carry the dirt on the cans. Poorer resting places for volunteers will directly affect how active they participate in their works, which will eventually cause influence on the condition of garbage cans.

Given the fact that government investment on infrastructures in urban fringe areas is less than that in downtown areas, as mentioned in the background section (Zou 2010), and combining the clue above about potentially different funding method between these two types of areas, the economy could be a major cause of such a drastic disparity on supplementary

facilities. Specifically, supplementary facilities in downtown could be funded and maintained by multiple levels of government, while the smallest government branch in China- resident committee, would have to purchase and maintain the facilities on their own. Without an overarching coordination in a larger level, resident committees might also lack research resources to search for method to improve their supplementary facilities.

### **c. Conclusion on disparities**

These two areas of disparities proved that two challenges of urban fringe areas' development mentioned in the background section were present during the implementation of the Waste Sorting Guidelines: varied education level of migrant population and insufficient government investment on infrastructures. (Zou 2010) Although there is no direct clue indicating that restricted time slots and dumping spots after the establishment of the Waste Sorting Guidelines intensified the impact of these two challenges, they were not sufficiently tackled during the implementation of the policy neither. These two challenges undermine the effectiveness of the policy, as well as to continue to cause more threat to the sanitary condition in urban fringe areas than that in downtown areas.

## **2. Common Strengths**

### **a. Thorough coverage of new garbage cans**

All of the garbage cans spotted during the field research were new ones that meet with the sorting requirements in the Waste Sorting Guidelines. In downtown areas, all of the dumping spots in housing estates were equipped with all four types of garbage cans. In urban fringe areas, all of housing estates were equipped with at least one dumping spot with four types of garbage cans, and multiple other dumping spots with dry and wet waste garbage cans. The influence of this difference might be minimal because the yield of dry and wet waste was far more than that of recyclable and hazardous waste, since both interviews and field research indicated that dry and wet waste was collected daily mandatorily, while the

other two types of waste was collected only when the residential committee contact the collection company when the cans are full. Overall, the Waste Sorting Guidelines was at least implemented by a thorough range of basic government branches, which prevented disorders caused by confusions of residents on garbage cans that follow different standards.

#### **b. Reasonable elasticity on time slots and dumping spots**

Elasticity appears in downtown and urban fringe areas differently. In downtown areas, a feedback mechanism was established in both Beixinjing and Xinjing Town, which allowed the resident committees to apply for more time slots or dumping spots if they received frequent opinions from residents on such needs. Once a resident committee started an application, the town government will arrange a meeting among representatives from the party branch, resident committee, property owner committee, and the property management company of the target housing estate to discuss the eligibility of additional time slots or dumping spots. Funding will be given by the town government to the property management company to carry out further works if the application was considered eligible. There was a successful example of such an application in Jinzhong Units of Beixinjing Town. In late-2019, the residential committee successfully applied for a 12:00 to 14:00 time slot in addition to the original 7:00 to 10:00 and 17:00 to 21:00 ones of Jinzhong Unit, according to the interview with a local government official.

In urban fringe areas, elasticity appear more as spots for mistimed dumping, a type of special dumping spot that are available for waste dumping for 24 hours, designed as a backup facility if residents missed the time slots. Five out of the fifteen researched housing estates in urban fringe areas applied this type of spots. (Note that not all housing estates need such spot, so it does not mean that those that did not apply such spots was necessarily mistaken.) Although it was unknown whether and how much the spots for mistimed dumping alleviated residents' inconvenience caused by restricted time slots, they were logically tenable steps

towards the direction to tackle the inconvenience.

In short, these two forms of elasticities reflect the appeal for “temperature” by the city government (Yu, 2019), indicating to some extent that the potential problems caused by shortened time and reduced spots of waste disposal were on the agenda of many local government branches.

### **c. Conclusion on common strengths**

Government branches in both downtown and urban fringe areas demonstrated their commitment to implement the Waste Sorting Guidelines and adjust the implementation so that the new patterns of availability of garbage cans is more convenient for residents. This research had limited ability to assess the magnitude of influences of these strengths, but from a qualitative perspective, these means were helpful to improve the using experience of garbage cans and related facilities.

## **III. Findings and analysis for research area 2:**

Research on waste processing abilities on downtown and urban fringe areas was unable to produce an informative outcome. Although the problem of sporadic waste piling sites mentioned in Li’s article (Li, 2014) was not spotted, the information about waste processing plants was either incomplete or contradictory among different interviewees.

### **1. Proper initial sorting and transportation**

During the field research, open waste piling sites did not occur in both downtown and urban fringe areas. The only cases where wastes were piled openly were individual littering and wastes produced by construction, which did not indicate shortcomings in waste processing abilities since these phenomena occur before wastes were transported. In addition, an example of a countermeasure to prevent such piling sites from occurring was in Huaxin Town, a grocery market had a large waste sorting station in it, which can store and sort the wastes produced in the market near where they were produced.

Interviews also indicated an efficient initial transportation network of wastes. All interviewed officials from Xinjing Town, Beixijing Town, and Xujing Town stated that the waste transportation companies had the right to reject collecting wastes if they found wastes were not sorted in the garbage cans, and they could report the situation to the city management department of the town government. With this mechanism, they also said there were very few such cases, so mixing of waste was only a very minor issue for initial garbage collection and transportation.

These observations showed a relatively stronger ability to process wastes at the initial stage in urban fringe areas, compared to what was said in the literature.

## **2. Waste processing plants' ability to cover wet waste is unclear**

### **a. Incomplete information**

During the interviews, government officials and employees were unable to provide information about the number and distribution of waste processing plants because the information was meant to be accessible for government personnel only. In terms of the specific capacity for current waste processing plants, neither literature nor interviews were able to produce quantitative information for a more accurate comparison. The current waste processing plants were also inaccessible for visitors. Therefore, whether the government actually underestimated the amount of wet waste produced and whether it was planning to tackle the problem was unable to be answered by the research.

### **b. Contradictions between officials and the employee on capacities of waste processing plants**

Regarding how well current waste processing plants can cover the amount of wet waste, the interviews found contradictory information from government officials and employees in different units, which hindered the ability for this research to generate reliable conclusions on the statuses of waste processing in researched regions.

All interviewees working in the city management branches of the government stated that most of the wet wastes were covered by current waste processing plants mainly through recycling. They said that most of the wet wastes produced in their respective towns was recycled and reused as diesel, fertilizers, and methane for power generation. They also attributed this current status of wet waste recycling to the Waste Sorting Guidelines, saying that this policy mandated the waste to be sorted throughout the entire waste processing procedure and therefore allowed for more efficient wet waste reuse. The officials from Xinjing Town said specifically that the Waste Sorting Guidelines changed how wet waste was processed drastically, that most of the wet wastes was buried or burned before 2019, while most of them were reused nowadays.

On the other hand, an employee of the State Grid Corporation of China, a state-owned power company, said that most of the wet wastes generated in Shanghai was buried in landfills or burned in incineration plants, and most of them ended up in the Laochang Processing Plant, a landfill and incineration plant in the rural area of Shanghai. Very few of the wastes were recycled and reused, which was partially due to red tape: Since waste was gathered in district-level storages before being finally processed, district governments must apply for permits from the city government to recycle the wastes. According to the employee, it was not easy for such an application to succeed at least in the power generation field, and therefore only a tiny portion of wastes were reused as electricity. Moreover, in the power generation field, the employee said no methane and incineration power plants sort the garbage before processing, which meant at least that dry and wet wastes were often mixed together during the power generation process.

The distinctions between these two types of interviewees were mainly on how much of the wet waste were recycled and whether wet wastes were processed as a sorted type of waste. Such contradictions might be a result of the different positions of the interviewees. For



the three government officials, their work included managing waste from the initial user stage, which meant they were less familiar with how wastes were processed at later stages and may assume that they were sorted at the initial stage. These officials also had more frequent contact with government propaganda on the Waste Sorting Guidelines, meaning that they might overrate the performance of how it changed the waste processing pattern. For the employee in the state-owned company, he was closer to the final processing stage, so he may know more accurate details regarding similar topics. However, since none of the interviewees were able to support their statements with quantitative data, it is hard to verify either claim.

### **3. Conclusion**

To sum up, while there were no open waste piling sites spotted, the capacity, position, and plans for waste processing plants was largely unknown in both the downtown and urban fringe areas. Although research in these two types of areas did not find out which faces more challenge to process its wet waste, there was risks that waste processing was causing more pollution in rural areas, a type of areas that was not included in the research.

## **Policy Recommendations**

Based on the two issues of urban fringe areas identified, which are individualized littering behaviors and inferior supplementary facilities, future policies should tackle the problems through customization and combination. In this case, customization means that each housing estates should have their own means to manage garbage cans to optimize for their various population structures, and combination means that different residential communities should combine their financial and human resources to tackle the drawbacks on supplementary facilities.

### **I. Customization of means for facility management**

The field research had proved that housing estates at urban fringe areas had more

diversity in terms of the composition of their residences comparing to those in downtown areas: the overall percentage of residents with local Hukou was lower and those with Hukou of other provinces had higher percentage. Such diversity had caused difficulties for residential committees to regulate residents' behaviors through universal measures like fines, and persuasion from landlords lacked reliability. Therefore, different measures based on the population structures of different housing estates should be implemented in each housing estates. Although drawbacks on both behavior and facility management were spotted during the research, the recommendation will focus mainly on facility management because littering behaviors are tied to the nation-wide systematic educational issues that are beyond the reach of the city-wide Waste Sorting Guidelines, plus proper facility management can also reduce littering.

To accommodate the differences among the housing estates, the government agencies that are responsible for the customization measures should be residential committees (the smallest existing government branch in China), since higher level governments will be less efficient in implementing highly diversified policies, and the close personal relationships between the committees and residents will also ease potential resistances to policy implementation. Specific customization measures to improve the facility management include two phases: research and reallocation.

### **1. Research on differences of waste sorting statuses among housing estates**

Research refers to establishing more comprehensive databases of three dimension: the complaints on littering, number of poorly managed garbage cans (those cans that were still available outside the time slots), and the workload of volunteers of different housing estates. Quantity, location, and time of the complaints will indicate the different patterns and impact of littering behaviors in each housing estates. Number of poorly managed garbage bins reveals the performance of managing personnel (both hired and volunteers). And the

workload of managing personnel can reveal whether in some housing estates are overburdening these people while others are letting them idle. Each of the three dimensions should be quantified. After comparing the quantified data, the residential committees should score and rank the housing estates to indicate their overall performance. The scores and ranks must be private to the committees to avoid discrimination and should be renewed annually through recollecting the raw data.

## **2. Reallocation of management resources**

When the research phase is completed, the residential committees should then carry out the reallocation phase, which refers to redistribute existing management efforts to maximize their efficiency. Based on the information gained during the research phase, the housing estates with higher frequency of complaints towards littering, more poorly managed garbage cans, and heavier workload of managing personnel will indicate that these housing estates need more management efforts. Then, the residential committee should redistribute the managing personnel through assigning those who are working in highly-ranked housing estates to the housing estates with lower ranks. Deciding which housing estates to draw people from should be a gradual process. According to the findings that complaints on littering and poorly managed garbage cans were only present in a small fraction of housing estates, the residential committees should consider drawing managing personnel from all housing estates without such problems. The residential committees should also make the working locations of management personnel flexible to maximize the efficiency. For example, if a volunteer originally working in housing estate A is reassigned to housing estate B, and housing estate B is where the problems above is present, his/her working routine can be pushing out garbage cans in A, then going to B, pushing out the garbage cans in B and staying there for supervision, and finally enclose the cans of both estates. After the reassignment, follow-up monitoring should be carried out by residential committees as well:

if facility management problems start to appear in those housing estates with managing personnel drawn, the reassignment must be withdrawn.

In a word, customization involves knowing the disparities among housing estates and redistribute the human resources among them. Through more human supervision and guidance, the facilities could be more hygienic and save the cleaning effort of the government in a long run.

## **II. Combination of bargaining power and experience pool**

The findings implied that comparing to those urban areas, basic government branches like town and residential committees in urban fringe areas were fending for themselves to a greater extent. Individual government branches operating largely by themselves have potential shortcomings like the lack of funding, and experience exchanges. Due to a lack of funding, a single residential committee or town government might not have enough leverage to apply to their superior agencies for funds to upgrade their infrastructures. For lack of experience changes, successful examples taking place under one government branch are less likely to be learnt by others if they are running separately. Therefore, government branches in urban fringe areas should combine their bargaining power and experience pool to optimize their facility management performance.

### **1. Forming coalitions among residential committees**

The accumulation of leverage to apply for new funds needs to start from coalitions formed by residential committees. Although the decisions to build more of or upgrade facilities are usually made by town or district level governments, they will be less likely to recognize the problems caused by inferior facilities as urgent ones without a unified and pervasive feedback on these problems from their subordinates. For instance, if only one residential committee applies for more funds to upgrade the waste related infrastructures, the town government would most likely make the request pending or reject it because the

application only reflect the need of one municipality. Taking the examples in this paper of the two urban fringe towns where inferior waste related facilities were present across multiple residential committees' territories within, these residential committees should form two coalitions and apply for more funding for the facilities from their respective town governments on behalf of the coalitions. The executive board of each coalition should at least contain the chair and the head of waste management personnel of the residential committees. Moreover, residential committees within each coalition should form a consensus based on a thorough recognition on the extent of current waste disposal facilities causing sanitation problems before they apply for more fund. A joint fund request from multiple subordinates will push the town government for a more efficient decision making process.

## **2. Experience sharing on the usage of mistimed dumping spots**

The findings also indicate that spots for mistimed dumping were only applied by a small faction of housing estates in both downtown and urban fringe areas. More witnesses of littering in urban fringe areas, however, reflect more mismatch between the need for waste disposal and the length of time slots. Therefore, applying the use of mistimed dumping spots to more housing estates is a feasible option to mitigate littering. Here, residential committees that has housing estates using such spots should share their experience with those that has littering problems and not using this mean. Such communication of experiences could be achieved through the coalition platform mentioned in the last paragraph. To utilize the coalition, residential committees using this mean should provide quantified reports to other committees, which must at least include the cost of maintenance of these spots, feedback from the volunteers working at these spots, and the daily capacity of such spots in comparison to the more common fixed-time spots. These information will inform those residential committees without spots of mistimed dumping about the operation situation of these spots and thus help them analyzing the practicality of applying such a mean in their

territory.

In short, the combination strategy asks residential committees in urban fringe areas to work in solidarity to urge for more government investment in waste related supplementary facilities, and to form a smoother channel to exchange experiences.

## **Conclusion**

Overall, the Waste Sorting Guidelines was implemented in downtown and urban fringe areas in Shanghai differently, with urban fringe areas performing worse in terms of the sanitary conditions and quality of supplementary facilities of the waste dumping spots in housing estates. These drawbacks to some extent reflected the heavier challenges of complex demographic structure and lack of government infrastructure investment in urban fringe areas which were longstanding issues faced by municipality governments of these regions. Since the Shanghai Waste Sorting Guidelines is the first implemented policy of its type in China, and disparities between urban, urban fringe, and rural areas are widely present in the country, future expansions of research are necessary to yield more comprehensive results on the different implementation situation of the policy in Shanghai so that it can provide more constructive experiences nationally.

Directions to further this paper's research should include an increase of the sample size and an improvement of the interview method. For the sample size, the current research covers only four towns located in downtown and urban fringe areas. Further research should include more towns and expand the research domain into rural areas to examine the unique challenges faced by urban fringe areas more thoroughly. For the interview method, further research should design multiple styles of face-to-face contacts based on the attitude of the interviewees. During the research process, some of the interviewees showed impatience, particularly towards the quantity and length of questions, and therefore chose to skip some of

them. Thus, oral interviews consisting of concise questions should be applied to interviewees who are not that forthcoming to help researchers acquire a complete answer set.

Potential ways to improve the current Waste Sorting Guidelines include a customization of management resources and a combination of bargaining power and experience pool, both to be carried out by residential committees. The point is to push the lower level government branches to realize and adapt the different population structures of housing estates within their jurisdictions, and allow these branches to build up a bottom-up momentum to positively affect higher-level decision making process within the city government.

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