Waste Sorting In Shanghai From An Economic Perspective

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Abstract: This paper talks how effective the *Regulations of Shanghai Household Waste Management* policy in Shanghai is to reduce negative consumption externalities caused by waste, and gives opinion on how to improve it. Data is collected from the internet, and news about waste sorting are traced. This paper analyzes the problem from an economic perspective with game theory and compares Shanghai's waste sorting with other countries.

1. Introduction

On July 1st, 2019, Shanghai started conducting Regulations of Shanghai Household Waste Management policy, that wastes are sorted into wet waste, dry waste, recyclables, and hazardous waste, the time of throwing garbage in some neighborhoods is fixed, and the places to throw garbage are reduced. Since garbage is the result of production and consumption and resources are included in waste, waste sorting has influences on the economy.

Nowadays, waste has been a big issue. In Royal Society's journal on February 27th, 2019, it reported that plastic has filled the deepest trench in the world that is "up to 13,000 feet deep and 300 miles offshore", which means that "to a large extent, it shows that there's no unpolluted ocean system on the Earth". Among all the wastes in ocean systems, more than 70% are plastics, and plastics can finally get back into humans' bodies through food chain. This is bad for humans' health, costs resources for health care, and the pollution of ocean systems is also a negative externality to some tourism industries that views are no longer beautiful.

Lands for landfills are becoming less and less, and 2/3 cities in China are facing the problem of being surrounded by waste. In some places, land is now very scarce for waste landfills, and Shanghai is such a city. In 2017, Shanghai secretly and illegally poured waste to Lake Taihu in Jiangsu because of the lack of land. Shanghai has the most take-out orders in China. In 2018, there are about 64 million orders of the two most popular take-out companies in Shanghai, and it is 1200 orders more than Beijing, which has the second most take-out orders in China. Garbage can pollute the environment, attract mice and cause disease, waste resources in need, etc., that are all negative externalities to everyone. The government's purpose of waste sorting is to reduce negative externalities.

The paper aims to discuss how effective the new policy is in reducing negative externalities and improving the current cleanliness of the city and give advice for improvement. This is analyzed from economics perspective using game theory and compared with other countries.

2. Facts

2.1. Test by the government

On July 24th, Shanghai Municipal Solid Waste Classification Promotion Joint Conference Office proposed the exam result of waste sorting in Shanghai, examining 4051 communities of 220 towns in 16 districts on facilities and propaganda of 45% of 100 in the form of adherence, and disposing, management, and sorting of 55%. 29 towns got above 80%, 44 towns got 60%-80%, 79 towns got 30%-60%, and 68 towns got lower than 30%.

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2.2. Methods used to encourage waste sorting

In many communities/neighborhoods, there are monitors collecting waste and charging fines, but still, some neighborhoods have no monitors. As known from people around, those who live in neighborhoods without monitors also do waste sorting, but less careful. On streets, waste is more easily be thrown into the wrong bins, especially in crowded shopping centers.

The government has developed green accounts to encourage people, which people can exchange some commodities by the credits in the accounts. Fines are also charged at 200 RMB the highest for individuals, and 5000 RMB the highest for firms. In the first of July, there were 199 fines tickets and more than 3000 warnings. But people are feeling better for being used to waste sorting. Not just individuals and firms make mistakes when doing waste sorting. And some waste stations, mainly small ones are mixing separated waste when collecting, which means that former works are wasted.

2.3. Complaints from the public

As discussed online, since many garbage bins are removed, waste is sometimes left on the side of the roads or accumulate around the bins in some neighborhoods, attract flies and mice, and produce odor. These were not supposed to happen if the garbage bins are not removed. Disposing waste in inappropriate ways creates new negative consumption externalities. Many young workers are also complaining online about the time regulation and additional works, and say “they are not Japanese housewives”.

3. Economics Perspective

3.1. Economics of waste disposal

Waste is part of the economy. It’s the result of consumption of resources, and recyclable and reusable resources are included in those waste we throw away every day. We humans produce so much waste, and 150 million tons of waste is produced annually in China.

Household waste does not only include resources but also cause negative consumption externalities, which are negative impacts on third parties caused by consumption of goods. Resources are wasted, third parties living environment is polluted, lands are occupied because of landfill and can’t be used in other ways, etc.. It’s a market failure that resources are being inefficiently allocated, and is bad for the economy.

To reduce negative externalities and save resources, efficient waste disposal and waste management is needed. Doing waste sorting when it’s produced can efficiently cut waste and prevent some resources from being wasted, and then can save labor and maximize the saved resources. Waste disposal can also provide jobs or/and give opportunities to some firms and help increase power of consumption to make positive effects on the economy.

3.2. Analysis of effectiveness on reducing negative externalities

Since the new policy has been launched, apparently people started acting. According to the data of the exam about waste sorting in Shanghai conducted by the government, about 33% of towns got the score of the test on adherence above 60%. By separating the usable resources out like turning the recyclables into new products and making wet wastes into fertilizers for gardening, the rate of sorted waste has increased significantly compared to the past that people seldom care about waste sorting(if the works were not just done to show to the government). Waste is reduced, and other natural resources are saved. Thus, waste sorting has certainly been effective in reducing negative externalities to some degree.

3.3. Waste sorting policy analyzed with game theory

According to game theory that discusses strategies between parties, we can analyze the situation further. (See Figure 1) The government aims to do waste sorting in order to reduce the negative externalities of waste and deal with the problem of scarce land and large amount of waste. It can either keep pushing waste sorting or leave people to adapt to the new policy slowly. The public is

not used to waste sorting in daily lives, and many people consider it as a trouble in their lives. People can either do waste sorting as required (cooperate) or not.

Table 1 Game Theory of Waste Sorting

The Government \ The Public	Cooperate	Not
Push	Improve very quickly on waste sorting and negative externalities are reduced	Don't improve. Conflicts between the government and the public occur
Not	Improve but slower than pushing and cooperating	Don't improve and negative extrnalities keep increasing

If the government chooses to push and the public chooses to cooperate, the new policy of waste sorting can be conducted well, and negative externalities can be faster reduced. If the government chooses to push but the public doesn't cooperate, it will be difficult to make improvements. Maybe people will slowly change because they don't want to be fined, or there can even be conflicts between government workers and the public. If the government chooses not to push but the public cooperates, the new policy can also be conducted well, but just reducing negative externalities slower because mistakes are easier to made without the government's propaganda and correction. If the government chooses not to push and the public doesn't cooperate, the problems will remain, or even fall back to be like the past, thus, negative externalities will not be reduced or even increase that the amount of waste still increase to fill the scarce lands in Shanghai, and the new negative externalities on people's daily lives keep existing.

So the win-win situation is that the government push and the public cooperate. This strategy can also be considered as the Nash equilibrium that both the government and the public are having their best choice whatever the choice of the other party is. But as widely known and according to complaints online, people are rather a bit reluctant to do waste sorting because of laziness but not hating it and would liked to make some efforts if they are pushed and encouraged.

3.4. Actions that can be taken

Fines (200 yuan the highest for individuals and 5000 yuan the highest for firms) have played an important role in encouraging waste sorting. People, especially firms don't want to pay the fines and do waste sorting. But a big problem of the effect on individuals is that they don't easily get caught. In many neighborhoods and on streets, there is no monitor. Although there are cameras in some places, the government don't send enough people to catch and fine those who didn't do waste sorting because the cost is too high. So fines should be increased to some degree to reach the purpose to prevent people from mixing waste because higher fines can make people be more afraid of getting caught. But the government shouldn't just push but also encourage. To meet the public's needs and according to the complaints about fixed time and reduced garbage bins, the government can make the time more flexible and doesn't take away too many garbage bins. This can give people a nice environment and motivation to cooperate.

A new business is also starting that some firms sort and throw garbage for consumers. Comparing with paying fines, this can be cheaper if the consumers are usually getting caught and saves labor of their own. Thus waste sorting also provides jobs and has positive effects on the economy. This can be encouraged, because consumers of this service can save labor as they want and providers of this service can get benefit from working.

4. Comparing with other countries

There are many countries who started waste sorting policies long ago and relatively succeed, they can be good examples, but good sorting doesn't mean everything.

4.1. Rigorous sorting in japan

Japan is a widely known example of waste sorting. All regions in Japan have detailed sorts for wastes, and different sorts are collected on different days in a week. Some garbage bins are transparent, and there are vivid graphs for people to know what waste should be in certain garbage bins. Penalties for not doing waste disposal properly are very serious in Japan. People who don't throw waste according to the regulation are punished from 300 thousand yen's fines to be in prison for at most 5 years and 100 million yen's fines. Behaviors of not throwing garbage against the regulation will get the penalty of less than 5 years' imprisonment and less than 100 million yen's fines. Looking at Japan's clean streets, we know that these penalties must have worked. Facing the laziness of people, Chinese government should consider to rise the fines for improve other penalties to force waste sorting at the beginning to make it a habit and to optimize the effect of waste sorting on negative externalities.

4.2. Simpler sorting in the US

Waste sorting of the US is rather simpler, more detailed works are done in later processes, and landfill is the main way of waste disposal. This way more or less fits the feature of the US that the population is not quite dense on average. It conducted Pay As You Throw, Waste Wise, Mechanical Biological Treatment, Material Recycling Facility, Plastic Recycling Facility, Material Recycling For Future, and so on. In 2010, the work of reducing from the beginning and recycling avoided 209 million tons of wastes. There are companies collecting and disposing waste in the US, so competence exist, and this can promote the companies to do better works. Having these companies can also offer jobs, opportunities to the society, which is good for the economy. China can also do this, but regulations on firms should be very strict to make sure they do works well but don't cheat.

4.3. Analyzing together

What waste sorting aims to do is to cut the waste of resource from the beginning and help to reduce negative externalities caused by waste production, but as it is in daily lives, it takes a long time and much work to make all individuals take part in on their own initiative. For crowded areas like Japan, it's more significant to save every piece of resource and use less landfills, but for the less crowded areas like America, there is less burden. Policies in those developed countries have been improved to fit their own conditions, and people are willing to follow. This takes time to change people's minds and habits, and making the policy that fits Shanghai's condition is also helpful to get over the barriers at this time and in the future. Even though Shanghai has dense population and more detailed waste sorting is better to save resources in such a city, the government can't make too big a change in people's lives and make it too complicated to understand.

5. Conclusion

5.1. Effectiveness

In conclusion, a month or so after the start of *Regulations of Shanghai Household Waste Management* policy, works are getting done, and citizens are gradually adapting to the new policy. But the beginning of is hard and improvements should be made, or it will be easy for the situation to fall back.when people find it's still in a bad situation or it's not strict.

5.2. Advice on how to improve

Using game theory, we find that it's best for the government and the public to cooperate to reduce negative externalities caused by waste because the government's goal is clear. And making people see the effect on reducing negative externalities and other benefits can make waste sorting easier to improve. The government should see what useful has been done to push the society and how they can improve. It should also learn from the experiences of other countries and remember it's a long way to make the whole society independently do waste sorting. Lastly, to ensure the

effectiveness of waste sorting, laws must be rigorously monitored, and fines should be effectively charged and measured, or the policies will be likely to be ineffective.

When problems occur, we should work to solve them. As people realize the importance of cutting the waste and adapt to waste sorting, initiative will be brought up. The government can encourage and push people, to drive the society to work together.

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