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緑地に対する住民満足度と植物性廃棄物収集活動への参加の関連—北京市西城地区を事例として

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Correlation between residents' satisfaction of green space and their participation on activities pertaining
to the collection of green waste----a case study of the Xicheng District, Beijing

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ABSTRACT

In view of the fact that the loose texture and huge volume has resulted in the decrease of transportation efficiency and the disposal capacity of garbage treatment plants, the increasing amount of greenery waste in Beijing has given household disposal plant great pressure. Whereas, non-collection of deciduous leaves is obviously inconsistent with Beijing's climate in winter, when the dry and windy weather will make scattered deciduous leaves a great fire hazard. In order to solve the contradiction between the collection and non-collection of deciduous leaves, Beijing started the greenery waste collection project in 2009, in which the separately recovered deciduous garbage can be treated as fertilizer, so as to reduce the cost of green space nutrients while achieving the maintenance of soil fertility and solving a variety of problems in cities including fire hazards. However, over the past decade, Beijing's greenery waste reutilization has not gone as smoothly as expected. Some treatment plants have to be closed because of problems such as capital turnover, while the project that has lost government's support is gradually declining. At the same time, the Xicheng District which implements greenery waste collection in the whole area of the district only realizes the coverage of the green space of Landscape Bureau, while the other green space controlled by property companies are not involved in the collection. There are nearly 400 communities of different sizes in Xicheng District, including a considerable area of green space. This environmental friendly project, which is dedicated to resource recovery, will break through the embarrassing situation of merely relying on the government guarantee the funds of the collection project to a certain extent in case of the participation of residents in greenery waste collection can be realized, which will not only promote environmental protection, but also benefit the cultivation of residents' environmental awareness.

In view of the different quality of communities, the author speculates that residents in communities with pleasant living environment may be more satisfied and willing to pay more. Therefore, this study conducts survey by dividing the communities into three types in accordance with the status of green space.

Hence, the study carried out a questionnaire survey among residents in Xicheng District in this study with the purpose of identifying the relationship between residents' satisfaction with green space and their willingness to pay. Residents' satisfaction with the function of green space and the aesthetic perception of the landscape in communities are obtained through SPSS analysis and AHP landscape aesthetic perception analysis.

It can be concluded from the results that the level of remuneration is the influencing factor that affects Type A community, i.e. community with the worst landscape in Xicheng District. The significant influencing factors of Type B community include age, length of residence in the community, frequency

of spontaneous activities in green space, satisfaction with the number and function of green space, the willingness to contribute to environmental protection, as well as the demand for dual payment motives of the willingness to contribute to environmental protection and the stipulation of the government; The significant influencing factors of Type C community include gender and their willingness to contribute to environmental protection.

In addition, the relationship between landscape aesthetic perception and residents' willingness to pay is analyzed, the results of which imply that the willingness to pay of Type A community with the worst landscape aesthetic perception and Type C community with the best landscape aesthetic perception are both higher than that of Type B community with the middle ranking, while Type C community has the highest number of residents willing to pay extra fees.

In spite that interviews with property companies indicate their lack of confidence in charging residents with additional reasonable collection fees, the results of this study have demonstrated that residents are generally highly supportive for participating in the cause of environmental protection and resource utilization.

Keywords: greenery waste, Xicheng District, property management company, collection, satisfaction, intention, correlation

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LIST OF ABBREVIATIONS

AHP: Analytic hierarchy process

VEP: volunteer-employed photography

SD: Semantic differential

CHAPTER ONE

1. INTRODUCTION

1.1 Definition of Greenery Waste

According to <the National Standard of the People's Republic of China>, greenery is plants which are used for ecological forestry and garden greening including arbors, shrubs and herbaceous. They locate in forestland, urban green space, suburban green space or interior decoration.

Greenery waste is a kind of waste produced during natural regeneration or greenery maintenance. It includes tree trimmings, grass clippings, flower and weeds and other plant waste materials from garden, parterres and so on (Technical regulation of disposal and application for greenery waste, 2015). In a real operation, the greenery waste materials vary from regions. In Beijing, it includes grass or flower cuttings, hedge, trees trimmings, weeds, fallen leaves, fallen flowers, fruit, waste from wood processing (Xiangyang Sun, 2010)

The greenery waste in this study is all from Xicheng District, Beijing.

1.2 Background

The climate in Beijing is temperate monsoon climate, and the winter is dry and cold. If the fallen leaves are not cleaned in the season of falling leaves, they will be blown up by strong winds in winter, which will affect the appearance of the city. Besides, it is also a fire hazard in the city, so it is necessary to collect the fallen leaves and concentrate on handling them.

Greenery waste is classified as a household waste in Beijing, and the situation of household waste treatment in Beijing is not ideal. According to Kang, Wang (2011), landfill reaches to 91.2% of total household waste disposal. Compost is only 4.1% and incineration is 2.4%. It is not difficult to see that most of the greenery waste is treated with landfill, leading to a waste of resources.

On the contrary of expectation, the ratio of reutilizing greenery waste remains low because delivering other household waste can get subsidy from government while there is no fund compensation policy for green waste. Also, on account of the bulky waste, the volume of greenery waste is 5-7 times as big as normal household waste in case of an equal quality (Huang, 2016). Therefore, landfill sites generally are not willing to accept greenery waste because they reduce the daily processing capacity (in terms of quality). As a result, a myriad of greenery waste is abandoned.

An interview was conducted by the author at the end of May to two participants in the greenery waste reutilization project in Beijing in 2009. It was found that the waste disposal capacity of Beijing was almost in a saturated state. Greenery waste was once mixed and disposed with household waste. This has brought great pressure to the sanitation bureau of Beijing. Moreover, considering the value of resource recycling, greenery waste started to be collected and disposed separately. In this way, the burden of the Sanitation Bureau of Beijing was lightened.

Green space in residential area which belongs to property management companies is a significant part of source which produces greenery waste. However, according to interview mentioned above, residents need to pay landscape bureau to deliver greenery waste. This extra payment highly depends on their satisfaction to property management company's service quality (Wen, etal 2014). As one of the important elements of living environment, green space quality influences residents' satisfaction to property management companies' service quality.

1.3 Organization of Thesis

This thesis is organized into 6 chapters. Chapter 1 is and brief introduction about the definition of greenery waste and research background. Chapter 2 is a summary of relevant literature related to the research. Chapter 3 is an outline of research design including research purpose, hypothesis, study area introduction, research content and methodology. Chapter 4 details the result for each research content and chapter 5 discuss and synthesizes the results. Chapter 6 makes a conclusion of the study with suggestions and further study opportunities.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 The Importance of Greenery Waste in Ecosystem

The ecological cycle of garden soil cannot form ecological communities like forest, mountain. Natural circulation between plants and soil fertility is important. The undisturbed areas, leaves on the forest floor keep the nutrients circle with only a small amount lost. However, it needs landscape management involved in urban areas on these processes (**Figure 1**). A study conducted in urban residential area of Boston shows that leaf litter removal in the urban area leads to considerable loss of C and N from urban ecosystem (Templer et al., 2015).

First, the greenery waste removal leads to the deterioration of the landscape of ecological system because of the gradual loss of productivity of the soil. The waste removal from the ecological system is also responsible for the increased fragility, poor stability of garden pest predators (Baoguo Zhou, 2002).

Second, organic matters which accumulate on the top soil contribute soil development.

Third, litterfall on the ground reduces evaporation and the impact of rain drop on the soil (José M. Facelli, Steward T. A. Pickett, 2015).



Figure 1. Natural Biogeochemical Cycle & Urban Biogeochemical Cycle

2.2 Greenery Waste Disposal Status

2.2.1 Greenery Waste Disposal Status in the World

Relevant cases show yard waste collection is common around the world. A lot of cities have stipulations for collecting yard waste. Residents put yard waste with specific bags and leave them in drop-off site or street side. Delivering fee maybe also needed for each house. For example, New York City Sanitation Bureau offer leaf and yard waste collection for residents. Yard waste as one of the garbage categories, also should be placed in organic bins or bags tagged "yard waste only" with size and categories regulated (Leaf and Yard Waste, 2018)

There are several cities in Japan conduct yard waste collection. Noda city has detailed guidance for yard waste collection. Pruned branches and fallen leaves and grasses generated from the general household in the city are collected free of charge. The guidance specified in detail the criteria of the pruned branches,

fallen leaves and grass, plants which are not suitable for compost, schedule and so on. (Processing of pruned branches, 2018)

Few researchers have been focusing on collection and transportation part of yard waste disposal to improve the efficiency and recycling ratio. A curbside collection of yard waste route time model was developed by Everett et al. (1997) for estimating route time of delivering vehicles.

2.2.2 Greenery Waste Disposal Status in China and Beijing

Several major cities in China has been developing greenery waste disposal in recent years. For example, Beijing started a project in 2009 for developing its essential technologies and industrialization. Jing'an District in Shanghai has promulgated new specification of greenery waste disposal technology. Shenzhen also promulgated <Technical code for compost of comminuted branches> in 2009. However, it is still in an initial stage in China and still under a conducting test in several locations. Other cases in China are restricted to only running within greenery waste companies' own business. In summary, the product remains simple with only using composting. The collection categories, size, apparatus and so on are not detailed. Therefore, the output cannot be stabilized.

2.3 Public Participation and Property Management Companies

Firstly, the explanation of Chinese housing typologies is necessary in order to gain a better understanding of the relation between communities' greenery space and residents. "Sealed residential quarters" (gated communities) is a dominant housing type in most of China. This is a dramatical change of Chinese house in past hundreds of years under variable possible reasons such as deep-rooted collectivist culture, traditional courtyard house of the extended family and commoditized housing system in the past (Staub and Yu, 2014). The model illustration example of gated community will be explained in the questionnaire distribution communities in this study in **Chapter 3**.

This housing type in China determines the public maintenance cost in the community public space that is shared by each resident. Technically each community hires a property management company for taking charge of facility, maintenance and so on. Residents will only pay annually bill for property management companies for the services. This leads that some residents show less concern to public space and strong interaction between residents and property management company which, in other words, can be described as willingness to pay and service quality.

For collecting and delivering greenery waste from communities, residents need to extra service payment. (interview conducted by the author in May to Sun Xiangyang¹). Residents paying willingness strongly related to their satisfaction to their living environment condition which also reflects property management company service quality. As one of the important elements in one community, greenery space influences residents' satisfaction and participation willingness.

2.4 Research Gap

Although cases existing in lots of cities especially in developed countries, studies about greenery waste collection are still little. There is a growing consensus among researchers and government on greenery

¹ Sun Xiangyang, Professor in Beijing Forestry University, College of Environmental Science & Engineering

waste re-utilization. Nevertheless, most of studies focus either on chemistry process, evaluation of production or potential products made from greenery waste. Moreover, studies about forest biomass account for majority compared with studies in urban area.

According to Mingjun Gong, collection and transportation system is the fundamental link of the whole greenery waste utilization industry. It provides a stable supply of greenery waste to disposal plants (Gong Mingjun, 2004).

According to I. D Williams and J.Kelly(2003), Public behavior and interaction between management scheme and public are two approaches to improving the collection rate. However, there is little published evaluation of the perceived effectiveness and public attitudes towards collection and recycling, which heavily dependent on voluntary behavior of the public (Lundmark, Linda, 2003).

Therefore, this study will lay the emphases on collection management in a public perception.

CHAPTER THREE

3. RESEARCH DESIGN

3.1 Research Purpose and Hypothesis

In the way of questionnaire, interview, understand the factors which affect resident’s participation intention to greenery waste collection in Xicheng District and provide indicators to predict residents’ participation intention in the future.

Due to the interactions between property management companies and community residents, there will be a large space for improving the greenery waste re-utilization rate. The communities with better quality greenery space and higher residents’ satisfaction will be easier to conduct greenery waste collection. Those factors which significantly influencing residents’ participation intention can be used to predict the future along with residents’ demographic characteristic changes and new building communities.

3.2 Study Area

Beijing is in latitude 39°26’--41°03’ N and longitude: 115°25’-- 117°30’ E. The climate of Beijing is typical temperate monsoon climate. The area of Beijing is 16,410km²(Tokyo is 13,400km²), including 1,381 km² of urban area. (Urban area in Tokyo is 622km²). There are 16 Districts in Beijing, 10 for suburb districts, and 6 for urban districts (**Figure 2**). Xicheng District is one of the urban districts in Beijing which is also the political center of Beijing.

The grey area in the map of Beijing is urban area. There are two greenery waste disposal plant locates in urban area. One is Dongbaxiang Disposal plant, it covers the whole Xicheng district. (**Figure 2**) Another one is Huamu Disposal, it only covers small area around the company. This study will choose Xicheng district for the existing collection policy and building-up system. (**Table 1**)



Figure 2: Location of Beijing and Map of Beijing

Table 1. Jurisdiction of Each Greenery Disposal Plant in Urban Area of Beijing

Disposal Plant	Cover Area

3.3 Research Contents

3.3.1 Classify the Type of Communities

Through investigation, communities in Xicheng District range from 1950's to 2016. Therefore, the quality of construction and design of the communities have a big difference between each other. Except for construction part of design, Vegetation part (green space) is also one of the important differences. This study will classify communities according to their greenery space situation.

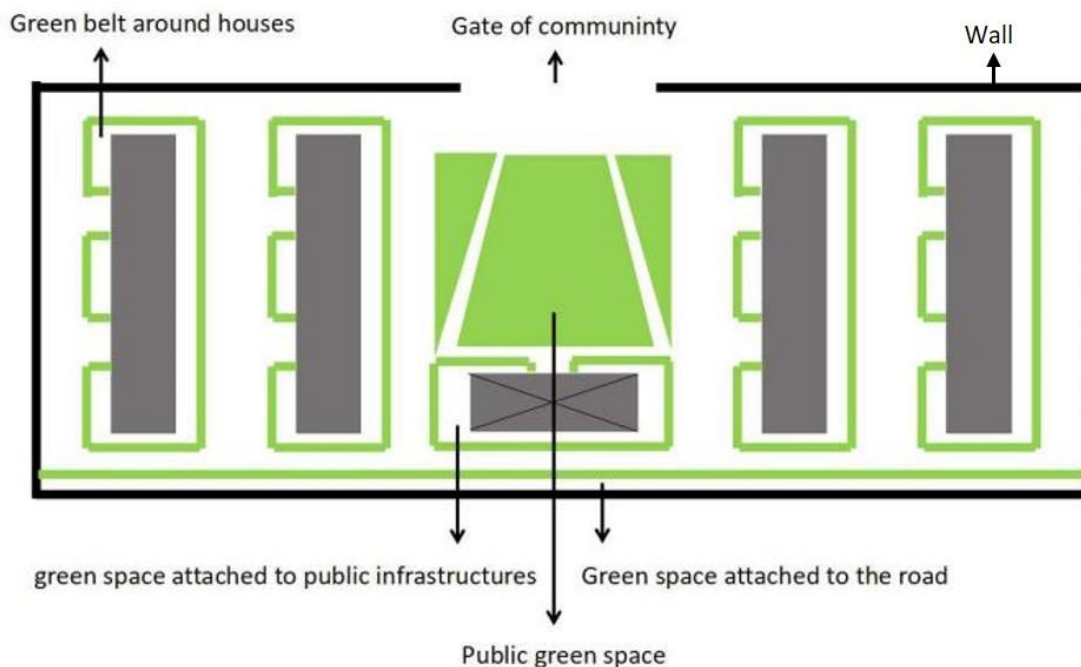


Figure 3. Gated Community Illustration Model

4 types of green space in a community according to <Standard for classification of urban green space > CJJ/T 85-2002: public green space, green belt around houses, green space attached to road, green space attached to public infrastructures (**Figure 3**). Among all of them, public green space shows the quality of green space in this community (according to the classification standard definition). Therefore, this study classifies communities into 3 types according to their public green space situation:

Type A community: Lack of designed green space

Type B community: have green space but no public green space attached

Type C community: have green space and public green space attached.

3.3.2 Landscape Characters of Community

Landscape characters will contain year of built, area size, the type of the community, green space ratio, whether paying for property management company and management system.

3.3.3 Residents Satisfaction to Green Space in Their Community

Residents satisfaction to green space contains three parts. Part I is satisfaction to green space function. Part II is satisfaction to green space aesthetic. Both Part I and Part II will be done through questionnaire. But analysis method will be different. Part I analysis is through SPSS analysis. Part II analysis is through AHP analysis. Part I questionnaire also contain two perspective: green space social function and green space environment function. A question about residents' participation intention will be included in Part I questionnaire. This simple question will be the only one dependent variable for analyzing.

3.3.4 Interview to Property Management Companies

Interview to property management companies contains several questions as below:

Interview question No.1: Has this community participate into greenery waste collection so far?

Interview question No.2: Residents' payment for greenery waste

Interview question No.3: A rough number of how much management fee you must raise for greenery waste collection?

Interview question No.4: Motivations to participate greenery waste:

- a. It's our duty to conduct greenery waste collection and participate into resource reutilization
- b. We can get free fertilizer for my community green space
- c. I can get reward from government if we are doing well among all the communities in Xicheng District.
- d. Others: _____

3.4 Research Methodology

3.4.1 Iconography Based on Satellite Image and Field Investigation

Iconography will give a visual sensitive to understand the area size of community and design of green space. Field investigation was finished in October 2019.

3.4.2 Questionnaire and Questionnaire Distribution

Questionnaire----Part I: Initially, respondents were asked to report their perspectives on several issues including their daily activities types and frequency in community green space, satisfaction to green space function design and size, agreement of some environmental protection activity statement and willingness to pay. In addition to the above questions, which were directly connected to the hypotheses of the research, the questionnaire obtained information relevant to the household's demographic characteristics, such as the age, gender, monthly income range, education level of the respondent as well as living period in current community in question.

Almost all of constructs were presented through a 5-point Likert scale²except for two question from residents' participation intention and 5 question questions from demographic characteristics.

Questionnaire---Part II: 18 photos were taken from 9 communities to represent community's landscape view. Each responder will score for each picture with according to 7 questions (score range 1-10). Therefore, each photo will get 7 scores from each responder.

Questionnaire Distribution : To address the research gaps highlighted, the authors conducted a questionnaire survey within the boundaries of Xicheng District in Beijing, 9 communities within the jurisdiction of Xicheng District, located in Beijing, China. The communities included in the survey were 9 communities from Xicheng District, which are comprised of different building year and different levels of green space quality.

A pilot survey was first conducted amongst about 20 students and professor in order to identify possible issues with the questionnaire, and the final survey was then conducted between 1st September to 5th of October 2017, using a random sample of 204 residents (193 valid feedback). Figure 2 below illustrates the location of these 9 distinct communities within Xicheng District.

Questionnaire targets in residents from 9 chosen communities above 18 years old who have ability to legally work in China. Questionnaire distribution was done by distributing inside the community to residents passing by. Small gift was prepared for each responder.

3.4.3 SPSS Analysis

Descriptive analysis: Number of questionnaires from each type of community, Gender Composition Education composition, Staying period, Age composition, Salary composition.

Correlation Analysis: Willingness to pay is the dependent variable. Other questions will all be independent variables.

After analyzing the significant variables, other analysis will be done among these variables and dependent variables.

Regression analysis: Regression provide a reliable method of identifying which factors have significant impact on residents' participation intention (willingness to pay), which factors can be ignored, and the confidence of using these important factors to predict future residents' participation intention.

3.4.4 AHP Analysis

Landscape aesthetic analysis started from late 60's in twentieth century. Then vast number of researches are aiming at finding a model for landscape aesthetic analysis. Landscape aesthetic can influence how we perceive the world around us. According to Terry C Daniel (2001), landscape aesthetic quality is people's psychological process which is in an interaction with landscape characteristics.

Photographic images and digital drawings are usually used as a method in order to evaluate the environmental quality. To sum up, there are two photographic data collection methods:

1) Photos taken by researchers (AHP theory, SD theory)

² 1=Strongly Agree/Never, 2=Agree/1-2times per week, 3=Remain Neutral/3-4 times per week, 4=Disagree/5-6 times per week, 5=Strongly Disagree/Everyday

2) Photos taken by public (residents, tourists).

According to Nika Balomenou, Brian Garrod (2014), the second method is usually accompanied with interviews, diaries or questionnaires to the public, for example, volunteer-employed photography (VEP). Therefore, this approach to residents in Xicheng District may take long time and the result cannot be guaranteed. In recent years, the most popular ways to assess the aesthetic is AHP quantitative evaluation model and Semantic differential (SD) quantitative evaluation model. According to WU HAN (2016), AHP theory is a more detailed and clear analysis compared to SD theory. Therefore, this study will use AHP accompanied with Delphi as a tool for quantitative evaluation of landscape aesthetic.

AHP is a structured technique for organizing and analyzing complex decisions, based on mathematics and psychology.

There are three simple steps to finish AHP analysis: 1) Establish evaluation criteria system 2)Criteria weights 3)Analyze data

From step 1) to step 2), there are also several steps to accomplish the evaluation criteria system: a. Experts score for each criterion b. Compute the vector of criteria weights c. Compute the matrix of option scores. d. Ranking the options e. Checking the consistency f. Automating the pairwise comparisons

3.4.5 Contents and Methodology in Summary

Table 2. Contents and Methodology in Summary

Contents			Method
Classify types of communities in Xicheng district			Field investigation and Baidu satellite map
Green space characters---- basic information about green space in each community	Greening rate		Ichnography
Residents satisfaction to green space in their communities	Analysis of satisfaction to green space aesthetic		AHP (questionnaire)
	Analysis of satisfaction to green space functions	Social functions Ecological functions	Questionnaire (SPSS analysis)
Residents participation intention			Questionnaire (SPSS analysis)
Property management company participation motivation			Interview

CHAPTER FOUR

4. RESULTS

4.1 Results for Content “Classify Types of Communities in Xicheng District”

As aforementioned, the author classified communities into 3 types according to green space conditions.

Type A community: Lack of designed green space

Type B community: have green space but no public green space attached

Type C community: have green space and public green space attached.

There are 374 communities in total in Xicheng District. Type A community is 4%, type B community is 20% and type C community is 76% (**Figure 4**). Type C community is the majority. Physical characters of communities show in the **Table 3**. Type A communities do not have any green space ratio. In the contrast, type C communities’ green ratio keep around 20%. Questionnaire feedback from type A communities notable less than other types of communities.

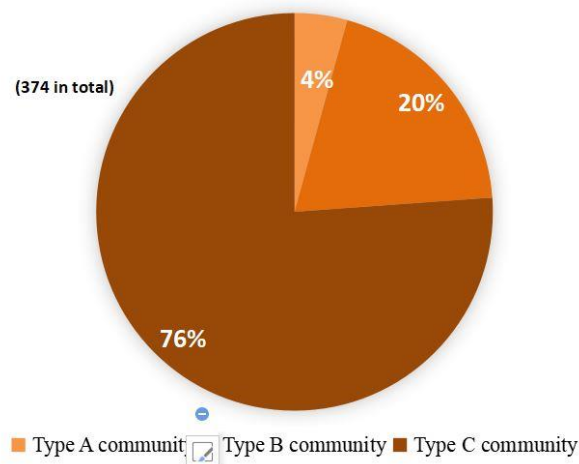


Figure 4. Percentage of Each Type of Community

4.2 Results for Content “Green Space Characters----Basic Information About Green Space in Each Community”

According to the year of built, this study chose 9 communities in total. All communities are divided according to year of built into 4 groups: communities built in 1950-1970, communities built in 1971-1990, communities built in 1991-2010, communities built in 2011-2018.

However, type 1 community doesn't have communities built after 1990 and after 2010. And type 2 community current data does not have communities built after 1990 and after 2010. What's more, for type 1 community is the minority, type 3 is the majority and type 2 is in the middle, only two communities from type 1, three communities from type 2, and 4 communities from type 3. Number of questionnaires feedback from each type of community showed in the **Figure 12**.

Table 3. Physical Characteristic of Questionnaire Distribution Community

Name of communities	Type of the community	Year	Area size (square meters)	Green space ratio	Management system	Property Management Payment needed or not	Number of valid feedback questionnaire
TaipingjieNo.17	Type1	1970	2042.996	0%	Residents' committee	N	4
Maxiangxixiang	Type1	1983	943.463	0%	Residents' committee	N	17
Wulutongbeijie1 &2	Type2	1964	2424.708	2.06%	Residents' committee	Y	31
Yuetannanjiebei li	Type2	1984	2943.938	5.37%	Property management company	Y	29
Baiwanzhuangwuqu	Type2	1956	12652.638	12.17%	Residents' committee	N	31
Fuzhuohuayuan	Type3	2003	15599.293	34.8%	Property management company	Y	18
Huaibaishujiebei li	Type3	1979	12571.032	19.58%	Residents' committee	N	28
Zijinyinxiang	Type3	2016	16032.441	26.22%	Property management company	Y	12
ChezhandongjiejiaNo.9	Type3	1995	4548.069	11.1%	Residents' committee	Y	23

The questionnaire distribution communities' location map is as below (Figure 5). Map of each community and photos of each communities are shown in the **APPENDIX A, APPENDIX B.**

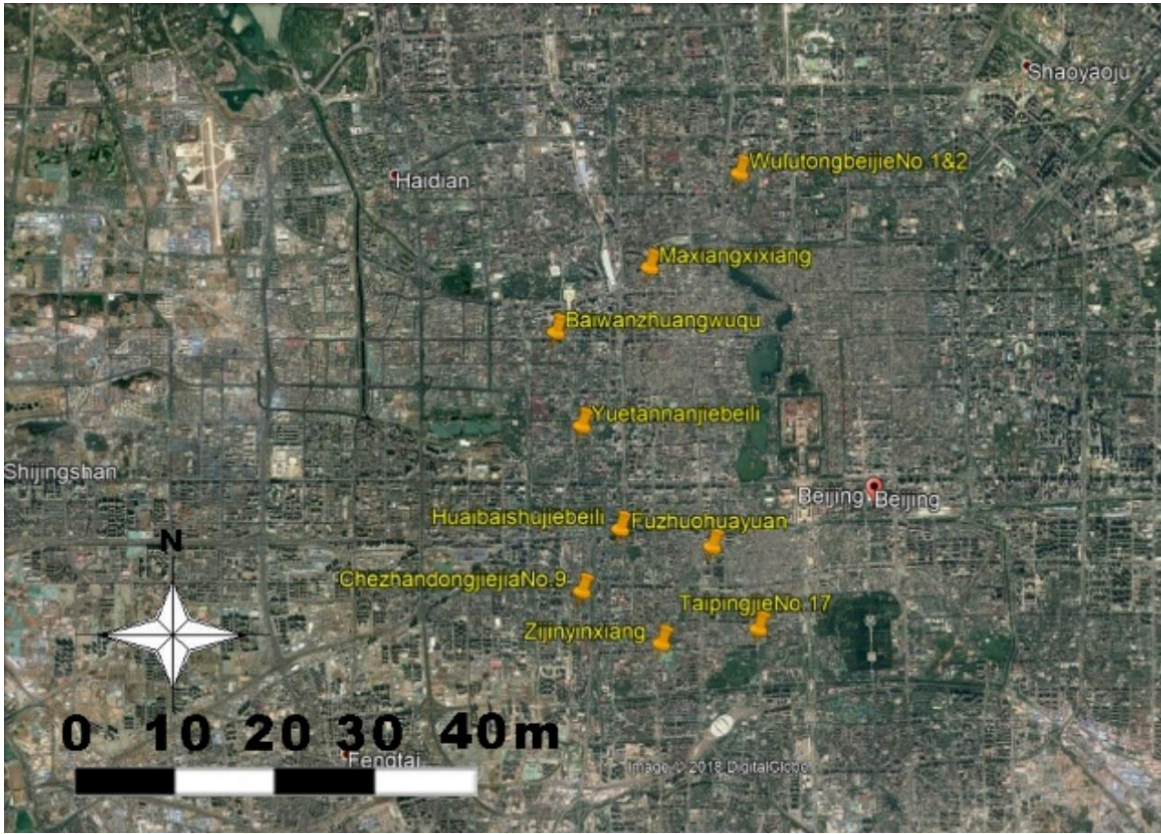


Figure 5. Location Map of Questionnaire Distribution Communities

4.3 Results for content” Analysis of satisfaction to green space aesthetic”

4.3.1 Construction of AHP model of landscape aesthetic index in residential areas

The landscape aesthetic index system based on the landscape aesthetic index of the residential area is as shown in Table 9, which consists of three grade I decision-making indexes and seven grade II decision-making indexes. Among them, the highest level is the final target layer (A) of the comprehensive evaluation, the second layer is the main index layer (B), and the third layer is the evaluation factor layer (C) which is subordinate to a variety of major components.

Table 4. Structural Table of Landscape Aesthetic Index Layer in Residential Areas

GOAL (A)	CRITERIA 1 (B)	CRITERIA 2 (C)
Evaluation System of Landscape Aesthetic in Residential Areas	Overall Intuitive Feeling B1	The Richness of Color Change in Four Seasons C1
		Comfort of Landscape Elements Matching C2
		The Richness of Spatial Level of Landscape C3
	Vegetation Landscape B2	Species Diversity of Vegetation C4
		Maintenance of Vegetation C5
	Hard Landscape B3	Cleaning Status of Hard Landscape C6
		Maintenance of Hard Landscape C7

4.3.2 Judgment matrix of landscape aesthetic in residential areas

Three experts are consulted in the study, all of whom are professors of horticulture or related majors. The judgment matrix is constructed by calculating in groups the geometric mean of the scores given by the professors.

Table 5. Comparison Judgment Matrix between the First Layer and Second Layer

A	B1	B2	B3
B1	1	2	5
B2	1/2	1	3
B3	1/5	1/3	1

Table 6. Comparison Judgment Matrix between the Third Layer and B1 of the Second Layer

B1	C1	C2	C3	C4	C5	C6	C7
C1	1	7	1/3	4	7	1/2	7
C2	1/7	1	1/9	1/4	1	1/8	1
C3	3	9	1	6	9	2	9
C4	1/4	4	1/6	1	4	1/5	7
C5	1/7	1	1/9	1/4	1	1/8	1
C6	2	8	1/2	5	8	1	8
C7	1/7	1	1/9	1/7	1	1/8	1

Table 7. Comparison Judgment Matrix between the Third Layer and B2 of the Second Layer

B2	C1	C2	C3	C4	C5	C6	C7
C1	1	8	4	8	4	2	8
C2	1/8	1	1/5	1	1/5	1/7	1
C3	1/4	5	1	5	1	1/3	5
C4	1/8	1	1/5	1	1/5	1/7	1
C5	1/4	5	1	5	1	1/3	5
C6	1/2	7	3	7	3	1	7
C7	1/8	1	1/5	1	1/5	1/7	1

Table 8. Comparison Judgment Matrix between the Third Layer and B3 of the Second Layer

B3	C1	C2	C3	C4	C5	C6	C7
C1	1	7	1/3	1/2	7	7	1/2
C2	1/7	1	1/9	1/8	1	1	1/8
C3	3	9	1	2	9	9	2
C4	2	8	1/2	1	8	8	1
C5	1/7	1	1/9	1/8	1	1	1/8
C6	1/7	1	1/9	1/8	1	1	1/8
C7	2	8	1/2	1	8	8	1

4.3.3 Consistency check of landscape aesthetic in residential areas

The maximum eigenvalues, weight vectors and correlation values of the above comparison judgment matrices are calculated by excel.

Table 9. Consistency Check of Judgment Matrices

Matrix	Weight Vectors	λ_{max} Maximum Eigenvalues λ_{max}	CI	RI	CR
A-B	(0.5813,0.3091,0.1096)	3.0036	0.0018	0.58	0.0032
B1-C	(0.1876,0.0298,0.3678,0.0974, 0.0298,0.2587,0.0289)	7.3786	0.063	1.32	0.0478
B2-C	(0.3714,0.0338,0.1330,0.0338, 0.1330,0.2614,0.0338)	7.2032	0.0339	1.32	0.0257

B3-C	(0.1498,0.0279,0.3318,0.2173, 0.0279,0.0279,0.2173)	7.1284	0.0214	1.32	0.0162
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According to the research results, the CR values of the four layers are 0.0032, 0.0478, 0.0257 and 0.0162 respectively. All being less than 0.1, the data indicate that these judgment matrices all satisfy the requirement of consistency.

4.3.4 Calculation of Total Ranking Weight of Hierarchy

It can be concluded from the consistency check that the ranking weight of the second layer (B) to the total target layer (A) is $w_1 = (0.5813, 0.3091, 0.1096)$.

The ranking weight of the third layer to various factors in the second layer (Bi) is:

$$a_1 = (0.1876, 0.0298, 0.3678, 0.0974, 0.0298, 0.2587, 0.0289)$$

$$a_2 = (0.3714, 0.0338, 0.1330, 0.0338, 0.1330, 0.2614, 0.0338)$$

$$a_3 = (0.1498, 0.0279, 0.3318, 0.2173, 0.0279, 0.0279, 0.2173)$$

And the ranking weight of various indexes in the third layer to the first layer is:

$$W = (a_1, a_2, a_3) \times w_1 = (0.2403, 0.0308, 0.2912, 0.0909, 0.0615, 0.2343, 0.0510)$$

As suggested by the weight results:

1) In accordance with the landscape aesthetic index of residential areas, in the construction of the landscape aesthetic index system of the residential area, from high to low, the importance of indexes in the major index layer (B) are respectively the overall intuitive feeling B1, soft landscape B2 and hard landscape B3.

2) In accordance with the landscape aesthetic index of residential areas, in the construction of the landscape aesthetic index system of the residential area, from high to low, the importance of indexes in the grade II index layer (C) are respectively the richness of spatial level of landscape C3, the richness of color change in four seasons C1, cleaning status of hard landscape C6, species diversity of vegetation C4, maintenance of vegetation C5, maintenance of hard landscape C7 and comfort of landscape elements matching C2.

4.3.5 Synthesis Score of Landscape Aesthetic in Residential Areas

Relevant data at the grade II index layer are collated through distributing questionnaires in the first to ninth residential areas. Then the average score of the grade II index layer of these residential areas is obtained by calculating the median of each index in the grade II index layer, which, then being multiplied by the corresponding weight to obtain the final synthesis score. The specific formulas is as follows:

$$Score_i = \sum_{i=1}^7 W_i C_i$$

The $Score_i$ in the formula is the synthesis score of the first residential area, while W_{Ci} refers to the weight and C_i is the average score of various grade II index layer.

The synthesis scores of the 9 residential areas can be obtained with the above comprehensive evaluation formula.

Table 10. Landscape Aesthetic Score of Each Community

Communities' Name	TaipingjieNo.17	Maxiangxixiang	Wulutongbeijie	Yuetannanjebeili	Baiwanzhuangwuqu
Synthesis score	1.6996	2.1448	3.1979	5.0738	4.6634
Communities' Name	Fuzhuohuayuan	Huaibaishujiebeili	Zijinyinxiang	ChezhandongjiejiaNo.9	
Synthesis score	8.0116	7.1524	8.5301	7.2994	

It can be concluded from the scores of various residential areas that since the residential area 8 has obtained the highest score, it is of the greatest landscape aesthetic, while the residential area 1 assumes the poorest landscape aesthetic with the lowest score. the ranking of landscape aesthetic score of communities is as followed : Zijinyinxiang(8.5301)> Fuzhuohuayuan(8.0116)> ChezhandongjiejiaNo.9> Huaibaishujiebeili(7.1524)>Yuetannanjebeili(5.0738)> Baiwanzhuangwuqu(4.6634)> Wulutongbeijie(3.1979)> Maxiangxixiang(2.1448)> TaipingjieNo.17(1.6996)

Therefore, the ranking of landscape aesthetic score of communities has always been Type A community being the lowest, followed by Type B community, while Type C community being the highest. (Type A=TaipingjieNo.17+Maxiangxixiang/ Type B=wulutongbeijie+Yuetannanjebeili+Baiwanzhuangwuqu/ Type C=Fuzhuohuayuan+Huaibaishujiebeili+Zijinyinxiang+ChezhandongjiejiaNo.9

4.4 Result for content” Analysis of satisfaction to green space functions”

4.4.1 Descriptive Results

The analysis indicates that 44% of the respondents were male and 55% of the respondents were female, as shown in **Figure 7** below. Majority of their monthly income ranged predominantly from 1000 yuan (15, 795 yen) to 10,000 yuan (157, 850 yen) (**Figure 8**). Approximately half of the respondents had acquired a bachelor’s degree or equivalent (**Figure 9**). Age and staying period distribution are approximately even (**Figure 10, Figure 11**). The number of feedback questionnaire from each type of community is shown in **Figure 12**.

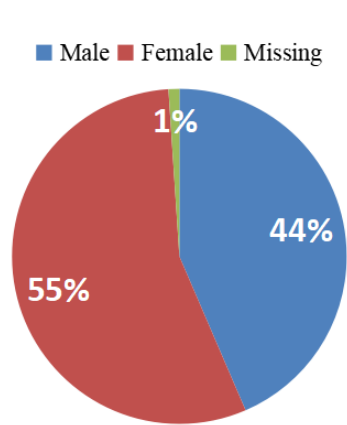


Figure 7. Gender Composition

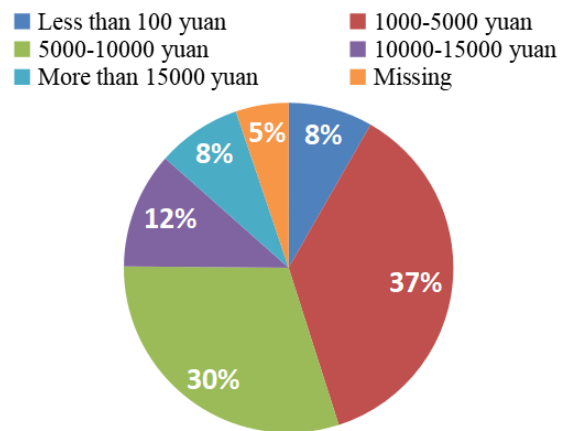


Figure 8. Salary Composition³

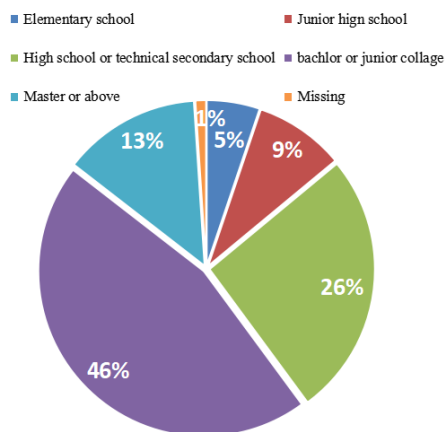


Figure 9. Education Composition

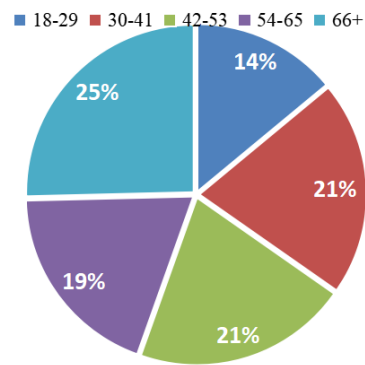


Figure 10. Age Composition

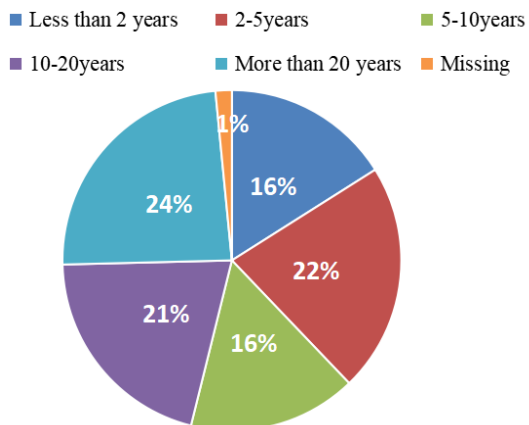


Figure 11. Staying Period

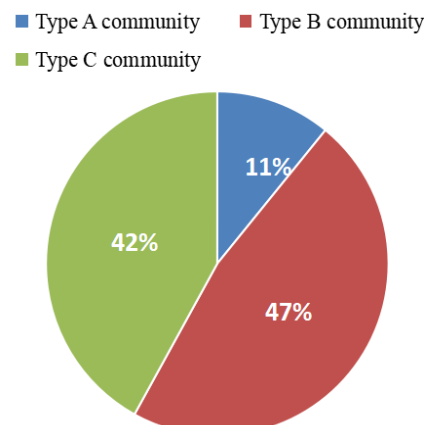


Figure 12. Number of Feedback from Each Type of Community

³ Salary composition: 1,000yuan=15,795yen/ 5,000yuan=78,975yen/ 10,000yuan=157,950yen/ 15,000yuan=236,925yen

4.4.2 Correlation Analysis

In view of the significant differences in the green space status of different types of communities, the author will conduct correlation analysis for the three types of communities respectively. The table below lists 36 independent variables and one dependent variable which are included in the analysis.

Table 11. Dependent and Independent Variables for Correlation Analysis

Dependent variables
Willingness to pay
Independent variables
Gender
How old are you
Education level
How long you stay in this community
Salary per month
The frequency you pass by the green space
The frequency you stay in the green space
I just pass by for going to another place (in or out community, go to friends' house, parking lot etc.)
I just jog along the green space
I just take a walk along the green space
I stay in the green space because I want to look for my kids, pets, things etc.
I stay in the green space because I want to do some exercise (jogging, taking a walk, dancing, taikyoken)
I stay in the green space because I want to eat something (along or with friends)
I stay in the green space because I want to walk a pet
I stay in the green space because I want to play with children
I stay in the green space because I want to talk with people
I stay in the green space because I want to read books
I think the amount of green space in my community is enough for my daily activity
I think the amount of green space in my community is not enough for my daily activity

I think the functional design of my community green space is enough for my daily activity
I think the functional design of my community green space is not enough for my daily activity
The frequency you pass by the public green space
The frequency you pass by the green belt around buildings
The frequency you pass by the green space attached to road
The frequency you pass by the green space attached to public infrastructures
The frequency you stop and stay in the public green space
The frequency you stop and stay in the green belt around buildings
The frequency you stop and stay in the green space attached to road
The frequency you stop and stay in the green space attached to public infrastructures
The agreement of environmental functions of the green space to your community----Diminution of urban air pollution
The agreement of environmental functions of the green space to your community----Diminution of urban air temperature
The agreement of environmental functions of the green space to your community----Carbon dioxide sequestration
The agreement of environmental functions of the green space to your community----Biodiversity promotion
The agreement of environmental functions of the green space to your community----Noise reduction
I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization
I will pay more money for property management company for greenery waste collection because I think it is a policy and I must pay
Do you know how much the property management fee you should per square meter?

It can be concluded from the correlation analysis that each type of community assumes different significant independent variables, which are respectively shown in **Table 12**, **Table 13** and **Table14**.

Table12. Significant Independent Variables for Residents' Willingness to Pay in Type A Community

		Salary per month	I just pass by for going to another place (in or out community, go to friend's house, parking lot etc.)	The frequency you pass by the public the green space	The frequency you stop and stay in public the green space
Willingness to pay ^a	Pearson Correlation	0.591**	-0.609**	0.768**	0.482*
	Sig. (2-tailed)	0.01	0.003	0	0.027
	N	18	21	21	21
a. Willingness to pay: 1=0.00yuan(0.00yen)/2=0.01-1.00yuan(0.159yen-15.9yen)/3=Any amount of money is acceptable if it is reasonable					

* Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 13. Significant independent variables for residents' willingness to pay in Type B community

		How old are you	How long you stay in this community	I stay in the green space because I want to eat something (along or with friends)	I think the amount of green space in my community is not enough for my daily activity	I think the functional design of my community green space is not enough for my daily activity	I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization	I will pay more money for property management company for greenery waste collection because I think it is a policy and I must pay
Willingness to pay ^a	Pearson Correlation	-0.307**	-0.36**	0.268*	0.277**	0.346**	-0.3**	-0.336**

	Sig. (2-tailed)	0.005	0.001	0.014	0.016	0.004	0.006	0.002
	N	84	81	84	75	67	84	80
a. Willingness to pay: 1=0.00yuan(0.00yen)/2=0.01-1.00yuan(0.159yen-15.9yen)/3=Any amount of money is acceptable if it is reasonable								

* Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 14. Significant independent variables for residents' willingness to pay in Type C community

		gender	I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization
Willingness to pay ^a	Pearson Correlation	-0.232*	-0.433
	Sig. (2-tailed)	0.045	0
	N	75	74
a. Willingness to pay: 1=0.00yuan(0.00yen)/2=0.01-1.00yuan(0.159yen-15.9yen)/3=Any amount of money is acceptable if it is reasonable			

* Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

In accordance with **Table12**, 4 independent variables out of 37 independent variables exert significant influence on residents' willingness to pay of Type A community. In view of the absence of any green space in Type A communities, other three significant influencing factors except salary should not appear in theory. Whereas, residents may have not fully understood that these types of green space did not exist in their communities when filling out the questionnaire and thus filled out according to the imagination of their previous experience in green space. Nevertheless, as a necessary activity, I just pass by the green space to go to other places has a negative effect on residents' willingness to pay. The more frequently this necessary activity is carried out, the more reluctant residents are to pay. In contrast, the frequency you pass by the public green space and the frequency you stop and stay in the public green space demonstrates a positive effect on residents' willingness to pay. That is, the more frequently they pass or stay on the green space, the more willing they are to pay.

It can be concluded from **Table 14** that only two factors have a significant impact on residents' willingness to pay of Type C community. That is, gender and the recognition of the statement of voluntary contribution to the environment protection. The more they agree with this statement, the more willing they are to pay more to participate in greenery waste collection. The case of Type C community is simpler and is only subject to fewer significant influencing factors.

To further scrutinize the relationship between the dependent and significant independent variables, the authors continued examining the data through further correlation analysis and regression analysis.

4.4.3 Regression Analysis

To further scrutinize the relationship between the dependent and significant independent variables, the authors continued examining the data through regression analysis for each type of community.

Table 15. Regression Analysis of Type A Community

Model Summary ^b					
Type of communities	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Type A	1	0.688 ^a	0.473	0.311	0.34533

a. Predictors: (Constant), the frequency you stop and stay in public the green space, I just pass by for going to another place (in or out community, go to friends' house, parking lot etc.), Salary per month, the frequency you pass by the public the green space

b. Dependent Variable: willingness to pay

ANOVA ^a							
Type of communities	Model		Sum of Squares	df	Mean Square	F	Sig.
Type A	1	Regression	1.394	4	0.349	2.923	0.063 ^b
		Residual	1.55	13	0.119		
		Total	2.944	17			

a. Dependent Variable: willingness to pay

b. Predictors: (Constant), the frequency you stop and stay in public the green space, I just pass by for going to another place (in or out community, go to friends' house, parking lot etc.), Salary per month, the frequency you pass by the public the green space

Table 16. Regression Analysis of Type B Community

Model Summary ^b					
Type of communities	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Type B	1	0.567 ^c	0.322	0.234	0.53706

b. Dependent Variable: willingness to pay

c. Predictors: (Constant), I will pay more money for property management company for greenery waste collection because I think it is a policy and I must pay, I think the functional design of my community green space is not enough for my daily activity, How long you stay in this community, How old are you, I stay in the green space because I want to eat something(along or with friends), I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization, I think the amount of green space in my community is not enough for my daily activity

ANOVA ^a							
Type of communities	Model		Sum of Squares	df	Mean Square	F	Sig.
Type B community	1	Regression	7.392	7	1.056	3.661	0.003 ^c
		Residual	15.576	54	0.288		
		Total	22.968	61			

a. Dependent Variable: willingness to pay

c. Predictors: (Constant), I will pay more money for property management company for greenery waste collection because I think it is a policy and I must pay, I stay in the green space because I want to eat something(along or with friends), I think the functional design of my community green space is not enough for my daily activity, How long you stay in this community, I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization, I think the amount of green space in my community is not enough for my daily activity, How old are you

Table 17. Regression Analysis of Type C Community

Model Summary b					
Type of communities	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
Type C community	1	.455 ^a	0.207	0.185	0.62631

a. Predictors: (Constant), I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization, gender

b. Dependent Variable: willingness to pay

ANOVA ^a							
Type of communities	Model		Sum of Squares	df	Mean Square	F	Sig.

Type C community	1	Regression	7.284	2	3.642	9.284	.000 ^b
		Residual	27.851	71	0.392		
		Total	35.135	73			

a. Dependent Variable: willingness to pay

b. Predictors: (Constant), I will pay more money for property management company for greenery waste collection because I think it is duty to do something for our environment and resource reutilization, gender.

In the first table model summary, R refers to goodness of fit, which measures the degree of goodness between the estimated model and the observed value, while the closer its value is to 1, the better the model is. It is considered to be a small effect ($R^2=0.01$) when the goodness of fit is up to 0.1, a medium effect ($R^2=0.09$) when the goodness of fit is 0.3, and a large effect ($R^2=0.25$) when the goodness of fit 0.5. Hence, it can be known from the first form (model summary) of each set of tables that Type A community and Type B community belong to large effect, while Type C community belong to medium effect. Nevertheless, combined with the sig value of each group of ANOVA tables, the sig value of Type A community (0.063) is greater than 0.05, implying that independent variables do not indicate significant determinacy and predictability to dependent variables; the sig values of Type B community are between 0.01 and 0.05, implying that independent variables play a secondary role of determinacy and predictability to dependent variables; while the sig value of Type C community group is lower than 0.01, which indicates that independent variables assume obvious determinacy and predictability to dependent

In addition, from perspective of the value of F, as the significance test of regression equation, the value of F reflects whether the linear relationship between explained variables and all explanatory variables in the model is significantly inferred in general. The original hypothesis shall be rejected in the case that F is greater than $F_{\alpha}(k, n-k-1)$ (k is the number of independent variables, n is the sample size, and n-k-1 is the degree of freedom), that is to say, the explanatory variables included in the model are combined to have a significant impact on the explained variables. Otherwise, it has no significant impact.

Conduct the verification of Table F (= FINV (a, k, n), a = 0.05) with excel. Open excel and input = FINV (0.05, 7, 91) in the formula area to get the result of 2.111904705; input = FINV (0.05, 2, 81) to get the result of 3.109310547. Since the values of F in the table are both significantly larger than this value, it is affirmed that each explanatory variable has a significant impact on the dependent variables.

4.5 Results for Content “Residents’ Participation Intention”

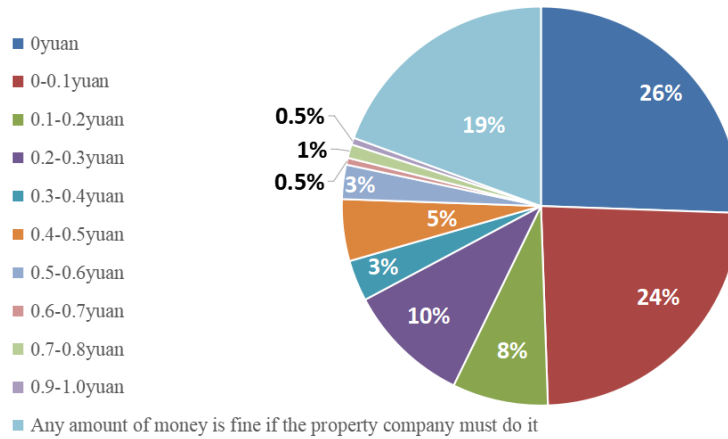


Figure 13. Residents’ Participation Intention (Willingness to Pay)

According to this table, 26% of the residents are unwilling to pay any additional property fees to support greenery waste recovery, 24% are willing to pay a small amount of fees, while 19% are willing to pay any amount of additional fees to the property company in case of reasonable payment requirements. However, few people choose the payment range of 0.1 Yuan to 1 Yuan, especially the option of more than 0.3 Yuan that is chosen by almost no one.

It is believed by the author that compared with residents not knowing the total property fee per square meter in their communities, the answer of those having a clear understanding of the total property fee per square meter in their communities is more credible, which is due to that only on the premise of knowing the property fee can it be reasonably measured that whether the additional property fee is acceptable can be. In accordance with the collected questionnaires, 106 residents exhibit an understanding of their own property fees, accounting for 53.4% of the total number of questionnaires retrieved. The answers of these residents' willingness to pay extra property fees are as follows.

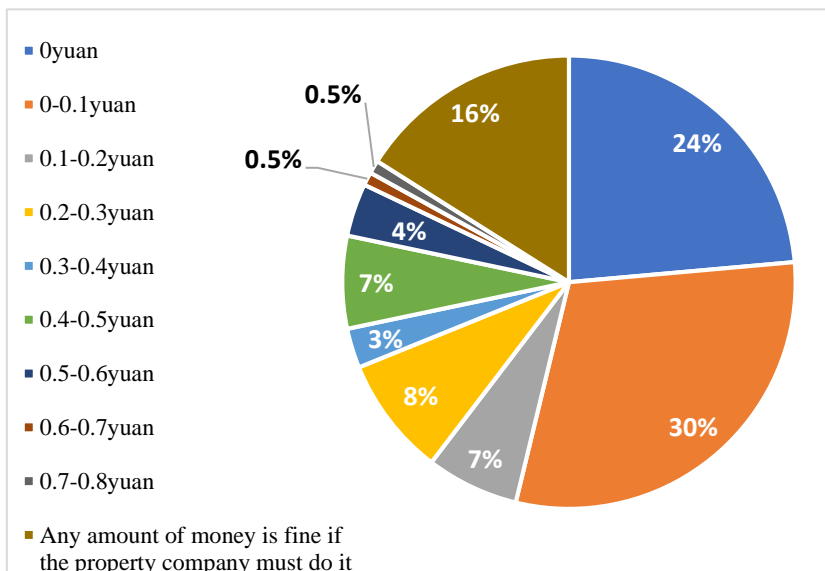


Figure 14. Knowing Payment Group of Residents’ Participation Intention (Willingness to Pay)

4.6 Result for Content” Property Management Company Participation Motivation”

Table 18. Answer of Interview to Property Management Company

Community's Name	*Interview Question No.1	*Interview Question No.2	*Interview Question No.3	*Interview Question No.4
TaipingjieNo.17	NO	×	Cannot be estimated so far	a. It's our duty to conduct greenery waste collection and participate into resource reutilization
Maxiangxixiang	NO	×	Cannot be estimated so far	×
Wulutongbeijie1&2	YES	Free of charge	Cannot be estimated so far	d. Labor support from Landscape Bureau and free of charge
Yuetannanjebeili	NO	×	Cannot be estimated so far	×
Baiwanzhuangwuqu	NO	×	Cannot be estimated so far	d. Financial support from government
Fuzhuohuayuan	NO	×	Cannot be estimated so far	d. Financial support from government
Huaibaishujiebeili	YES	Free of charge	Cannot be estimated so far	d. Labor support from Landscape Bureau and free of charge
Zijinyinxiang	NO	×	Cannot be estimated so far	a. It's our duty to conduct greenery waste collection and participate into resource reutilization
ChezhandongjiejiaNo.9	NO	×	Cannot be estimated so far	d. Security (fire risk)

× Not answered

* Interview question No.1: Has this community participate into greenery waste collection so far?

Interview question No.2: Residents' payment for greenery waste

Interview question No.3: A rough number of how much management fee you must raise for greenery waste collection?

Interview question No.4: Motivations to participate greenery waste:

- a. It's our duty to conduct greenery waste collection and participate into resource reutilization
- b. We can get free fertilizer for my community green space
- c. I can get reward from government if we are doing well among all the communities in Xicheng District.
- d. Others: _____

CHAPTER FIVE

5. DISCUSSION

5.1 Discussion for “Classify types of communities in Xicheng district”

It can be learnt through the classification of communities that Type C community assumes a largest quantity and its year of completion is later than Type B and Type C community, which indicates that the green space environment of newly built communities has been improved due to the enhancement of construction standards, while this is also the development trend of community construction in the future. As older communities, the numbers of Type B communities and Type C communities are smaller, especially those of Type C communities facing demolition will particularly decrease. Therefore, the reference significance of the analysis of Type B and Type C community in this study acts on the existing communities in Xicheng District rather than the newly constructed ones.

5.2 Discussion for “Green space characters----basic information about green space in each community”

Firstly, all the selected communities for questionnaire of Type C Community are built after the 1970s from the perspective of the completion time, while Type C Community is basically larger than Type B and Type C Community in area, and so is the Green Rate, which implies that Type C Community is intuitively a type of community with comfortable living environment. This is also reflected in the floor plan.

5.3 Discussion for” Analysis of satisfaction to green space aesthetic”

In accordance with the score of landscape aesthetics, Zijinyinxiang community that belongs to Type C Community, with the highest score, possesses the green space of the highest aesthetic perception. Four communities belonging to Type C Community rank the top four in the survey, indicating that Type C Community does hold the highest aesthetic perception of green landscape. The communities belonging to Type B community are all in the middle of the ranking, while those in Type A community rank the bottom one and the second. The scores of three types of communities in landscape perfectly correspond to the classification of communities in this study, which verifies the rationality of the three classifications of communities in Xicheng District that makes a clear division of the grade of communities to some extent. Zijinyinxiang (8.5301) > Fuzhuohuayuan (8.0116) > Chezhandongjiejia No.9 > Huaibaishujujibeili (7.1524) > Yuetannanjiebeili (5.0738) > Baiwanzhuangwuqu (4.6634) > Wulotongbeijie (3.1979) > Maxixiang (2.1448) > Taiping No.17 (1.6996)

In addition to ranking the landscape aesthetic perception, the relationship between landscape aesthetic perception and willingness of participation is also further explored in this study.

Data analysis in the preceding part of this article focuses on the relationship between residents' satisfaction with green space function and willingness to pay. What follows will discuss the relationship between the score of community landscape aesthetics and residents' willingness to pay.

The types of communities are firstly taken as the object of analysis. The distribution tables of willingness to pay of residents of Type A, Type B and Type C communities are respectively as follows:

Table 19. The Distribution Tables of Willingness to Pay of Residents of Each Type of Communities

Type of communities		Frequency	Percentage
Type A=TaipingjieNo.17+Maxiangxixiang	Valid	1.00	3 14.3
		2.00	15 71.4
		3.00	3 14.3
		Total	21 100.0
Type B=wulutongbeijie+Yuetannanjebeili+Baiwanzhuangwuqu	Valid	1.00	28 30.8
		2.00	46 50.5
		3.00	10 11.0
		Total	84 92.3
	Missing System	7 7.7	
Total	91 100.0		
Type C=Fuzhuohuayuan+Huaibaishujiebeili+Zijinyinxiang+ChezhandongjiejiaNo.9	Valid	1.00	15 18.5
		2.00	38 46.9
		3.00	22 27.2
		Total	75 92.6
	Missing System	6 7.4	
Total	81 100.0		

It is thereby can be obtained that the percentage ranking choosing willingness to pay (2+3=0.01-1.00 Yuan (0.159yen-15.9yen) +Any amount of money is acceptable if it is reasonable) is:

Type A (85.7%)>Type C (74.1%)>Type B (61.5%)

Then, the participation frequency distribution tables of each community are ranked separately, as shown in the **Table 20** below.

Table 20. The Participation Frequency Distribution of Each Community

Community's name			Frequency	Percentage
TaipingjieNo.17	Valid	2.00	4	100.0
Maxiangxixiang	Valid	1.00	3	17.6
		2.00	11	64.7
		3.00	3	17.6
		Total	17	100.0
Wulutongbeijie	Valid	1.00	7	22.6
		2.00	13	41.9
		3.00	4	12.9
		Total	24	77.4
	Missing	System	7	22.6
	Total		31	100.0
Yuetannanjebeili	Valid	1.00	11	37.9
		2.00	16	55.2
		3.00	2	6.9
		Total	29	100.0
Baiwanzhuangwuqu	Valid	1.00	10	32.3
		2.00	17	54.8
		3.00	4	12.9
		Total	31	100.0
Fuzhuohuayuan	Valid	1.00	2	11.1
		2.00	9	50.0
		3.00	4	22.2
		Total	15	83.3
	Missing	System	3	16.7
	Total		18	100.0
Huaibaishujiebeili	Valid	1.00	5	17.9
		2.00	10	35.7

		3.00	10	35.7
		Total	25	89.3
	Missing	System	3	10.7
	Total		28	100.0
Zijinyinxiang	Valid	1.00	2	16.7
		2.00	9	75.0
		3.00	1	8.3
		Total	12	100.0
ChezhandongjiejiaNo.9	Valid	1.00	6	26.1
		2.00	10	43.5
		3.00	7	30.4
		Total	23	100.0
Willingness to pay: 1=0.00yuan(0.00yen)/2=0.01-1.00yuan(0.159yen-15.9yen)/3=Any amount of money is acceptable if it is reasonable				

It can be learnt that the percentage ranking choosing willingness to pay (2+ 3=0.01-1.00 Yuan (0.159yen-15.9yen) + Any amount of money is acceptable if it is reasonable) is:

TaipingjieNo.17(100%)>Zijinyinxiang

(83.3%)>Maxiangxixiang(82.3%)>ChezhandongjiejiaNo.9(73.9)>Fuzhuohuayuan(72.2%)>Huaibaishu jiebeili(71.4%)>Baiwanzhuangwuqu(67.7%)>Yuetannanjiebeili(62.1%)>Wulutongbeijie(54.8%)

It is basically consistent with the ranking in Table 9 and the scores of Type B community are lower than those of both Type A and Type B.

This implies that the Type B Community will face the greatest difficulty in the future greenery waste collection, while it can also be concluded from the factors that affect willingness to pay that the Type B Community has the most influencing factors and the most complex situation. According to the analysis, Type B Community is expected to enhance the aesthetic perception of its residential environment, and if the possibility of increasing green space is low, it might be tried to strengthen the management and maintenance of existing green space. From the landscape maintenance scoring tables of Type B and Type C community, it can be seen that compared with Type A community without green space, the existence of green space may not necessarily improve residents' satisfaction with the living environment in the case that there is green space in the community yet is failed to be well maintained.

5.4 Discussion for “Analysis of satisfaction to green space functions”

From the perspective of the influencing factors of the willingness to pay of residents of Type A Community, salary is considered to be controllable at present. In view of the higher salary, the stronger people's willingness to pay, the community can promote greenery waste collection according to the income level of residents in the community when formulating strategies in the future. On condition that the income of residents in a community is generally less than 1000 yuan (15, 795yen) per month and the payment rate of the community is 85.7%, we can predict that the financial support of the government might be required. In contrast, it can be encouraged through publicity and education if the income of residents in a community is generally higher than this value. Nevertheless, regression analysis indicates that these factors have failed to fully predict the willingness to pay of residents in a community, the reason of which

may be that the ideal regression curve cannot be formed with sufficient samples due to the small number of questionnaires that has been retrieved.

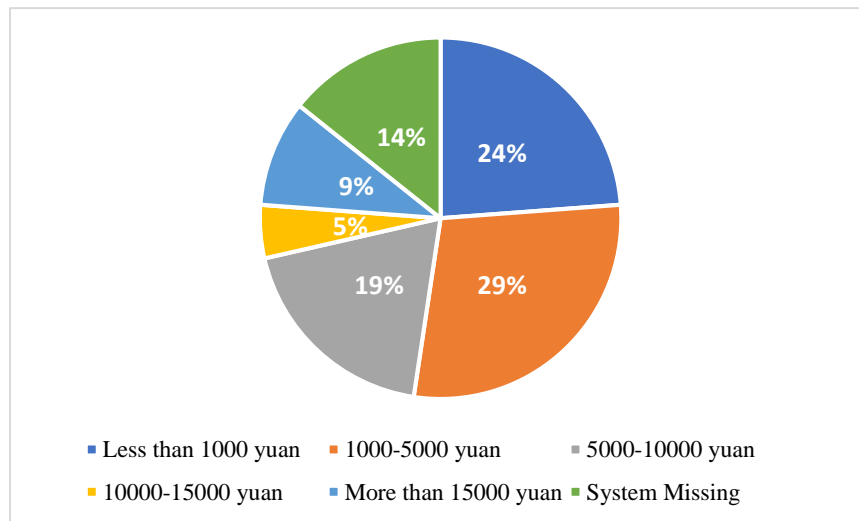


Figure15. Salary Composition in Type A Community

From the perspective of influencing factors of residents' willingness to pay of Type B community, firstly, the property company of communities should count the age and the time of residence of residents, while the attention should be especially paid to the publicity, education and encouragement for the elderly and the people who have lived there for a long time. Secondly, in the case that the number of green space cannot be increased, the quality of maintenance of existing green space in the community might be improved, so that people who stay nearby can enjoy their time staying there. In addition, the neighborhood committees of these communities should improve the participation of residents by formulating relevant provisions on collection. These factors can also be used to estimate the willingness

to pay of residents in a community to provide reference for the participation of residents in greenery waste collection in other communities in Beijing.

In terms of the influencing factors of residents' willingness to pay in Type C community, considering that only residents' willingness to protect the environment and recycle resources can effectively predict the willingness to participate in greenery waste collection in an unknown community, property companies can make a greenery waste collection judgment merely by investigating the individual willingness of residents to carry out resource recycling.

5.5 Discussion for “Residents’ participation intention”

From **Figure 13**, it says that the amount is expected to be not too large despite that most residents are willing to pay extra fees or a reasonable amount of expenses. When it comes to the reasonable degree of property payment, it is indeed rational to pay less than 0.3 Yuan per square meter. That is, it is agreed by most residents that as long as the amount is reasonable, they can accept additional payment. The number of residents who can accept the payment of less than 0.3 Yuan per square meter and any reasonable amount is up to 61%.

Also, From **Figure 14**, It can be learned that among residents with an understanding of their own property fees, the proportion of those who are willing to pay reasonable amount and less than 0.3 Yuan per square meter is exactly 61% on the whole, while the proportion of those who are not willing to pay extra amount is slightly reduced to 24%.

Overall, there is a quite objective proportion of residents willing to pay, it is very possible to conduct greenery waste collection among residents.

5.6 Discussion for “Property management company participation motivation”

According to interviews with property companies, despite that the details of the community are not informed of, almost all property companies demonstrate anxiety that residents will not agree to pay extra money. Zijinyinxiang Community's property company says that the greenery waste collection can be carried out only with the consent of more than 50% of the owners, while such concerns are actually unnecessary from the results of the study.

CHAPTER SIX

6. CONCLUSIONS AND RECOMMENDATIONS

This study aims to investigate the status of collection system of greenery waste disposal in Xicheng district of Beijing, and to understand the factors which affect the attitude and behavior of residents.

Through the investigation, it is found that only the service from Dongbaxiang greenery waste to the treatment plant covers an entire urban area--Xicheng district within the urban area of Beijing. From the current situation of greenery waste collection in Xicheng district, the fallen leaves in residential areas are not involved in the recycling activities. In the previous investigation, it is found that the residents must pay the property company extra money if they want to participate in the recycling of fallen leaves in residential areas. Xicheng district has a total area of 374 residential areas, so greenery waste in the residential areas also occupies a very important proportion of all greenery waste in Xicheng district. If the residential areas can participate in the recycling of greenery waste, it will further reduce the pressure of the household waste treatment plant. The key to the problem is whether the property company can persuade the residents to pay money to support the recycling of greenery waste. The satisfaction degree of the residents of the community on the service quality of the property company affects their willingness to pay money. This study assumes that green space is one of the important living environment elements in the residential areas, and the satisfaction degree of the residents may affect their willingness to pay money.

The study will focus on the relationship between the satisfaction degree of residents on the green space and the willingness of residents to pay money. The study will use the form of questionnaire to investigate the satisfaction degree of residents in the community on the green space. The satisfaction degree is divided into two parts, the first part is the satisfaction degree on the green space function, and the second part is the satisfaction degree on the aesthetics of the residents. The first part will use SPSS to analyze the satisfaction degree of green space function, and the second part will use analytic hierarchy process (AHP) to analyze the satisfaction degree on the aesthetics of the residents. The author divides 374 residential areas in Xicheng district into three categories according to the situation of green space and selects 4 residential areas in each category according to the age. Since most of the districts in categories 1 and 2 are old residential areas, two residential areas in category 1 are selected as samples, three residential areas in category 2 are selected as samples, and four residential areas in category 3 are selected as samples. A total of 193 responses to valid questionnaires are received.

The results indicate that the willingness of residents to pay extra property fees in three types of communities is affected by various factors. Among them, the significant influencing factor of Type A community is the level of remuneration; The significant influencing factors of Type B community

include age, length of residence in the community, frequency of spontaneous activities in green space, satisfaction with the number and function of green space, the willingness to contribute to environmental protection, as well as the mandatory requirement from the government; The significant influencing factors of Type C community include gender and their willingness to contribute to environmental protection. It can be concluded from the subsequent regression analysis that these significant influencing factors can be adopted by Type B community and Type C community to carry out prediction and estimation of residents' willingness to pay in the future, thus providing a reference for future estimation of the possibility of residents paying extra expenses.

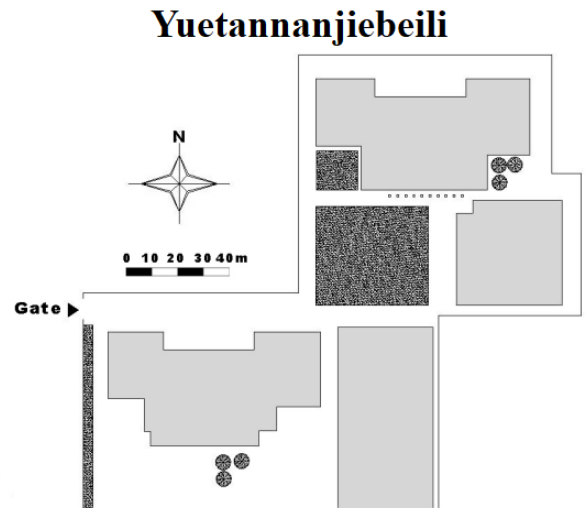
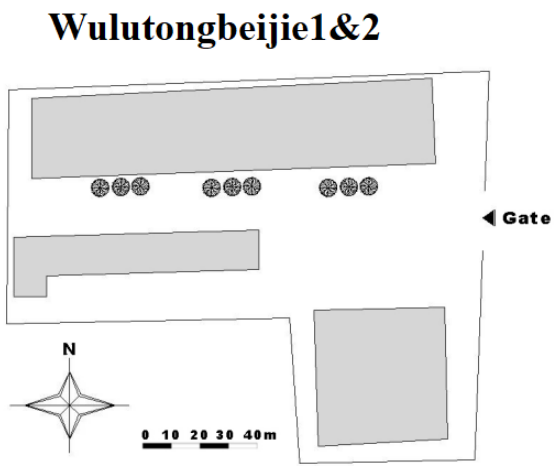
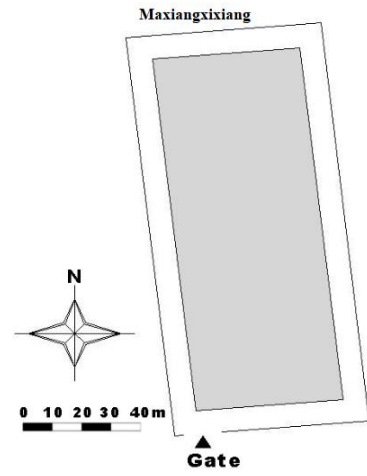
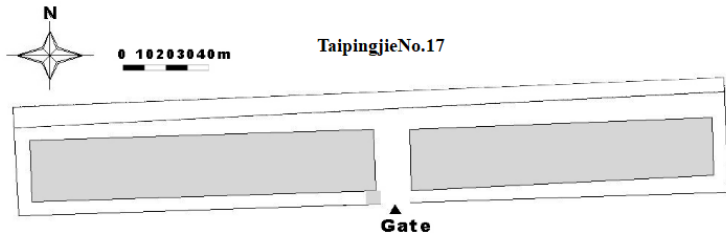
In addition, the relationship between landscape aesthetic perception and residents' willingness to pay is analyzed, the results of which imply that the willingness to pay of Type A community with the worst landscape aesthetic perception and Type C community with the best landscape aesthetic perception are both higher than that of Type B community with the middle ranking, while Type C community has the highest number of residents willing to pay extra fees. After analysis, the reason for this may lie in the high satisfaction of residents brought by the high quality of green space landscape in the community, while to a certain extent the quality of green space landscape in the community is also a manifestation of the service quality of the property company. In the case of high satisfaction, residents might be more willing to pay the property company additional reasonable cost for greenery waste recovery. Despite that the residents of Type A community may be more willing to carry out environmental improvement as the type of community with the worst landscape quality since there is no green space in Type A community, they can participate in greenery wastes recovery activities by encouraging residents to collect greenery wastes of their own potted plants in the future. Finally, the promotion of the payment willingness of the residents of Type B community could be achieved through improving landscape aesthetics in daily maintenance and taking into account the significant influencing factors mentioned above.

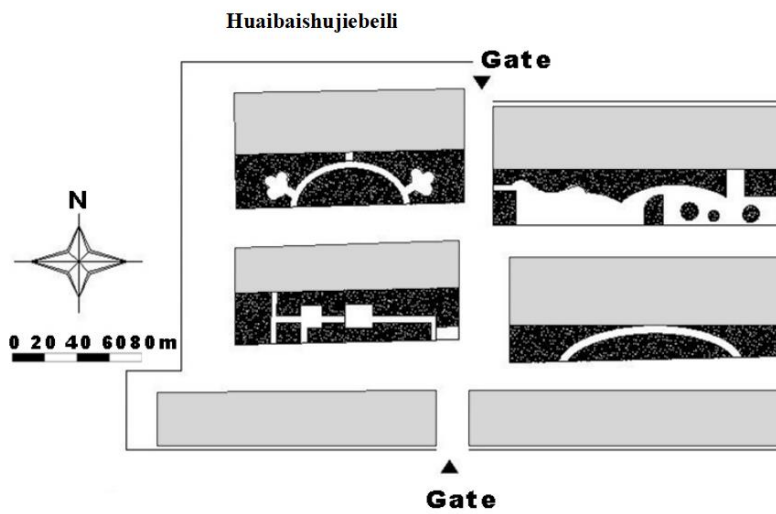
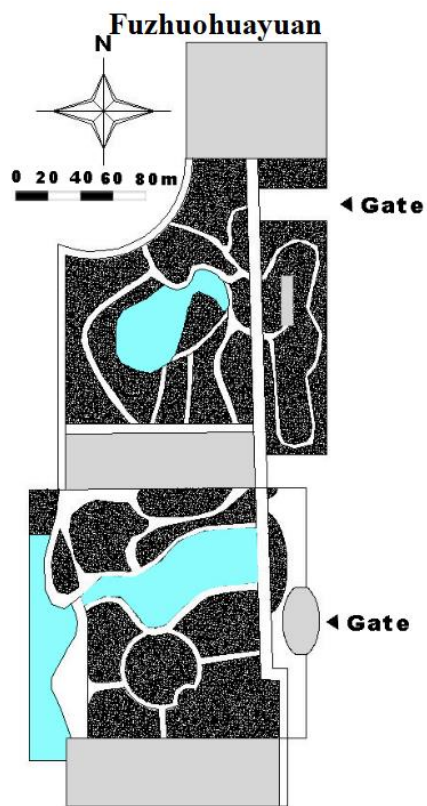
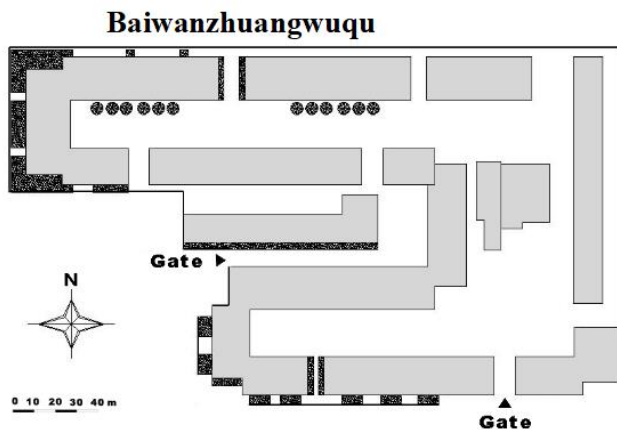
In conclusion, Type C community is the community type with the largest quantity and the greatest convenience to implement greenery waste collection in Xicheng District at present. Accompanied with the improving construction standards of communities is the gradual increase of the number of Type C community, which can be embodied in the year of built of communities. Type C community was all built after 1970, the reason of which is that the green space construction standards of it are higher than those of the previous communities. The improvement of residents' willingness to pay in Type B community requires that the government's publicity and education should be combined with the improvement of the quality of green space and maintenance in the community, especially the encouragement of the participation of the permanent residents and the elderly in the community. At present, the number of

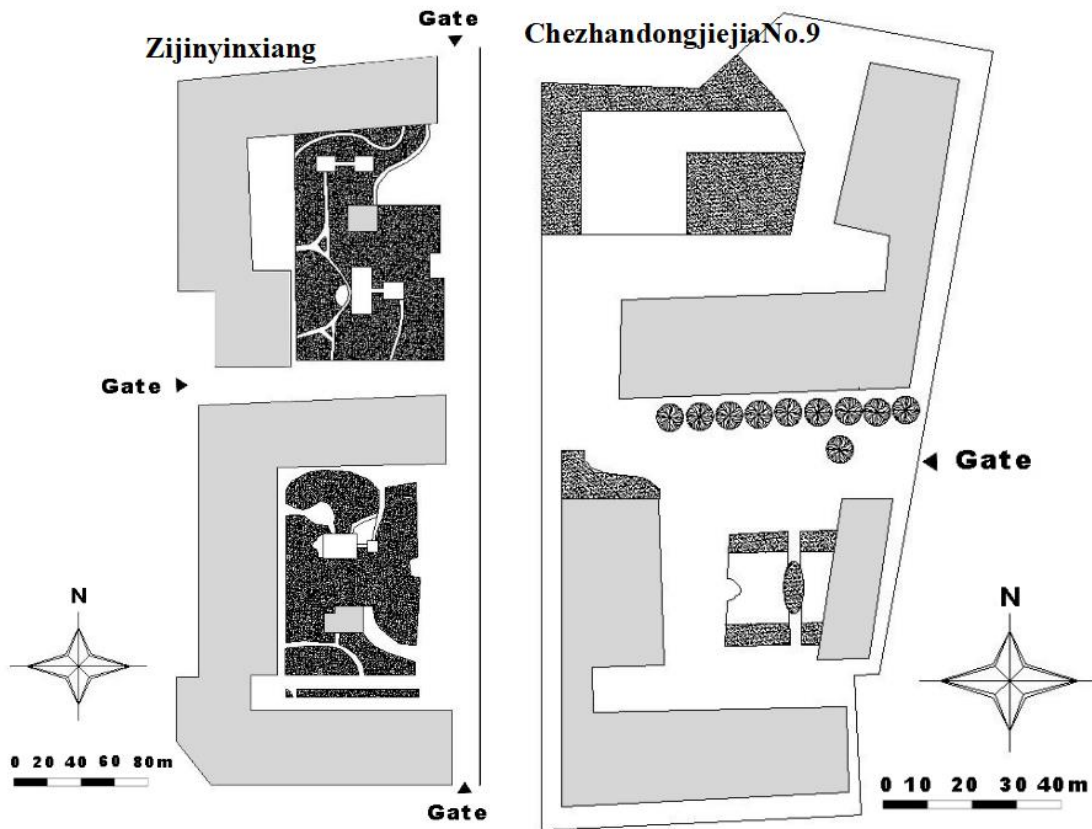
Type A community is the smallest in Xicheng District, accounting for only 4%, which is predicted to continue to decrease in the future considering that some of the communities are faced by demolition.

Among them, the accuracy of the conclusion analysis will be affected by the small number of questionnaires retrieved by Type A community compared with Type B and Type C. In addition, the analysis on the relationship between landscape aesthetics and willingness to pay can only objectively reflect the status quo, while there is a lack of the corresponding regression analysis to indicate whether it can predict residents' willingness to pay in the future.

APPENDIX
APPENDIX A. Iconography Map of Each Community







- Water
- Green Space
- Building
- Construction Part

REFERENCES

- Alexandra Staub, Qingyang Yu (2014): The “New” Gated Housing Communities in China: Implications for Urban Identity. The Pennsylvania State University, University Park, Pennsylvania
- Baoguo Zhou (2002): The consideration of green waste reutilization accessibility in the ecological system. Chinese Society for Horticultural Science Youth Scientific Symposium, 670-675
- Gong Mingjun(2004): Site Selection Planing for Greening Residue Collection Points:a Case Study in Jing’an District,Shanghai. Chinese Urban Forestry, vol12, no. 3: 50–52.
- Huang Yan (2016): Greenery waste recycling survey Report. Government of Changsha City Furong District.
http://www.furong.gov.cn/xxgk/gov1/nlsj/news/201612/t20161209_268716.shtml
- I.D. Williams a, J. Kelly (2003): Green waste collection and the public’s recycling behavior in the Borough of Wyre, England. Resources, Conservation and Recycling,38: 139-159
- Jess W. Everett, Patrick Riley (1997): Curbside Collection of Recyclable Material: Simulation of Collection Activities and Estimation of Vehicle and Labor Needs. Journal of the Air & Waste Management Association Vol47, Issue 10: 1061-1069
- Jianyong He (2010): Turn the green waste into treasure----the green waste in Beijing (2010), Beijing Suburb Daily.
http://www.moa.gov.cn/fwllm/qgxxlb/bj/201012/t20101201_1783219.htm
- José M. Facelli. Steward T. A. Pickett (1991): Plant litter: Its dynamics and effects on plant community structure. The Botanical Review. 1-31
- Kang Gai, Wang Xuedong (2011): Current Situation on Beijing Municipal Solid Waste Treatment and Its Countermeasures. Northern Environmental.vol4, no.23: 38-40
- Leaf and Yard Waste (2018). The NYC Department of Sanitation.
<https://www1.nyc.gov/assets/dsny/site/services/food-scraps-and-yard-waste-page/leaf-and-yard-waste>
- Lundmark, Linda (2003): Green Waste Collection and the public’s recycling behaviour in the Borough of Wyre, England. Resources, conservation and recycling, no. 38: 139–159.
- Nika Balomenou, Brian Garrod (2016): A Review of Participant-Generated Image Methods in the Social Sciences. SAGE Journals. Vol: 10 issue: 4: 335-351
- Pamela H.Templer. Jonathan W.Toll. Lucy R.Hutyr. Steve M.Raciti(2015): Nitrogen and carbon export from urban areas through removal and export of litterfall. Environmental Pollution, 256-261.
- Processing of pruned branches (2018). Noda City—Treatment of pruned branches.
<http://www.city.noda.chiba.jp/kurashi/kankyo/gomi/1000610.html>
- Resource utilization of green waste and development plan of forestry biomass energy industry in 12th Five-Year in Beijing (2012). Environmental Sanitation Science and Technology.
<http://www.cn-hw.net/html/sort056/201203/32694.ht ml>
- Technical code for compost of comminuted branches (2009). Shenzhen Agricultural Local Standards

Technical Regulation of Disposal and Application for Greenery Waste GB/T 31755-2015(2015). The National Standard of the People's Republic of China

Terry C Daniel(2001): Whither scenic beauty? Visual landscape quality assessment in the 21st century. *Landscape and Urban Planning* Vol54, Issues 1–4:267-281

Wen Haoran, Ouyang Zeyu, Shi Jian (2014): The present situation, reasons and countermeasures of the difficulty of collecting property fees. *China Real Estate (Academic Edition)*.

WU HAN (2016): Evaluation of visual preference for Chengdu Huanhuaxi Park landscape based on the SD theory and the AHP theory. (Doctoral dissertation).

Xiangyang Sun (2010): The status and consideration of reutilization of green waste in Beijing. The conference papers of the symposium of Landscape in Beijing, 414-4