Empirical Study on the Point system of Urban Household Garbage Classification in China -- Taking Hangzhou as an example

XU Zheng[1, a]

[1]Economics and Management School of Hangzhou Normal University, HangZhou, ZheJiang, 311121 China

[a]562982601@qq.com

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Abstract. With the gradual improvement of China's economic development, residents' household garbage increase with rapid growth, which not only endangers the environment and people's health, but also poses a major threat to the social and economic development. The management of "garbage besieged city" is urgent, and it is the premise to deal with the problem of "garbage besieged city" to conduct household garbage classification and recycling. Garbage classification and recycling is a specific operation to improve the efficiency of resource utilization. It not only effectively improves the environmental quality, but also conforms to the concept of circular economy and realizes sustainable development. The classification and recycling of household garbage is a comprehensive interdisciplinary subject, which must combine the theoretical knowledge and practical experience in multiple fields. As a famous tourist city and Yangtze river delta center city, Hangzhou actively works on household garbage classification and explores the point system with innovation, which can stimulate the enthusiasm of the residents and set up the awareness of garbage classification, in order to promote the development of circular economy and to achieve the goals of sustainable development at last. The paper chooses this proposition to explore the significance of the point system of garbage classification and recycling in Chinese cities.

1. Introduction

The management of urban household garbage is often used as an indicator of urban governance and even a sign of good governance of a city. Economic development, urbanization and improvement of living standards lead to the increase of both the quantity and the complexity of garbage production; household garbage is the main source of urban garbage, occupying the most part of cost of urban environmental renovation. In France, the government investment in the field of waste disposal is as much as 33% of the total investment of the whole environmental control. However, landfill and incineration, as the primary means for urban garbage disposal, cannot keep pace with the growth of the garbage production; therefore, the fundamental way out lies in the "reduction" and "recycling", in which the source classification of garbage improves the recycling utilization of garbage and reduces the garbage transportation cost and difficulty of end treatment. In developed countries, garbage management has been very effective; and in some areas, the volume of garbage production has not increased with the increase of population. China is the world's largest garbage producer, and it still maintains an annual growth rate of 8% to 10%. Today, more than two-thirds of the country's cities are trapped in the "garbage city", and many cities have no place to fill them. Garbage classification is a complex process, and the recycling rate is affected by many factors, both macro factors such as policy and social environmental factors, and the micro factors such as residents' individual factors, including values, the popularity of garbage classification knowledge, etc. However, the domestic literature in the field of study is very rare, both the lack of theoretical framework, and the lack of a large sample of empirical research; through visiting the

municipal solid waste disposal regulation center, the municipal sanitation supervision center, the municipal legislative affairs office, this research makes analysis on the implementation statuse of point system of household garbage classification, finds out the problems in it, and puts forward solutions to solve these problems, so as to improve the point system of Hangzhou household garbage point system, optimize the urban household garbage management, and promote the development of circular economy.

2. Empirical analysis of the point system of urban household garbage classification.

A. Rules of the point system of Hangzhou household garbage classification

The bonus point amount of collected garbage classification by residents is mainly determined by the type of household garbage and its weight. The article 14 of *Hangzhou Urban Household Garbage Management Regulations* stipulates the standards of living garbage classification, mainly divided into four categories of recycling waste, kitchen waste, hazardous waste and other waste. At present, there are several types of live garbage that can be redeemed for recyclable garbage and hazardous waste in the Green Point Website.

Table 1 Point table of household collected garbage classification

Category	Type	Product	Unit	Points
Solid waste (Glass)	Colored glass	Beer bottles	kg	30
		Rice wine bottles	kg	20
		Red wine bottles	kg	15
		Colored glass vessels	kg	15
	Colorless glass	White spirit bottles, canned bottles	kg	20
		Glasses, white glass	kg	20
		Ashtray, white glassware automobile glass, steel tea table.	kg	20
	Tempered glass	Desks and chairs	kg	15
Hazardous waste (light source with Hg)	Various modulator tubes	Energy-saving lamp tubes	kg	10
		Spotlights, neon lights, etc.	kg	10
		Fluorescent tubes, incandescent bulbs.	kg	10
Hazardous waste (batteries)	Telephone batteries	Nickel fluoride, nickel hydride, His ionic	kg	1650
	Rechargeable batteries	Ni-Cb, nickel hydride, Lithium-ion	kg	1650
	Lead-acid cell	Rechargeable battery, battery and other lead acid.	kg	1350
	Ordinary dry batteries	Alkaline and non-rechargeable.	kg	10
Hazardous waste (electrical waste)	Computer type	Mouse, keyboard	Number	1350
		Camera, various USB	Number	1350
		Memory, floppy drive	Number	1350
		Video card	Number	1350
		Network card	Number	1350
		Router	Number	650
		Motherboard, CPU, hard disk, optical drive.	Number	1350

		External power supply, drive device.	Number	1350
	Communication type	BP machine, copy machine, etc.	Number	1350
		Mobile phone charger	Number	1350
		Telephone	Number	650
		Mobile phone	Number	1650
	Digital products	MP3,MP4, MP5	Number	1350
		Electronic dictionary, walkman.	Number	1350
		U disk	Number	6
		Game console	Number	650
	Other products	Electronic watches, toys.	Number	1350
		Radio, hair dryer, blood pressure meter, etc.	Number	1350
		Induction cooker, rice cooker and other food cooking classes.	Number	1350
		Electric oven, humidifier and other daily life.	Number	1350
Solid waste (plastic and metal products)	Plastic bottles	Coke bottle	Number	10
		Water bottles	Number	10
		Other plastic products	kg	300
	Pop cans	Tin can	Number	10
		Aluminum cans	Number	15
		Other metal products	kg	270

The Green Point Website exchange guide also clarified that any costs incurred during the use of the Green Point Website service will be paid by the points. At the same time, the Green Point Website provides the residents with the distribution services of the point exchange products, which are express delivery and reception at certain service sites. There is no need to pay any fee for the fixed point exchange. As for express delivery, at the same time of the user exchanging for goods, the cost of delivery will be directly generated in the order, and after the user completes the transaction, the points needed for express fee and commodity will be deducted from the user account as a whole. When the total value of a single exchange of goods exceeds 50,000 points, the website system will automatically transfer the points deducted for the express fee to the user account after the transaction is completed. Other after-sale services are also held by the Green Point Website.

Table 2 Descriptive statistics of sample population attributes.

	Population attribute variable	Population	Proportion of total sample proportion (%)		Population attribute variable	Population	Proportion of total sample proportion(%)
Gender	Male	352	47.4	Education level	Never go to school	8	1.1
	Female	390	52.6		Primary school	32	4.3
Age	<20	6	0.8		Junior high school	98	13.2
	20~30	196	26.4		High school (secondary school, vocational	191	25.7

					school, technical school, etc.)		
	31~40	278	37.5		Junior college (higher vocational)	160	21.6
	41~50	127	17.1		Undergraduate course	233	31.4
	51~60	64	8.6		Postgraduate and above	20	2.7
	>60	71	9.6		Government departments, public institutions, military units.	116	15.6
Total monthly income after tax (yuan)	<5000	95	12.8	Profession	enterprise	341	46
	5000~10000	254	34.2		Social group, residence/village committee.	23	3.1
	10001~15000	177	23.9		Soho	104	14
	15001~20000	113	15.2		Retired	78	10.5
	20001~25000	61	8.2		Other	80	10.8
	>25000	42	5.7				

Table 3 Factor analysis and verification results of measurement items

Public factor	Measurement index	Factor loading.	AVE	CR	Public factor	Measurement index	Factor loading.	AVE	CR
Value perception	PV1	0.833	0.88	0.98	Perceptual behavior control	PBC1	0.762	0.73	0.96
	PV2	0.784				PBC3	0.722		
	PV3	0.794				PBC3	0.73		
	PV4	0.682				PBC4	0.719		
	PV5	0.788				PBC5	0.504		
	PV6	0.805				PBC6	0.538		
	PV7	0.737				PBC8	0.546		
	PV8	0.63				PBC10	0.572		
Subjective norms	SN1	0.658	0.87	0.98	The effectiveness of the informal recovery system.	IRM1	0.655	0.74	0.92
	SN2	0.656				IRM2	0.801		
	SN3	0.702				IRM3	0.811		
	SN4	0.683				IRM4	0.803		
	SN5	0.697			Garbage classification participation level.	WR1	0.803	0.82	0.98
	SN6	0.671	0.82	0.98		WR2	0.834		
	SN8	0.544				WR3	0.838		
	SN9	0.629				WR4	0.925		
	SN10	0.597				WR5	0.934		
Policy effectiveness perception	PPE1	0.772	0.88	0.97		WR6	0.902		
	PPE2	0.779				WR7	0.926		
	PPE3	0.761				WR8	0.874		
	PPE4	0.776				WR9	0.877		

Based on the analysis results, this paper just extracts a common factor respectively from measuring items of the six kinds of variables (named after the original variable name), so as to realize the dimension reduction of the original index system. Based on this, this paper firstly conducts descriptive statistics of the classification status of all kinds of waste (see table 4); it is easy to see that, as for the recycling categories of waste, the population with a high frequency of waste paper/paper plate accounts for the highest number of (58. 22%); kitchen waste follows; the proportion of high frequency classification of discarded plastic bottles and discarded cans was over 50%; the proportion of discarded glass bottles was the lowest (41.91%). Among them, the waste paper/paper board, waste plastic bottles and cans are of high recovery value; waste glass bottles have a lower market value because of high cost in reproduction and small renewable profit, which

are not accepted by recycling acquisition merchants. Kitchen waste is the emphasis of the classification in current community propaganda.

Table 4 Relevant description information of various types of waste

Type of waste	Classification frequency（%）					
	1[A]	2	3	4	5	High classification frequency[B]
Waste paper/ waste paper board	6.47	11.99	23.32	32.61	25.61	58.22
Disused batteries and electronic equipment.	11.46	17.12	24.66	26.82	19.95	46.77
Kitchen waste	12.94	15.09	15.23	27.22	29.51	56.73
Plastic bottle	10.11	15.09	21.02	29.38	24.39	53.77
Discarded cans.	11.32	15.36	19.95	28.57	24.8	53.37
Scrap metal	14.69	18.19	20.49	26.28	20.35	46.63
Renewable plastics	12.67	17.79	19.81	29.65	20.08	49.73
Waste glass bottle	16.44	21.16	20.49	23.85	18.06	41.91
Discarded clothing and textiles	14.96	17.12	21.83	24.26	21.83	46.09

Table 5 Relevant description information of the classification of various community residents.

Community groups	Propaganda <1 year	1-2 years	2-3 years	>3 years	Incentive policies	Community groups
The average score of residents' classification factors.	-0.468	-0.006	0.513	0.643	0.563	The average score of residents' classification factors.

Thus, residents tend to make classification on the waste of high recovery value and with emphasized propaganda, which fully shows that the important impact of policy propaganda education and the informal recycling system. At the same time, through the comparison of average classification factor score of the five community residents (see table 5), we can see that, in the communities with policy propaganda education, the results and overall situation are better in those with longer propaganda time; in the communities with incentive policies, residents normally have higher level in garbage classification. Based on the extracted common factors, this paper applies the STATA12 software and uses the hierarchical regression model to verify the aforementioned assumptions. The model of influencing factors of residents' classification behavior is as follows:

$$y_i = \alpha + \sum_{k=1}^{K} \beta_k \chi_{ik} + \sum_{k=1}^{K} \beta_k \chi_{ik} + \mu_i$$

yi stands for the degree of resident i participation in garbage sorting; α is model intercept; μ_i is random disturbance; x_{ik} is the psychological variable of resident i; d_n is policy virtual variable; z_{im} is the population background characteristic variable of resident i; β_k, γ_n, δm represent the corresponding coefficients of these three independent variables. In the process of regression, this paper firstly carries out multiple co-linear tests. Due to the weak correlation of each factor and the entire variable VIF lower than 10, there are no serious collinearity problems. Secondly, in order to avoid the bias of inspection findings caused by the phenomenon of heteroscedasticity, this paper adopts a robust regression.

3. Conclusion

Urban garbage management is a complex and extremely important issue, and the research in the future will be deeper and more specific. Interdisciplinary research teams need to be introduced to make research on this. As a new mode, the recycling point system of urban household garbage sorting plays an important role in household garbage management of Hangzhou city, which is the

concrete incentive measurement and technique to implement the *Circular Economy Promotion Law*, *Regulations for Urban Household Garbage Measures* and other laws and regulations. In view of the difficulties encountered in the classification and recycling of urban household garbage in our country, we can learn from this Hangzhou mode. Due to the restrictions of many conditions, the implementation of garbage classification and recycling point system in Hangzhou has encountered some unavoidable difficulties. Therefore, we should strengthen the legal system construction and enforcement, promote outstanding experience, and develop circular economy, to ensure that recycling point of urban household garbage sorting system achieves remarkable achievement, so as to do a good job in the household garbage management in our country, to improve the protection of the environment, and to promote the development of national cyclic economy, ultimately achieving sustainable development.

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