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Influential socio-economic factors on the satisfaction of household to domestic household recycling schemes in Minamata City Japan

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1. Introduction

Japan has shifted the purpose of municipal solid waste management from mitigating environmental pollutions to sustainable development from 2000 along with the international major trend of integrated waste management. In 2000, "Basis act on establishing a sound material-cycle society" with the main idea of promoting 3Rs (Reduce, Reuse, Recycle) to achieve a sustainable society has been launched. From then on, the municipal solid waste management in Japan entered a new era.

During the past 2 decades, many municipalities established unique waste management schemes to increase the recycling rate. The most popular idea of the waste management schemes is to separate household waste in the source, so-called household recycling. Different from the majority countries adopting the idea of separate household waste into 2-5 categories, Japanese municipalities tend to ask the residents to separate their household waste into more than 10 categories. Due to the household recycling scheme, the recycling rate has been almost doubled within 20 years, the concept of 3Rs also permeated through the country.

While the household recycling has been successfully spread in Japan, Thi indicated the difficulty for household recycling in other countries that the various program of waste separation at source deployed over several decades have only existed in the form of pilot-programs and have generally not been replicable on large scales (Thi Thu Phuong Nguyen, 2015). Thus, to investigate the key factors of spreading household recycling scheme is very important.

2. Study area

Minamata City Kumamoto Prefecture located at Kyushu land, the Southwestern part of Japan. The population is around 24,493 (March 2019), the area is 163.29 km[2][3]. Minamata City is famous for Minamata Disease and Minamata Convention on Mercury. After experiencing one of the most

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severe environmental problems, Minamata Disease, in the middle to the late 20th century, Minamata City published "Declaration on environmental and development" in 1992 to revitalize the city to an environmentally friendly city.

As the environmental capital of Japan, Minamata City has started household recycling from 1993 to separate waste into more than 20 categories, which is the first group of municipalities that started advanced waste management. For the recyclable garbage, there are more than 300 garbage stations in the city and will be collected once to twice every month depending on the different categories. For the kitchen garbage and burnable garbage, due to its large generation amount compare to the recyclable garbage, the city collects twice a week from more than 700 garbage stations. Kitchen garbage should be thrown with a special biodegradable plastic bag. The effect of household recycling scheme is significant (Fig.1). The recycling rate has been increased to around 40% within the 25 years, which is also as double as the national average.

Minamata City has introduced many events and campaigns related to waste management. Out of a series of policies, "Rotation Volunteer System" is thought to be the key that Minamata City successfully maintains the household recycling at a high quality. "Rotation Volunteer System" is a system that, several volunteers, decided within each community at the beginning of every year based on rotation, help on preparing, tidying up the containers at garbage stations and provide a double check of garbage stations while other residents come to throw their garbage.

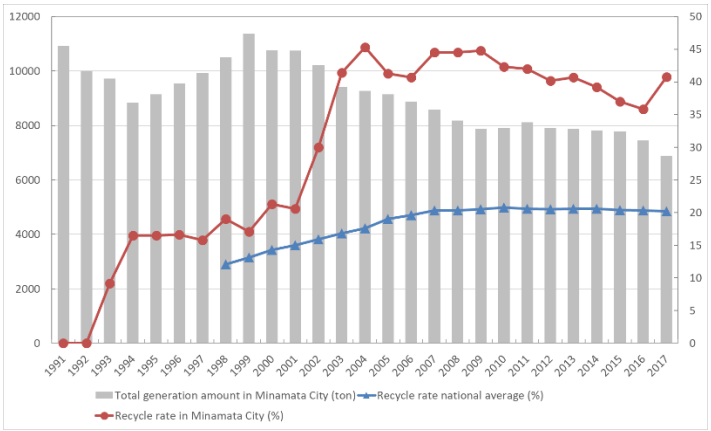


Fig. 1 The total generation amount and recycle rate of municipal solid waste in Minamata City[4]

3. Methodology

An originally designed questionnaire survey cooperated with Minamata City and Kyushu University conducted in Minamata City from December 2016 to January 2017. The questionnaire was designed based on existing academic researches and existing social questionnaire surveys. It consists 8 parts of questions, which are questions "About Daily life", "About Health and Welfare",

[4] Source: Ministry of Environment Japan http://www.env.go.jp/recycle/waste_tech/ippan/index.html

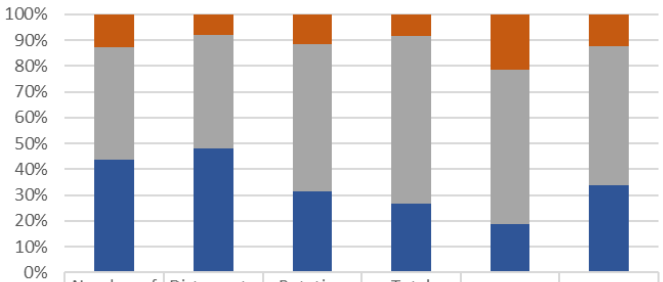
"About Education and Culture", "About Industry", "About Disaster and Crime Prevention", "About Environment", "About Community", and "Basic Information".

Despite the facts about throwing garbage in daily life, the questions related to waste management in existing questionnaire surveys ask the satisfaction degree on waste management policies as well. The questionnaire was distributed to all 11,891 households in Minamata City at that time. The people who do garbage separation and bring it to the garbage station in the households have been asked to answer the questionnaire to assure a high reality of the answers.

Apart from the questions related to waste management and recycling, some basic information about each household has been asked in the questionnaire as well. 6 questions on basic information are the total population in the household, the number of children that under 18-year-old in the household, the number of elders that over 60-year-old, the dwell type, the occupation that makes major income, the annual income for the household.

4. Results

The satisfaction degrees of household recycling scheme is surprisingly high (Fig. 2). Averagely only 12.5% of responders answered negatively to current household recycling scheme. The number of separation category which is around 20 categories and the rotation volunteer system has 12.7% and 11.7% of negative answers, the distance to the garbage station and the total burden on the garbage include separation in the household and bring it to the garbage station have only 8.0% and 8.6% of negative answers. The total cost on garbage has 21.6% of negative answers which is the highest rate out of the 5 aspects of the household recycling scheme.



	Number of separation category	Distance to garbage station	Rotation volunteer system	Total burden on garbage	Total cost on garbage	Average
Unsatisfied	12.7%	8.0%	11.7%	8.6%	21.6%	12.5%
Neither	43.7%	43.8%	56.8%	64.7%	59.6%	53.7%
Satisfied	43.6%	48.2%	31.5%	26.8%	18.8%	33.8%

Fig. 2 The satisfaction degrees of the household recycling scheme

Table 1 shows the correlation among the socio-economic factors and the satisfaction degree of different aspects of the household recycling scheme. While the family size, the number of children in the household and the annual income of the household increase, the satisfaction degree

on the household recycling scheme decrease. However, for the number of elders in the household, which is the only one out of all the socio-economic factors in this survey that have the positive correlation with the satisfaction degree on the household recycling scheme, the satisfaction degree increases along with the number of elders in the household.

Table 1 The correlation among the socio-economic factors and the satisfaction degree of different aspects of the household recycling scheme

	Number of separation category	Distance to garbage station	Rotation volunteer system	Total burden on the garbage	Total cost on garbage
Family size[5]	- 0.13	- 0.07	- 0.13	- 0.13	- 0.15
Number of children in the household[6]	- 0.18	- 0.11	- 0.20	- 0.19	- 0.22
Number of elders in the household[6]	**0.08**	-	**0.08**	**0.03**	-
Dwelling type[6]	0.21	0.20	0.20	0.20	0.19

While for the dwelling type, it would also influence the attitude to household recycling scheme (Fig. 3). The correlation with the satisfaction degree on rotation volunteer system showed that people who live in a rental apartment or house have a relatively low satisfaction, people who live in the purchased house have higher satisfaction than people who live in a purchased apartment.

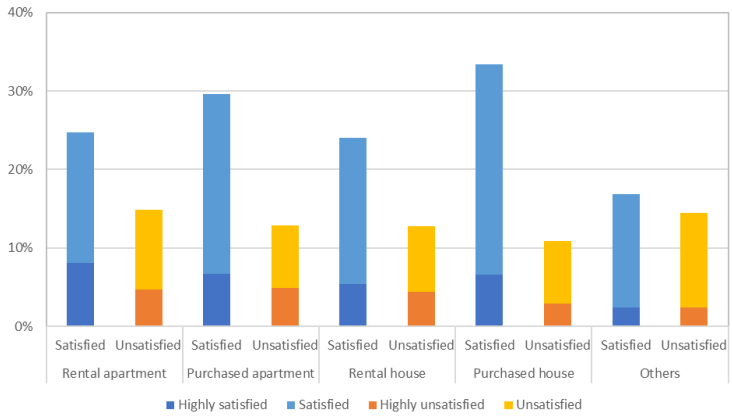


Fig.3 The dwelling type and the satisfaction degree on a rotation volunteer system

5. Discussion and Conclusion

The satisfaction of respondents to the current household recycling scheme is significantly high.

[5] Family size, Number of children in the household, Number of elders in the household, Annual income were calculated with Spearman's Rand-Order Correlation

[6] Dwelling type and occupation were calculated with Cramer's coefficient of association

From the residential point of view, the household recycling scheme in Minamata City could be regarded as a successful example.

Minamata City provides a lot of environmental campaigns and education program targeting children. However, the effects are not significant from this survey. It shows that the number of children has a negative impact on the satisfaction degree of the household recycling scheme. On the other hand, for the households that have more than one elders are tend to much satisfied with the current waste management system. This is similar to Azilah's result, that the elder people are found to be more active in recycling compared to the younger ones (Azilah M. Akil, 2015).

For the dwelling types, the order of satisfaction on rotation volunteer system is people who live in the rental house < rental apartment < purchased apartment < purchased house. According to Takahashi, people who live in a purchased apartment or house will have a stronger connection with neighbors and a stronger sense of belonging to the community, on the other hand, people who live in the rental apartment or house may not worried that much what neighbors think about them (Takahashi Wakaha, 2013). The satisfaction degree on rotation volunteer system in this survey which could exam the connection with neighbors and the sense of belonging to the community showed the same order to the connection with neighbors and the sense of belonging to the community according to Takahashi. Therefore, the family structure and dwelling type, the connection with neighbors and the sense of belonging to the community might be the key factors that impact on the satisfaction of the household recycling scheme. Since the elders live in the city for a longer time and the people who live in purchased apartment/house have a stronger sense of belonging to the community, they are much willing to participate to the household recycling.

Thi mentioned that only by knowing what drives people to participate in separation of waste at source and whether they are ready to cooperate or not can we find conditions and interventions that effectively maximize cooperation for the implementation of waste separation programs (Thi Thu Phuong Nguyen, 2015). In this research, the impact of family structure and dwell type on the satisfaction of the household recycling scheme has been proved. The influence of other socio-economic factors to household recycling behavior will be studied in further research.

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