Factors Influencing Household's Solid Waste Classification Management: The case of HANGZHOU.

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Abstract

Households' contribution in solid waste classification and recycling of municipal household solid waste is one of the essential factors influencing municipal solid waste management. We identify and investigate the factors influencing solid waste management classification as well as mechanism used by households to dispose waste in their communities. Based on the survey data of households in Hangzhou China in three different communities, factors that affect household disposal and their degree of influence have been analyzed, followed by discussion on decision-making mechanisms. The results show that household behavioral selection has been linked to several key factors which are Environmental attitude, knowledge and education, classification facilities and services, and policies. The research has also determined to reveal the response of the people to solid waste classification, and the combined effect of the factors is almost twice that of the former. In addition, environmentally friendly facilities and programs are most successful in encouraging the involvement of household in identification and recycling. Finally, the research put forward applicable policy suggestions for the comprehensive management of municipal Household Solid Waste classification and recycling.

Key words: Solid waste management; household's Solid Waste classification; Hangzhou

1. Historical background

China has been practicing Municipal solid waste management source classification in different areas since the year 2014. China's municipal solid waste management was initiated in the late 1980s, when China's municipal solid waste consisted mainly of small-scale lime soil. Due to the growth of the municipal economy and the improvement in the utilization mode of households, the types and total amount of municipal waste were greatly increased in the late 1980s and early 1990s. During this phase, domestic waste research focused on facilities for processing, transportation and treatment of waste. The management system and domestic waste policy research in China gradually increased in the late 1990s and the positive transition of waste classification abroad.

The situation of solid waste classification management has concentrate on how to deal with the increase of garbage in which the results accounted to reduce the garbage generated from the source by measures, categorized collection and recycling. Moreover, solid waste classification has been practiced in china for many years, but still there are problems that are not yet to be solved, example, The problem of mixed

loading and transport in the waste classification and disposal system has not been resolved in Beijing, and the waste classification of the entire city, Shanghai, the category of garbage is faced with hot government cold citizens, In Guangzhou, 781 households introduced a "fixed-time" classification system, with only 46.16 % of the city's community population participating in the "fixed-time" classification mode. The contribution of people is not strong, and the actual impact is not good. Classification of garbage is still in the stage of encouraging and promoting.

Hangzhou is the capital city of Zhejiang Province, which is at the forefront of Chinese practice. In Hangzhou there was an introduction of a mode of classification which took part in helping to managing and maintains the waste control.

In 2014, The Zhejiang provincial government announced the 'Notice on the Pilot Project of Waste Reduction and Resource Treatment', As in the year 2013, Hangzhou exceeded 3 million tons/a of the total Municipal Solid Waste generation, which was far in excess of its expected dumping capacity. The Hangzhou municipal government established a number of pilot projects for decreasing the Domestic Waste sent to municipal dumping facilities based on the '2 + T' source classification method (biodegradable waste, other waste, and toxic waste) and waste resource treatment. In 2015, the Hangzhou government published the 'Three-year Action Plan for Classification and elimination of Domestic Waste'. After four years of development, Hangzhou formed a series of systems for the classified deposit, collection, transportation and disposal of garbage in cities. Additionally, effective source classification and resourcing treatment patterns were developed in some districts of Hangzhou. However, no systematic studies have been conducted on the performance of typical source classification and resourcing treatment patterns systems, although it was important to do because of the size of cities and dividing them into patterns increased efficiency.

2. Literature Review

Solid waste management is the most threating and critical problems affecting the environment especially in municipal areas of developed and developing countries of the entire world. The trends of solid waste generation are to be related to the development of urbanization, industrialization and economic development at large. As from 1998–2017, there was an increase of urbanization in China at an average annual growth rate calculated to be of more than 1%. As of 2017, 58.52% of China's a total population are living in urban areas (National Bureau of Statistics of China, 2018). This environmental problem remains to be a threat to the environment and the public health if measures are not taken and efficiently implemented (UNEP, 2010). Solid waste management and disposal have overcome serious challenges, in developing countries due to the rapid increase in population, economic development and waste generation, and this proven day by day, as the communities develop the solid waste also increases, this means the relationship is rational (Diaz and Otoma, 2014; Taghipour et al., 2016). A number of cities are facing a problem of Garbage Siege, which means the cities are bounded by garbage heaped up in suburban areas (Hu et al., 2012; Liao et al., 2018).

As well as China has been one of the victims of this tragedy but to solve that the government have pledge much money into solving the problems by creating garbage system in each and every community starting

with few selected cities according to the ministry of housing of housing and Urban- Rural Development of China. A total of 21.3 Billion yuan will be invested to build more waste disposal facilities in 46 cities that are in a basic classification and disposal system pilot program, allowing them to reach their target by the end of 2020 (Gao Yang, Yang Qiang 2017). Two thirds of big and medium cities in china are covered in waste, approximately more than 500 million square meters of land nationally intruded due to the dumping around of household solid waste (Fei et al., 2016). Municipal disposal facilities lack the ability to process the solid waste made from urban and rural areas because of the rapid increase in municipal solid waste. A number of cities are facing a problem of Garbage Siege, which means the cities are bounded by garbage heaped up in suburban areas (Hu et al., 2012; Liao et al., 2018). Keramitsoglou.M.K et.al. , 2013 argued that a recycling program is usually imposed from top to down by the municipal authorities without public participation, the authorities playing a role of decision-making and implementation it's not enough. To accomplish the recycling goals, the waste management problem should as much as an issue and responsibility of the local community rather than of the local council waste services. The thing that matters is component materials that the community people are willing to recycle, and what collection system would be more convenient for them. In some communities, most studies are centered on a general image of the status of solid waste management (Ying, 2014). The rest of the aspects of recycling received less attention. The study investigates the practice of recycling among households and, in particular, the demographic profile and the influence solid waste management, conditions for active participation and options for improving solid waste collection services. This report is valuable regarding household waste dumping, recycling planning, as well as overall waste management. Many reports have revealed that the composition of Rural Domestic Waste is not similar from that of urban waste, and that the recyclable components of Rural Domestic Waste account for 50% and above of the total garbage (Guérin et al., 2018; Han et al., 2018; Kumar and Samadder, 2017; Saidan et al., 2017). It has been confirmed that the recyclable components can be significantly reduced in site by biological treatment (He, 2012). Nevertheless, there are no standard methods on Rural Domestic Waste reduction and resource utilization systems based on source classification.

3. Hangzhou mode

Hangzhou municipal solid waste classification research has developed the whole system of Hangzhou mode, that incorporates policies and regulations, classification methods and implementation plans," headed by the government and included all levels of departments and social forces, and has traveled along the path of garbage classification management according to its own attributes.

The physical waste composition in Hangzhou has led to an observation that the recyclable material is more than 50% of the garbage collected. %. Recyclable waste referring to include, plastics, paper, metals, glass, and textiles, comprised of 13.86 to 52.06% of the components.

There are special collection and dumping procedures for toxic waste in the communities which is been handled in a special way, it consists of 0.45 to 1.96% of the components. biodegradable waste and recyclable materials are the most focused source reduction and recycling targets. Although, the domestic waste moisture component is generally high due to the biodegradable waste component that usually

contaminates the recyclable materials and leads to pollution during tr

however, requires high knowledge, ability, and implementation of classification of household waste.

4. Empirical research of factors influencing household waste disposal behaviors

The study reviewed and summarized a large number of similar researches on the influence factors of the waste disposal behavior of households in order to suggest rational hypotheses of the initial measurement method. In previous years, relevant research has been carried out by domestic and foreign scholars (Boonrod et al., 2015; Borthakur and Govind, 2017; Guo et al., 2016).

This paper is based on literature reviews, sums up factors that occur frequently and have a major impact. Recent studies have shown that the household disposal behaviors can be indirectly affected by four key aspects, including attitude, education and knowledge, policies, facilities and services for the environment. This study presents an initial concept of the factors and measure of influencing factor of household waste disposal behaviors. (as figure 1)

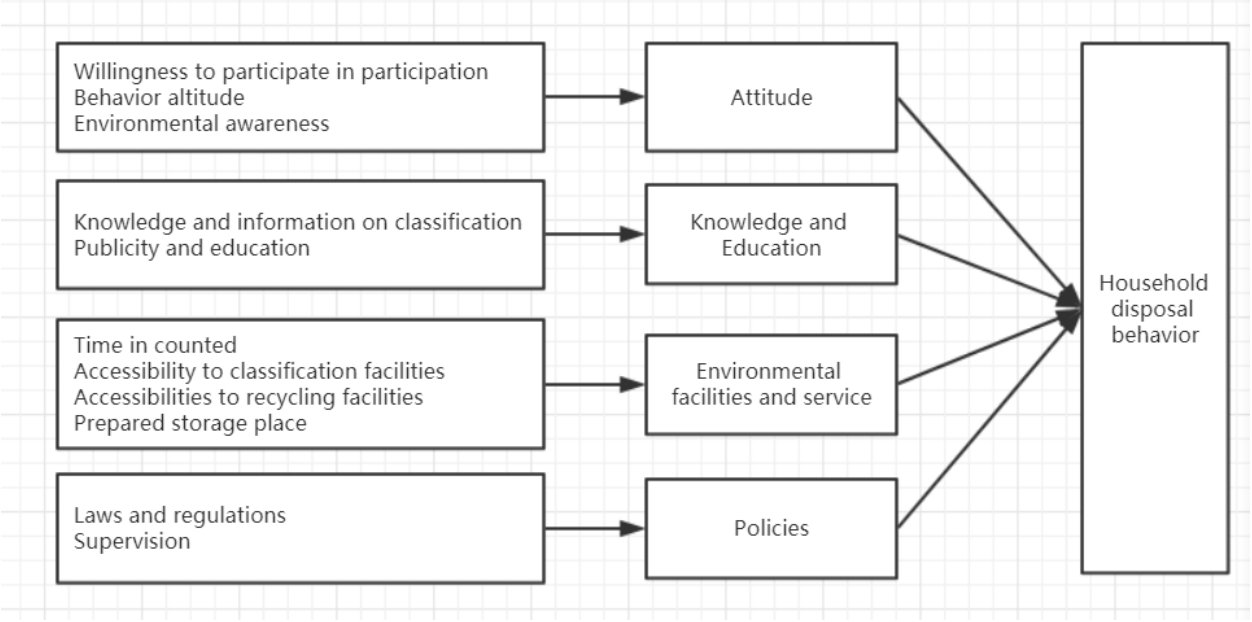

Figure 1. The conceptual model of household waste disposal behaviors.

it is reasonably to explore the kind of factors that will play an important role in developing the household's solid waste classification in developing countries. For this reason, a questionnaire survey was designed and investigated in the three communities in Hangzhou. It is believed that demographic structure and education level will affect the quality of garbage classification in rural areas (Bhawal Mukherji et al., 2016; Martinez-Pena et al., 2013; Song et al., 2016; Wang et al., 2018).

The study used a questionnaire to investigate the households and their influencing factors depending on the basis of the initial conceptual model the research has proposed. The questionnaire consisted of two parts: (1) the demographic and social attribute information of the respondents, including gender, age, education level, income and occupation. (2) The second part covers questions investigating response of the people on the classification of solid waste, views on the intensity of the factors influencing the solid waste

classification, the availability of services in the community as well as the equipment. Items measuring the initial research hypotheses and the conceptual model, all measures were reported on 1 to 5 point scale from "Strongly Agree", "Agree", "Moderately", "Disagree" to "Strongly Dis- agree". The data was analyzed by OLS model to get the result of the research.

The research had distributed 210 questionnaires but only 159 questionnaires were collected and valid in which among the questionnaires 85 male and 74 female. These valid questionnaires helped to get results of the study.

It may be concluded that public participation has an important effect on the households in the Hangzhou. Furthermore, the different identified factors would result in considerably different results. It is stated that public classification willingness and attitude rather than advanced equipment or mandatory regulations are the most vital factors influencing garbage classification management in developed countries (De Feo and De Gisi, 2010; Junquera et al., 2001). Table 1 shows the gender, age, and education distribution in the investigated districts, and the respondents covered different gender, age, and education levels.

Table 1. Descriptive statistics

	Classification	Number	Percentage %
Gender	Male	85	53.5
	Female	74	46.5
Age	< 20	7	4.4
	20 -30	99	62.3
	31 -40	32	20.1
	41 -50	18	11.3
	>50	3	1.9
Income	4000	45	28.3
	4000-6000	44	27.7
	6000-8000	46	28.3
	8000 >	24	15.1
Education level	< Senior education	17	10.7
	Bachelor or collage	120	75.5
	> Bachelor or collage	22	13.8
Occupation	Government workers	19	12.0
	Private enterprises	36	22.7
	Public Enterprises	11	6.9
	University research	14	8.8
	Professional	24	15.1
	Student	55	34.6

In this study, 159 valid samples were tested by factor analysis, and the factor load of each factor corresponding variable was tested to determine the structural validity of the model. The KMO value is 0.845, which is greater than 0.7, indicating good effect. Bartlett statistic was significantly different from 0

(< 0.001), which indicated that the model had good structural validity and applicability of exploratory factor analysis.

To construct multiple regression models, its basic form is as follows:

Y= X1+ X2+ X3+ X4+ X5+ X6+

Among them, y is the willingness of residents to garbage classification, is a constant, X1 is the residents' garbage classification cognition, X2 residents' garbage behavior perception, X3 is the publicity of government and society, X4 is the government's reward and punishment, X5 is the supporting measures of society, x6 is the social demonstration force, and is the residual item.

In this paper, stata15.0 is used to regress the data step by step, and then six models are formed, which are residents' garbage classification cognition, garbage behavior perception, government and social publicity, government rewards and punishments, social supporting measures, and social demonstration force.

Table 2. Representing valuables Model results

Explanation Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Personal cognition	0.3849*	0.4232*	0.2718*	0.1440	0.2681*	0.2523*
Cognitive behavior		-0.2053**	-0.2257*	-0.3088*	-0.2511*	-0.2363*
Government and			0.2994*	0.2076**	0.0513	0.0138
The government				0.3591*	0.2502**	0.2067***
Social facilities					0.3111*	0.2631*
Social demonstration						0.1675***
R2	0.1311	0.1635	0.2397	0.2856	0.3721	0.3872
Adjusted R2	0.1256	0.1528	0.2250	0.2670	0.3516	0.3631
F value	23.69	15.25	16.29	15.39	18.13	16.01

Note: *, * *, * * * are significant at the level of 0.001, 0.5 and 0.1 respectively

The model results are shown in the table 2. It can be seen that with the increase of variables, R2 values also increase, indicating that the selected explanatory variables have better explanatory ability to the variables to be interpreted. In model 1, the residents' personal perception will improve the willingness of garbage classification, which indicates that the more concerned about environmental protection, the higher the willingness of garbage classification, which is consistent with our cognition. In model 2, there is a negative correlation between residents' behavior perception and garbage classification intention. It may take a lot of time and physical strength to classify garbage, and accordingly residents may reduce their willingness to classify garbage. Model 3 and model 4 study explanatory variables at the government level. Among them, model 3 is to test the explanatory variable of government and society publicity. The results show that government and society publicity will improve the willingness of residents to carry out garbage classification. Therefore, the greater the government publicity, the more residents may support the garbage classification policy, thus reducing the resistance of government policy. Model 4 discusses the government's reward and punishment measures. It can be seen that the variable passes the test at a significant level of 1%, and has a positive impact on the willingness of garbage classification. Therefore, the government needs to formulate strict reward and punishment policies to reward the residents who carry out garbage classification and punish the residents who do not carry out garbage classification, which can

improve the willingness of garbage classification of residents. Model 5 and Model 6 are tested from two variables at the social level, and social supporting measures and demonstration forces are positively correlated with garbage classification willingness. In model 5, the supporting measures pass the test at the significance level of 1%. For every 1 increase in social supporting measures, the residents' garbage classification willingness will increase by 0.3111. Therefore, it is necessary to provide complete supporting measures for garbage classification, such as formulating detailed garbage classification policies, providing classified garbage cans in the community, etc. In addition, the residents' garbage classification willingness will also be affected by the social demonstration force. The garbage classification behavior of neighbors, relatives and friends will improve the residents' garbage classification willingness. Therefore, it is necessary to give full play to the power of role models, encourage party members and advanced elements to actively participate in garbage classification and play a leading role, so that more people will participate.

5. Conclusion

The results of this study proposed the behavioral decision making mechanism which takes into account the involvement of both residents in origin identification and resource recycling, the main factors observed have a significant effect on the household solid waste disposal behaviors of residents and their degree of control. The classification system for solid waste management will manage waste origin separation for reduction environmental affect.

Among some of the household categorized deposits in doorway and gate-to-door biodegradable as well as other waste collection, there was the best solid classification and quality involvement, apart from operating costs. Research has demonstrated that the most significant factor affecting the conduct of origin identification is the public attitude. Factor results had a positive association with the accuracy and involvement in the identification of the origin. It is of great importance to somehow improve the efficiency and elimination of the category of urban solid waste management.: Develop suitable classification techniques and patterns to improve classification and reduction effects and cultivate positive social attitudes, improve publicity and education to increase public awareness of classification methods, maintain stable supervision of source classification behavior, and provide adequate financial assistance to encourage the popularization of waste classification.

The effect of laws and regulations on citizens ' behavioral selection of solid household waste administrators does not achieve a statistically meaningful level, as current Hangzhou waste classification and recycling laws and regulations are predominantly encouraging and useful, with no compulsory restraint policies yet authorized. In other words, the effect of legislation, laws and regulations on real-life communities is typically very limited on whether or not residents are interested in waste collection and recycling. It is not developed the hypothesis direction that unused storage space has a negative impact on the existing environmental factor, infrastructure and services of residents. Hopefully, the government should emphasize the planning and construction of solid waste classification and recycling facilities for municipal households, carry out extensive advertising and education events on waste classification and recycling among residents through multiple channels, and strengthen laws and regulations in long term comprehensive municipal

management.

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