

Government Regulatory Innovation in China: Drawing Comparative Lessons from International Experience on Garbage Management

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Received December 25, 2019; Revised February 04, 2020; Accepted February 21, 2020

Abstract In recent years, the rapid development of China's economy has been accompanied by the gradual deterioration of the living environment, which is an inevitable malpractice brought about by extensive development. In the process of accelerating urbanization in China, the scale and population of cities are gradually expanding, but the treatment of municipal solid waste lags behind. The phenomenon of besieging cities with municipal solid waste has become very common. Government departments must consider how to effectively deal with the problem of garbage and ensure the sustainable development of economy and society. This paper analyzes the main experiences of garbage control in five countries, and takes the enforcement of garbage classification by laws promulgated in Shanghai, China as an example, to explore the effective path of garbage control in cities and towns in China, so as to provide a reference for countries with similar situations.

Keywords: government regulation, innovation, garbage management, international experience, China

Cite This Article: Yitian Shao, Zuotian Ren, Rongjie Li, and Gang Chen, "Government Regulatory Innovation in China: Drawing Comparative Lessons from International Experience on Garbage Management." *American Journal of Environmental Protection*, vol. 8, no. 1 (2020): 27-33. doi: 10.12691/env-8-1-4.

1. Introduction

The extensive development of China's early economy was at the expense of ecological environment. In recent years, China has been advocating the concept of harmonious development of man and nature, and is committed to playing a great role in global governance. As the companion of human civilization, the proper disposal of garbage is directly related to the health of human beings and even the global biosphere. Human civilization is the continuous progress in the more and more meticulous disposal of garbage. Garbage classification can be traced back to France in 1884. Every country will face the problems of urbanization and garbage disposal, and every government will face the choice of incentive policy and mandatory implementation policy. From the point of view of garbage treatment in many countries, it is not significant to guide residents to deal with garbage treatment by themselves through encouraging policies. It must be based on legislation, on the basis of guiding residents to develop good habits of garbage classification, and form a new pattern of government regulation as the leading factor and the participation of the whole society in joint management.

In 1980s, Geller et al [1] put forward garbage classification behavior (Behavior for Source Separation, BSS) is the source of garbage management process, is the individual and family as the first link in the whole management process, the domestic waste is put in different garbage bags according to the regulations, and the classified garbage is dropped in the designated place. In recent years, many scholars have devoted themselves to the research of garbage management. Some scholars have used SWOT framework to analyze the advantages and disadvantages of social organizations involved in waste management in India [2]. Some scholars have discussed in detail the role, action mode and influencing factors of social organizations in solid waste management in developing countries [3]. Some scholars have described the key role of social organizations in garbage classification, resource recovery and cost saving through the comparison of 20 cities in developing countries [4]. Some scholars have also found that economic incentives and convenience are similar, but also an important factor affecting the behavior of garbage classification and collection [5].

By comparing the practices of several countries with remarkable effect of garbage treatment, combined with the scheme of garbage treatment in Shanghai, this paper puts forward some feasible suggestions for the treatment of urban garbage in China, in order to promote the

construction of ecological civilization in China and even in the world.

2. Present Situation of Municipal Solid Waste and Government Regulation in China

2.1. Present Situation of Municipal Solid Waste in China

According to the 2018 Annual report of the Ministry of Ecological Environment of the people's Republic of China on the Prevention and Control of solid waste pollution by solid waste in medium cities and the annual population data of major cities of the National Bureau of Statistics, in 2017, the output of municipal solid waste in China was 201.944 million tons. The situation of municipal solid waste in the top 10 cities and per capita garbage in each major city is shown in Table 1. In recent years, the total output of garbage in China has continued to increase, and the per capita output of garbage has also increased.

Some data show that the cost of municipal solid waste disposal by the Beijing municipal government alone is as high as 1 billion RMB [6]. In the face of so much garbage, the main measures taken by major cities and towns in China are landfill, incineration and dumping. Due to the mixed disposal of garbage, it increases the difficulty of garbage collection and reuse, and is not conducive to the incineration of garbage. Therefore, garbage disposal is mainly landfill, and individual places even dump garbage directly around the town. MSW incineration produces a large amount of carbon dioxide and other toxic gases, which will seriously pollute the atmosphere; landfills will cause soil pollution and groundwater pollution, especially plastic and glass products, which are not easy to decompose; and random dumping will cause sea, lake, river, soil and other serious problems affecting the ecological environment, as shown in Figure 1.

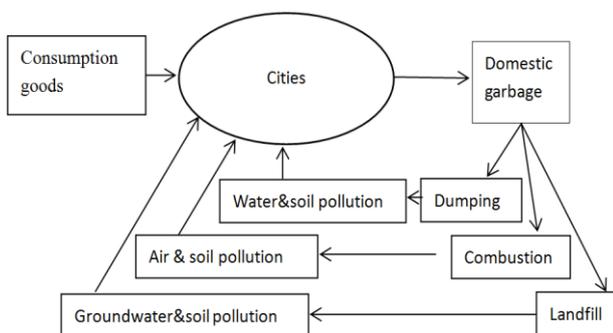


Figure 1. Vicious circle of environmental pollution caused by domestic waste

Since 2018, human waste production has been more than twice the rate of population growth, with most of the newly generated waste coming from developing countries, and that this trend will continue until 2050, and whether these countries will be able to establish formal garbage collection systems, according to reference sources. It is crucial to manage waste around the world and minimize

its impact on the environment. A 2018 survey of 3600 residents in China's major cities found that nearly 3/4 could not determine how to sort it out for recycling.

2.2. The Present Situation of Government Regulation to Deal with Garbage Disposal in China

As early as 2000, the Chinese government had foreseen the problem of garbage disposal and designated eight cities to carry out pilot garbage collection. However, because many cities not only lack garbage collection facilities, but also residents do not give due education, social publicity and garbage classification implementation are not in place, basically did not achieve the desired effect of garbage classification. In 2017, the Chinese government announced the implementation of compulsory classification of domestic waste in big cities. In the past two years, a number of cities have launched a considerable scale of pilot work, one after another introduced the implementation of garbage classification. In 2018, the National Development and Reform Commission issued the opinions on innovating and perfecting the Price Mechanism for promoting Green Development. It was made clear that by the end of 2020, cities throughout the country should establish a garbage charging system in an all-round way, and implement metering and differential charges for eligible resident users. For example, the mandatory garbage classification measure implemented in Shanghai on July 1, 2019 is a large-scale municipal recycling measure that China has tried before. The key is that the measure has risen to the legislative level and is open and punitive. Shanghai garbage control is also known as "the strictest garbage classification in history." China's garbage sorting campaign has directly boosted online trash can sales. In May, the number of searches for "classified trash cans" on corporate service platforms more than tripled, and transactions rose more than 70 percent from a year earlier. In particular, orders in Shanghai are ahead of Yao nationwide, with sales of household trash cans reaching 3 million units throughout June and 50 percent year-on-year sales in the week of June 24 to 30. According to data from Tmall, in June, the number of keyword searches in classified trash cans increased more than 30 times compared with the same period last year, and sales increased more than 5 times compared with the same period last year. The price of classified trash cans was on the high side, generally ranging from 150to 300RMB.

A series of measures by the Chinese government have shown that China should make up its mind to control the garbage problem, not only formulate specific laws and regulations on garbage control, but also resolutely implement it, and change the huge transformation from encouraging education to mandatory enforcement in the past.

3. Comparison of Typical Experiences in Garbage Treatment in Five Countries

In this paper, five countries with obvious garbage treatment effect are selected as the research objects, and their successful experiences in the process of garbage treatment are mainly discussed, which can be used as a reference for the formulation of garbage treatment programs in China and other developing countries.

3.1. Japanese Experience

Regular and fixed-point collection of garbage, large pieces of waste have to pay, waste disposal improper use of severe penalties. 95% of the kitchen waste currently generated in Japan is burned every year, and since combustion costs a lot of fuel, consideration is being given to building a composting center for kitchen waste, reducing fuel consumption and achieving circular development. In 1879, Japan formulated the rules for the removal of Municipal streets and regulations on toilet Construction and fecal disposal, the first step in Japanese history on waste disposal. In 1900, the sewage removal Act was promulgated. The obligation of local governments to dispose of garbage is fixed in the form of law, which is also the source of the duty of local government to deal with garbage today. In the late 1960s, Japan's economy entered a period of rapid growth, followed by a large amount of garbage called a headache. In the early 1970s, all parts of Japan fell into a "garbage crisis." By the 1990s, Japanese society had a more urgent understanding of the importance of resource recycling and the necessity of reducing waste, issued a series of recycling laws, issued a series of laws, especially the response and treatment of resource waste and harmful waste has become more and more detailed.

3.2. Korean Experience

Garbage classification and treatment has been implemented for more than 20 years. At present, the recovery rate of waste in South Korea is as high as 84.4%, and the output value of garbage classification and recovery accounts for 2% of GDP. The standard of garbage classification in South Korea is meticulous and strict, and the price of garbage bag is generally high, because the cost of garbage bag actually includes the fee of garbage disposal, as well as the arrangement of special management guidance classification. Since April 1994, some areas have implemented the collection and disposal fee according to the amount of garbage dropped, and the discharge of domestic waste in South Korea has been reduced by 23% in just four years, while the amount of renewable waste has increased by 74%.

3.3. French Experience

In 1539, the French king issued a decree prohibiting citizens from dumping garbage on the streets. In 1666, one of the causes of the Black death in Amien, France, was also confirmed to be caused by smelly gas from garbage, when the city hall ordered the removal of "mud and garbage that produce and spread harmful gases." The earliest public dustbin and garbage classification in the world appeared synchronously in Paris, France, in 1884. In 1992, the French National Assembly formally approved

and implemented the garbage Classification. Statistics from 2007 show that France collects and treats nearly 3 million tons of garbage every year, with a recovery rate of 61 percent, which is much higher than the average of 55 percent in the European Union. Nearly 90% of the French said they would sort out the garbage.

3.4. German Experience

In the early 1960s, the Federal Government of Germany guided it through the establishment of the garbage Recycling and Utilization Industry Association. In 1991, Germany issued the Packaging regulations, which stipulated that consumer goods manufacturers have the obligation to recycle packaging materials, and officially launched the German garbage separation and recycling system. In 2015, the revised Circular Economic Law stipulated for the first time that individuals have the obligation to classify garbage, which means, Since then, it has become illegal not to classify or misclassify garbage. Circular Economic Law also gives garbage collection and treatment enterprises the right to refuse to dispose of garbage correctly. According to the 2019 German fine catalogue, fines for illegal disposal vary from 10 euros to 5000 euros. Four kinds of domestic garbage bins and associated garbage collection services in German residential areas are purchased by homeowners or property companies on demand from local garbage collection and disposal enterprises according to household conditions. There are two main ways to dispose of waste in Germany. One is to make fertilizer from kitchen waste, which is 5 million tons of fertilizer made from kitchen waste every year. The second is for biogas power generation, Germany door-to-door recovery and treatment of restaurant swill company FeFood, to deal with only 300000 tons of food waste a year, power generation 54 million degrees (kilowatt-hours), supply 25000 households. Germany was one of the first countries to implement "forced garbage classification," Germany's focus magazine said on July 1. At present, Germany's garbage recovery rate has reached nearly 90 percent, of which 68 percent have been recycled. Germany's garbage disposal industry currently employs 250000 people and has an annual turnover of 50 billion euros.

3.5. Belgian Experience

Garbage sorting began in the 1990 s and is now at the forefront of the world in garbage sorting, mobile phones and disposal. The main characteristics of Belgian garbage classification are as follows: 1. 90% of the residents can be strictly classified; 2. Start education from kindergarten; 3. Spontaneously advocate "zero emission" life. Belgium pays attention to the propaganda of garbage classification, and decades of public welfare propaganda makes the awareness of environmental protection rooted in the hearts of Belgian people. The public constantly understands and supports the environmental protection policy, and even consciously participates in environmental protection affairs in accordance with the law, rationally and in an orderly manner. The experience of Belgian garbage classification and disposal shows that it is feasible to raise public awareness of environmental protection and actively participate in enthusiasm through various forms of

educational activities, so that there is a benign interaction between the government and the public.

Table 1. Comparison of typical experiences in garbage treatment in five countries

Country	Regulations and time	Characteristic
Japan	In 1879, 《Market and street cleaning rules and toilet construction and feces treatment regulations》	Timing and fixed point
	In 1900, 《Dirt removal method》	Big pieces of garbage have to be paid Severe punishment measures
Korea	In 1994, Implementation of collection and disposal fees according to garbage discharge capacity	The classification standard is meticulous and strict
		The price of garbage bags made from quantity is generally on the high side. Classification of management guidance for special personnel
France	In 1539, Members of the public are prohibited from dumping rubbish on the streets	The country with the earliest garbage classification
	In 1884, The world's earliest public dustbin and garbage sorting, unexpectedly appeared at the same time in Paris	Nearly 90% of the French said they would sort out the garbage.
	In 1992, 《Garbage classification》	The recovery rate was 61%, much higher than the EU average of 55%
Germany	In the early 1960s, the Association of garbage Recycling and Utilization was established.	Garbage bins and associated garbage collection services, purchased on demand
	In 1991, Germany issued the Packaging regulations, which officially launched the German garbage separation and recovery system.	Kitchen waste making Fertilizer and Power Generation
	In 2015, the revised 《Circular Economic Law》 the first time that the individual has the obligation to classify the garbage	Germany is one of the first countries to implement the "forced garbage classification"
Belgium	Garbage classification has been carried out since the 1990s.	Nine percent of the population can be classified strictly Education from kindergarten Self-advocacy of "zero discharge" life

4. Main Measures of Garbage Classification in Shanghai, China

4.1. Formulate and Strictly Implement the Regulations on the Management of Municipal Solid Waste (MSW) in Shanghai

The Shanghai Municipal solid waste Management regulations first clarify the legislative purpose and basis, the definition of domestic waste, management principles, classification standards, government responsibilities, garbage producer responsibility. Secondly, the main measures to promote the reduction of the source, the construction of the resource utilization system and the establishment of the classification and delivery, collection, transportation and disposal of the whole classification system are clarified. Finally, it clarifies and perfects the social mobilization system, strengthens the supervision and management and the legal responsibility. The regulations define the rules of behavior of garbage through legislation, cultivate and guide the habit of behavior, implement legal liability, bring garbage classification into the track of rule of law, formulate detailed fine measures for those who violate the regulations of garbage classification and strictly enforce them.

4.2. Implement a Series of Mandatory Measures for Garbage Classification

Shanghai has taken the lead in establishing and implementing a compulsory classification system for domestic waste. Products and packages listed in the national compulsory recycling catalogue are required to be

recycled and disposed of in accordance with regulations. And put forward mandatory requirements for specific objects: actively promote product packaging, express packaging reduction work, stipulate farmers' markets, standardized vegetable farms equipped with wet waste local treatment facilities; To reduce the use of disposable supplies, it is stipulated that party and government organs and institutions shall not use disposable cups and utensils in internal office space, catering services and catering distribution service providers shall not take the initiative to provide disposable chopsticks, spoons and other tableware, and hotel business units shall not take the initiative to provide disposable daily necessities. Enforce the necessary penalties for violations of administrative requirements.

4.3. Responsibility for Hierarchical Implementation of Garbage Classification

Shanghai has made it clear that units and individuals are the responsible subjects for the classification and delivery of domestic waste. The system of those responsible for the classification and delivery of domestic waste will be carried out, and the corresponding laws and administrative regulations will be responsible for violations of the regulations. At the same time, a management mode based on the combination of pieces and blocks has been established. The municipal people's government shall coordinate as a whole, and the district people's government shall be responsible for the management of domestic waste in the area under its jurisdiction: first, at the municipal level, it is emphasized that the municipal government should strengthen its leadership over the management of municipal solid waste, and it is clear that the city greening city appearance department is the competent department for municipal solid waste

management, and is responsible for the organization, coordination, guidance and supervision of the relevant work. And clear the responsibilities of the relevant departments of the city. Second, at the district level, it is clear that the district government is responsible for the management of domestic waste in the area under its jurisdiction, and the district greening city appearance department undertakes the corresponding specific work. Third, at the street and town level, in line with the requirements of the sinking focus of management responsibilities, the township people's government and street offices are responsible for the specific implementation of the relevant work.

4.4. Implementation of Punishment and Encouragement Policies for Garbage Classification

Shanghai pays attention to both incentive and restraint for garbage classification, pays attention to positive incentive mechanism, and formulates necessary punishment measures for violations of management requirements, which is called "the strictest garbage classification measure in history": if individuals or units fail to classify garbage according to regulations, they will face punishment. Among them, the maximum individual will be fined 200RMB; if the transportation enterprise fails to correct the behavior of "mixed loading and mixed transportation" within the time limit, the maximum will be fined 50, 000 RMB; if the end disposal enterprise of domestic waste fails to implement the classified treatment and fails to correct it within the time limit, the maximum fine will be 500000 RMB, and if the circumstances are serious, the license for the operation of domestic waste will be revoked. At the same time, in accordance with the regulations, we should encourage the development of standards for the utilization of waste resources; encourage social participation, industry participation, and market participation in garbage classification; encourage the recycling and reuse of waste in various ways and the comprehensive utilization and coordinated disposal of waste; encourage economical use, reuse, and give priority to the use of environmental protection products.

4.5. Attach Importance to the Propaganda and Guidance of Garbageclassification

Shanghai regards the propaganda and guidance of garbage classification as a key work, through strengthening the reduction of the source of domestic waste, the whole process of classification management, the propaganda and education of resource utilization, improving the awareness of municipal solid waste classification, popularizing the knowledge of municipal solid waste classification, and promoting the formation of a good atmosphere for the participation of the whole society. Through the public welfare propaganda of municipal solid waste management laws and regulations and classification knowledge continuously carried out by the news media, the behavior of violating municipal solid waste management is supervised by public opinion. At the same time, we should strengthen the guidance of garbage classification, guide all

kinds of market subjects to participate in the activities of source reduction and classification, collection, transportation, disposal and resource utilization of domestic waste, guide consumers to form good habits of garbage classification, and guide units and individuals to consciously fulfill their obligations of municipal solid waste management.

5. Exploration on the Path of Municipal Solid Waste Treatment in China

5.1. Improve the Relevant Laws and Policies on Garbage Classification

In recent years, China's provinces have promulgated and implemented measures for the classification and management of domestic waste one after another, and have achieved some results, but compared with the regulations of Shanghai, there are still some gaps, especially in terms of mandatory supervision and punishment, which still need to be improved and strengthened. Therefore, it is suggested that on the basis of perfecting the original methods, garbage classification should be legislated as soon as possible, and governments at all levels should formulate stricter local management measures according to local conditions, bring garbage classification into a higher level of legalization track, further standardize the relevant provisions of key links such as domestic waste classification, collection, transportation and disposal, and enhance the maneuverability and effectiveness of garbage classification. Make clear the corresponding rights, obligations, responsibility assessment and other contents, strengthen the pluralistic supervision mechanism of garbage classification, punish the violations of garbage classification "have laws to follow", "there are rules to follow", but also provide institutional protection for the supervision of public opinion of social groups.

5.2. Take Compulsory Measures for Garbage Classification and Supervision in Accordance with the Law

At present, garbage classification has become a serious public interest problem, and there are still deep-seated problems such as institutional mechanism. It is suggested that cities should draw lessons from the experience of Shanghai, strengthen the enforcement of garbage classification laws and regulations on the basis of strengthening the rule of law of garbage classification, and effectively solve the problems of inadequate implementation. The garbage classification is changed from encouragement to mandatory, mandatory supervision measures are taken according to law, and an integrated mandatory supervision system from source classification to terminal treatment is established. Form rigid constraints on garbage classification and establish a mandatory code of conduct for the whole society in our province. Clarify the subject of responsibility for garbage classification and severely punish the relevant responsible parties.

5.3. Improve the Infrastructure of Garbage Classification

At present, the construction of garbage classification infrastructure in cities and towns in China is not perfect. Some scholars point out that the supply of garbage classification facilities is insufficient [7] and the garbage collection and utilization system is not perfect [8]. For example, the garbage bins in some urban communities are not indicative, the allocation of classified garbage bins is not in place, the marked garbage separation and transportation system has not yet been established, garbage incineration, the shortage of landfill sites and unreasonable setting, and so on. Therefore, it is suggested that government departments at all levels should pay attention to the implementation, urge all regions to improve the infrastructure construction according to the actual needs of garbage classification, and complete the supporting work of infrastructure as soon as possible, especially to set up concise and clear garbage separation facilities in the community, fixed recyclable waste collection and purchase points, etc., so as to improve the convenience of residents' garbage classification behavior. Economists mainly analyze the convenience of garbage classification and collection facilities and the influence of external incentives on garbage classification behavior [9]. The so-called convenience refers to the classification and collection system used [10], such as the type and frequency of collection, the availability of collection points, and the adequacy of garbage classification information supply. The closer the garbage collection site is to the public residence, the more perfect the garbage sorting facilities and equipment are, and the more likely the public is to carry out garbage sorting behavior [11].

5.4. Implement the Responsibility, Supervision and Assessment Mechanism of Garbage Classification in Layers

According to the province, city, district (county), street and community layer to implement the responsibility of garbage classification, clear units and individuals are the main body of responsibility for the classification and delivery of domestic waste, and clearly define the responsibilities of all parties in the garbage classification chain. It is suggested that the hierarchical assessment system of municipal solid waste management should be improved, the assessment objectives at all levels should be set, the completion situation should be assessed regularly, and the evaluation results should be included in the performance appraisal content. We should carry out the system of those responsible for the classification and delivery of domestic waste, improve the hierarchical supervision mechanism, strengthen the supervision over the implementation of the relevant laws and regulations on garbage classification, and carry out necessary supervision and assessment of the garbage classification work of relevant departments, units and personnel.

5.5. Give Full Play to the Propaganda and Demonstration Role of Garbage Classification

To give full play to the role of propaganda and education in garbage classification, strengthen the media and community to different age groups, different industries, different regions of residents publicity, depth, breadth, improve the national garbage classification awareness, recognition, operational ability, strengthen the resident community "master" consciousness, so that residents fully understand the long-term interests of garbage classification. Advocate the whole society to participate in garbage classification, to learn the law, to know the law, to abide by the law, to use the law. Gamba et al [12] found that environmental knowledge is the main influencing factor of garbage classification behavior. Develop good habits in which everyone has a responsibility, everyone participates and everyone benefits from garbage classification. Gu and others believe that residents' living habits are the main influencing factors of garbage classification behavior, and promote the integration of rule of law, rule by virtue and autonomy [13]. Based on the theory of planned behavior, Lucy Chan analyzes the recovery behavior. The results show that the moral basis is highly related to the recovery behavior, thus affecting the actual recovery behavior [14]. Unite the government, the market and society. It is suggested that the demonstration role of garbage classification should be brought into play and some cities, streets and communities should be selected to carry out the pilot work of domestic waste classification. The demonstration effect can be gradually popularized in the whole province. The persuasion of the "acquaintance" relationship of community garbage classification is to use the social relationship network to make use of the nearest connected residents with each resident. Because of the close relationship between these residents, it is easier to form a consensus [15].

5.6. Establishing a Long-Term Mechanism of Garbage Classification

The establishment and implementation of garbage classification management system in various regions is not only a tough war, but also a protracted war. It is suggested that the medium and long term plan of garbage classification and the corresponding legal and policy system should be formulated and improved, and the long-term mechanism of garbage classification should be established. Formulate concise and clear classification standards, perfect classification and delivery, classification and transportation, classification and treatment, set up classification work information platform, construct garbage classification evaluation index system, strengthen source reduction, change single end treatment to system management, and parallel garbage classification with packaging reduction, junk trading, waste recovery and so on. To build bridges between community and recycling enterprises and non-governmental organizations, to clarify the detailed rules of classified recycling management, to give appropriate tax preferential policies and financial subsidies to renewable resources recycling enterprises, to encourage multi-party participation in garbage classification, to improve the efficiency of recycling of renewable resources, Schultz and other in-depth analysis of the impact of government policy incentives on garbage classification behavior [16]. The formation of public finance, the

pluralistic capital investment mechanism of social capital, the acceleration of the research and development of waste treatment terminal technology and the transformation of achievements, the harmless treatment of garbage classification collection, fine management and the realization of resource reuse. Werner and Makela [17] studies have found that the satisfaction obtained by recycling behavior plays an important role in the sustainability of garbage classification behavior and gives birth to garbage ecological industry. The person in charge of Shanghai garbage treatment enterprise: 1 ton of waste currently produces about 80 cubic meters of biogas, which can generate about 150 degrees of electricity. Reduce the environmental impact of garbage pollution to a minimum and promote the transformation to a circular society with low waste and no waste. The mode is shown in Figure 2.

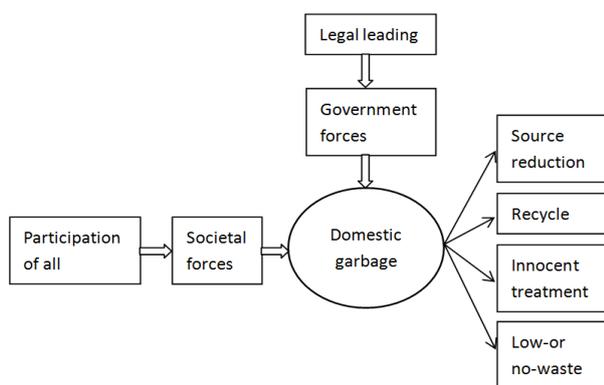


Figure 2. Long-acting mode of waste treatment

6. Conclusion and Prospect

The problem of economic development and living environment is the main problem that every country must face and choose. How to effectively solve the problem of domestic waste is the key factor to improve the living environment, especially in developing countries, we cannot blindly pursue economic development and ignore the ecological environment. China is taking urgent measures to deal with the waste crisis, putting waste disposal at the top of environmental control and restricting the import of non-metals as one of the actions against foreign waste. Through drawing lessons from the experience of five countries with obvious garbage treatment effect and combining with the garbage treatment scheme implemented in Shanghai, we summarize the feasible schemes of garbage control in developing countries, which can be used for reference by all countries similar to the urban garbage problem in China. It is hoped that through our joint efforts to build an ecological civilized society, to create a sustainable development model of harmonious coexistence between man and nature, to return the sky to blue, to return the sea to blue, and to return to the earth an ecologically balanced living home.

Conflict of Interest

The authors declare that there are no conflicts of interest.

Acknowledgements

The authors acknowledge the financial support from the National Natural Science Foundation of China. (Grant No. 71573223) and the Ministry of Education of the People's Republic of China. (Grant No. 14YJA790003).

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