Chapter 18
Building a Recycling-Oriented Society Through Collaboration Between Urban and Rural Areas: Sustainable Domestic Waste Treatment "Pujiang Model"

Kyungah Cheon, Chong Zhang, Xuepeng Qian, and Weisheng Zhou

Abstract With the rapid development of Chinese rural economy, the consumption has also achieved an incredible increase in rural areas. As a result, the waste problem has become a topic of concern for all. However, the existing approach to waste disposal remains problems including a high transfer cost and underutilized resources. Therefore, we focused on and analyze "the household waste disposal system model in Pujiang," which is an approach to dispose waste in a rural area and has achieved certain results. The result shows this approach is a usage of new public-private partnership (PPP) model which solved the disadvantage of the conventional PPP model. The new PPP model means the government purchases public service from the enterprise and could built a partnership between public and private involving more participation of local people. In this research, we evaluate the cooperation among the administration, the enterprises, and residents in Pujiang model from the perspectives of economy, environment, and society. Depended on the evaluation, we summarize the features of the model as following and make recommendations for promoting the model to other areas in China. The features of Pujiang model could be concluded in following six aspects: (1) waste reduction and recycling (organic fertilizer mainly); (2) waste collection and processing cost reduction; (3) soil restoration and improvement of agricultural production environment; (4) areas such as new tourist spots and places to visit economic promotion; (5) improvement of

K. Cheon
Research Center for Sustainability Science, Ritsumeikan University, Ibaraki, Osaka, Japan

C. Zhang
Zhejiang Gabriel Biotechnology Co., Ltd., Zhejiang, China

X. Qian
College of Asia Pacific Studies, Ritsumeikan Asia Pacific University, Beppu, Oita, Japan
e-mail: qianxp@apu.ac.jp

W. Zhou (✉)
College of Policy Science, Ritsumeikan University, Ibaraki, Osaka, Japan
e-mail: zhou@sps.ritsumei.ac.jp

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environmental awareness of residents and (6) achievements such as presentation of new waste disposal system of public-private partnership.

18.1 Introduction

As described in Chap. 17, in order to realize a recycling-oriented society covering a large area, circulation must be divided into medium circulation and global circulation. In this chapter, we analyze the Chinese Pujiang model of rural and urban mixed-type household waste disposal through public-private partnerships and discuss its role in the establishment of an East Asian Community.

Currently, the Chinese government aims to move toward a "recycling-oriented economic society" that utilizes regional characteristics to properly dispose of household waste according to national policies on improvement of living standards. The government is paying particular attention to Pujiang County as an example of a model of a household waste disposal system on the rural-urban fringe. The system has been in operation since 2014 and is being considered for application to other similar areas.

This chapter summarizes household waste issues currently faced in rural China, with respect to the desire for a sustainable recycling-oriented society. Based on interviews and field research in Pujiang County, we analyze the sustainability of the model from the perspectives of economy, the environment, and society. Although this solution to waste is unique to rural areas, we explore applicability of solutions to waste problems in other areas in China.

18.2 Household Waste Disposal in Rural China

One of the major characteristics of the household waste disposal problem in China is its severity in rural-urban fringe areas. According to the Sixth National Population Census (2010), 70.86% of the population in China is in rural areas. The economy in rural areas has rapidly developed due to the cooperative promotion of industrialization, information technology, urbanization, and modernization of agriculture. With this rapid economic development, waste disposal in rural areas has become an urgent problem. The total amount of household waste generated in China is now the largest globally, and the amount of waste per capita is rapidly increasing.

The amount of urban household waste collected and transported in 2017 exceeded 150 kg per capita, which is approximately one-third of the average per capita waste from 36 OECD countries (household waste and bulky waste collected by local governments) and approximately half of Japan's daily waste per capita. The volume of waste is expected to continue increasing due to population growth and economic development. Each region of rural China now actively promotes management of household waste, through the uptake of a waste treatment system called

"collection in village, transfer from town, disposal in prefecture." However, there are three major problems with this household waste disposal system.

First, all the waste discharged in an area is processed at the prefecture's landfill or incinerator. There is a shortage of final disposal sites, creating a heavy burden on prefectures, which must construct new processing facilities with large processing capacity. For example, the household waste collection and disposal system in Guangxi Zhuang Autonomous Region covers more than 90% of villages, but the amount of waste collected has already exceeded the capacity of the landfill disposal site in the prefecture. By 2020, 138 new incineration sites will be constructed. In Qian'an County, Hebei Province, nine landfill sites were constructed in 2009, but four were closed in 2017 after their disposal capacity was reached. Opposition to waste incineration facilities is common, due to problems such as air pollution and odors emanating from the facilities.

Second, such disposal systems place a heavy financial burden on municipalities in rural areas, which are not economically wealthy, due to high transportation costs. In Tangshan City, Hebei Province, the total area of the city is 1439 km^2, the rural population is approximately 200,000 (population density is low), and the financial income in 2016 was only 1.01 billion CNY. Due to lack of funds, the salaries of waste collection workers are low, and the operation and maintenance status of facilities, cleaning, and transportation are insufficient.

Third, in some areas, non-standardized landfill disposal and incineration facilities are in operation, causing environmental pollution. In order to solve the lack of funds for the disposal of household waste in rural areas, small-scale waste incineration facilities and simple landfills are used to dispose of household waste. However, a lack of environmental technology related to waste disposal, improper management and operation, and inappropriate supervision systems for waste disposal are causing pollution.

The processing system of "collection in village, transfer from town, disposal in prefecture" does not exploit the recycling value of household waste in rural areas nor the socio-economic characteristics of such areas. The current situation is that the waste is simply collected in one place and then discharged or landfilled, which does not contribute to waste reduction and increased recycling.

18.3 Pujiang Rural Household Waste Disposal System

Pujiang County is in the southern part of China and belongs to Jinhua City in Zhejiang Province. It has an area of 920 km^2, a population of approximately 390,000 people (490,000 including the floating population). In Pujiang, there are seven towns, five villages, and three subdistricts. It is divided into 409 administrative villages and 20 communities (housing complexes). In 2016, nominal GDP reached 21.1 billion CNY, and nominal GDP per capita was approximately 50,000 CNY (~8300 USD). The urbanization rate was 60%, which is the average level in China; Pujiang is representative of rural-urban fringe areas.

There are three main reasons for taking the Pujiang Prefectural (County) Waste Disposal Model as representative of the rural-urban fringe. Pujiang County is located in Zhejiang Province in the eastern coastal area and has a nationally average rate of urbanization. It is in the rural-urban fringe in China with a high raw garbage ratio and relatively high levels of economic development. The waste separation compliance rate is approximately 90%, and the waste reduction rate is 50%, representing a great achievement. Thirdly, a public-private partnership (PPP) model has been utilized to create a waste collection and disposal system centered on naturalization of waste in cooperation with the government and private companies. The potential of this policy to contribute to proper disposal of household waste in rural China from the perspectives of the economy, environment, society, and sustainability is analyzed.

18.3.1 Household Waste Disposal in Rural Areas of Pujiang

In Pujiang, the per capita GDP and the amount of cleaning and transportation of household waste per capita are increasing significantly. The Pujiang government noticed the rapid increase in the amount of waste generated and officially incorporated waste separation into government projects in 2010 by announcing the Pujiang Municipal Public Waste Collection and Comprehensive Use Plan.

In 2014, in order to reduce waste disposal costs and utilize private expertise, waste separation collection and household waste disposal services were purchased from the Zhejiang Gabriel Biotechnology Co., Ltd., and a system was introduced for separating and recycling waste. By 2017, 16 waste disposal centers (composts) had been constructed in all prefectures, and 18 natural composting facilities were created. Approximately 200 tons of waste was disposed of every day. Although the amount of cleaning and transportation of waste in Pujiang had remained constant until 2014, this new model of waste disposal has greatly improved the environment of the town. In the same year, Pujiang was selected by the Ministry of Housing and Urban Rural Development of the People's Republic of China (MOHURD) as "the first model prefecture of China's rural waste separation and resource utilization."

18.3.2 Characteristics of the Pujiang Model

18.3.2.1 Separation and Disposal of Household Waste in Rural Pujiang

The Pujiang government conducted a pilot project and fully disseminated the results to the prefecture. After that, Communist Party members oversaw instruction and supervision of waste separation, setting goals to maximize rates of separation, collection, and recycling. Waste is cleaned daily. Each trash bin has a resident number and contact number for the party member in charge of its supervision. If waste is not properly segregated, there is a mechanism to follow up with the party

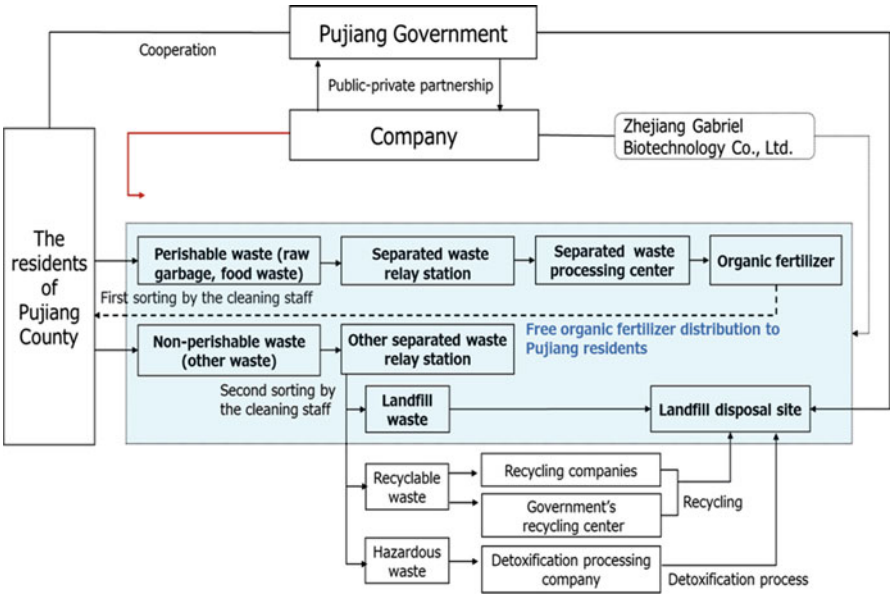

Fig. 18.1 Pujiang Prefecture household waste collection processing flow

responsible for dumping and responsible for supervision by tracking by number (with the "party-plus" system). With this system at its center, in collaboration with a private company, a model for waste separation, collection, and processing centered on the recycling of food waste was constructed (Fig. 18.1). This model takes advantage of the fact that the ratio of food waste to total waste is high in household waste in rural areas.

In urban areas in China and in other developed countries, household waste is generally separated into four types: harmful, perishable, recyclable, and other waste. It is difficult to directly introduce waste separation into rural areas where there is no prior experience of it. Thus, the system was implemented by considering simple and easy-to-understand ways of separating and collecting waste, called the "four kinds of waste/two kinds of waste" concept in Pujiang. The four types are (1) perishable waste (raw garbage, food waste), (2) nonperishable waste (other waste) (3) salable waste (recyclable waste), and (4) hazardous waste (landfill waste). The first sorting is performed by residents and the second by waste cleaning, collection, and transportation staff. First, residents sort household waste into raw garbage and other waste, and then the cleaning staff separates the waste further, checking whether collected waste contains other waste and reporting the rate of waste separation compliance to the village management committee. After that, the separated perishable waste is transported to a waste relay station, collected, and transferred to a waste-processing center where it is made into organic fertilizer. The organic fertilizer produced is provided free of charge to farmers in Pujiang to contribute to soil restoration. Other waste is carried to an ordinary waste relay station where it is divided into three types

by the cleaning staff: recyclable waste, landfill waste, and harmful waste, which are then transported to their respective destinations. Recyclables are sold to market recycling companies; where there is no commercial interest due to high recycling costs; items are sent to the government's recycling center. Hazardous waste is sent to a detoxification processing company, and landfill waste is sent to a landfill disposal site. Consequently, waste that can be recycled is collected as much as possible through the waste separation and collection process, and the amount of garbage going to landfill can be reduced.

18.3.2.2 The Role of Government

The role of the Pujiang model is to provide the private sector with a plan to establish and improve the system as a policy for waste disposal in the public works sector, to deal with the proposed public-private partnership, and to pay the full operating expenses to the private sector, which is contracted for waste disposal to be implemented as a PPP project. The government plans to raise the waste separation compliance rate through cooperation between Communist Party members (hereinafter party members) and residents of Pujiang County under the waste separation management responsibility system (a system with Chinese characteristics). The government further increases the waste separation compliance rate through waste separation guidance, public relations, and education. The government aims to improve reliability and transparency through disclosure of information (via Pujiang Prefecture Statistical Yearbook) on the above process.

18.3.2.3 The Role of Companies

As a public service to the government, the company separates, collects, and disposes of household waste discharged by residents of Pujiang County. Private companies recycle the waste generated by residents and transport it to final disposal sites. Planning and proposing a waste treatment system suitable for Pujiang County, developing related technologies, and applying a business model are suitable for management by private companies.

Using the experience and data gained through trial and error in design of the waste disposal service, the government will propose new policies on waste disposal and the use of related technologies. The company reports data on waste disposal management and discloses information (through its homepage) to build trust between the government and residents.

18.3.2.4 The Role of Residents

The residents of Pujiang County separate and dispose of household waste under the guidance of party members. Farmers use organic fertilizers created from recycled waste to grow organic products and consume agricultural products.

18.4 Evaluating the Sustainability of the Pujiang Model

The method of collecting waste has changed from conventional waste disposal (before separation) to a new waste disposal format (after separation). Compared with the cost of mixed collection and separation processing in the conventional system, separated collection and resource recovery processing can significantly reduce costs including those of waste collection and transportation and labor. According to data from the Pujiang government, daily waste emissions were about 514 tons in 2016. Considering the change in the cost of collecting 514 tons of waste before and after introduction of the new system, the collection of resource waste, and the value of the organic fertilizer produced, the economic benefits of waste separation (currently all organic fertilizers are distributed free of charge to residents of Pujiang County) can be estimated at approximately 39 million CNY per year.

18.4.1 Reduction in Waste Collection Processing Costs

The daily cost of waste disposal in this area is approximately 10% lower than the costs of mixed collection and mixed processing in the conventional system. The main reasons for the reduction in costs after separation are reduction in collection cost, reduction in transfer cost, and reduction in disposal cost. Although there is a cost to separating waste, this is less than the reduction in other associated costs. In 2016, the daily cost of waste disposal was 26,400 CNY (Fig. 18.2), equivalent to an annual reduction in costs of approximately 9.636 million CNY.

18.4.1.1 Collecting and Processing Costs Before Waste Separation

Before waste separation began in 2014, there was one garbage bin for every eight households in the town, and cleaners collected waste from each garbage bin and public places and carried it to the waste relay station. After that, it was transported to "town" by a waste transport vehicle, transferred from "town" to "prefecture," and was disposed of at the "prefecture" landfill site. In this centralized collection process, all waste was collected and disposed of at the landfill. We calculated the processing costs had this centralized system been in place in 2016 to be 174,000 CNY for

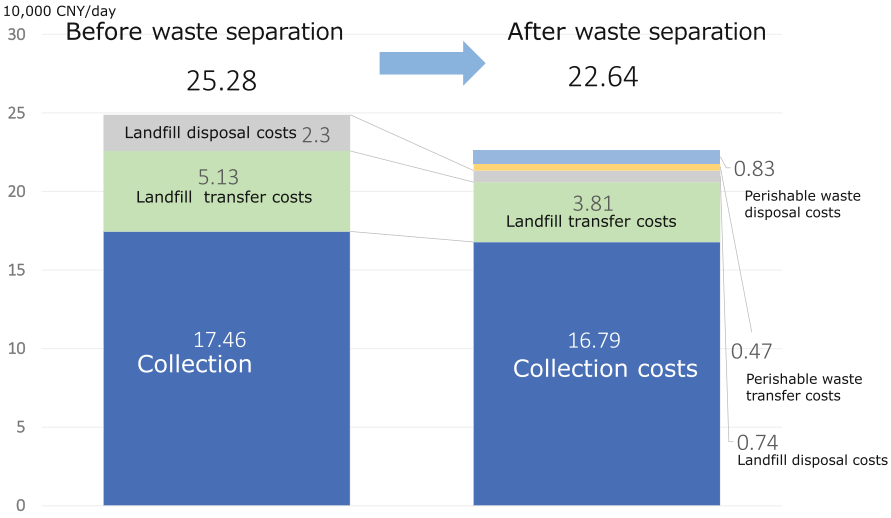

Fig. 18.2 Daily processing costs before and after introduction of waste separation processing in Pujiang County

collecting from the village, 513,000 CNY for transferring to the prefecture and 23,000 CNY for landfilling at the treatment plant. Therefore, total daily waste collection and treatment costs would have been 252,800 CNY.

18.4.1.2 Reduction in Collection Costs

Regarding waste collection costs, the standardization of waste disposal by the separation treatment has significantly reduced illegal dumping of waste in public facilities, rivers, and roads in Pujiang, thus reducing the workload and increasing the efficiency of cleaning staff. Although the number of households is increasing, the number of cleaners has been reduced from 150 cleaners per 10,000 households to 146 per 10,000 households, resulting in a reduction in waste collection cost from 174,000 CNY to 167,900 CNY.

18.4.1.3 Reduction in Transportation Costs Through Decentralization

Following implementation of the new system, 514 tons of waste are transported daily to the waste relay station after household waste has been separated and discharged in Pujiang (approximately 158 tons of raw garbage and 356 tons of other waste separated by cleaning staff). Approximately 1 ton of recyclable waste is collected, and 355 tons of remaining waste is transported. The volume of hazardous waste is negligible, so is excluded from the cost calculation.

Before introduction of waste separation, discharged household waste was transported to the single landfill in Pujiang Prefecture and disposed of through "dispersed" collection. In terms of processing, in keeping with the concept of local production for local consumption, waste that can be recycled into resources is instead preferentially transported to a nearby waste disposal center for processing, and only the remaining waste is transported to the landfill. According to 2016 data, the amount of waste transported to the waste disposal plant was reduced from 514 tons to 355 tons, and the transferring cost reduced from 55,100 to 38,100 CNY.

18.4.1.4 Reduction in Landfill Disposal Costs

If the proportion of raw garbage in total waste is large, the amount of organic substances that decompose in the filtrate will increase, and the processing cost of the filtrate will increase. Conversely, if raw garbage is removed before landfill disposal, processing costs decrease. According to data from the Pujiang Prefectural Health Bureau, the disposal cost after separation is about 7040 CNY.

18.4.1.5 Increased Cost of Waste Collection Processing

Raw waste is transported to a nearby processing center where it is recycled into organic fertilizer by a waste-processing machine. The cost of transporting 158 tons of waste a day is approximately 4700 CNY, and the cost of producing organic fertilizer is approximately 8300 CNY. In total, the transfer processing cost of raw garbage will be approximately 13,000 CNY.

As described above, even if the predicted costs for transferring and processing raw garbage are incurred, the overall waste disposal costs are reduced through reducing waste collection costs, landfill waste transfer costs, and landfill waste costs.

18.4.2 Economic Effects of Recycling

As shown in the flow chart for processing waste in Pujiang Prefecture (Fig. 18.3), raw (rotting) garbage is fermented and decomposed in a short time using a microbial fungus agent in waste mechanical fermentation equipment. In 10 days, approximately 511 kg of organic fertilizer can be produced from 2 tons of waste. Currently, this is provided free of charge to farmers in Pujiang County in order to incentivize them to separate their waste, but in the future it will be sold. According to a report from August 2018 (Pujiang County, Zhejiang), approximately 200 tons of raw garbage was processed per day in 2017, producing organic fertilizer worth three million CNY by the end of the year. Recyclable waste, which was originally disposed of by villagers under the two-time sorting system and mixed with general waste, is now sorted and collected by cleaning staff. Approximately 1 ton of

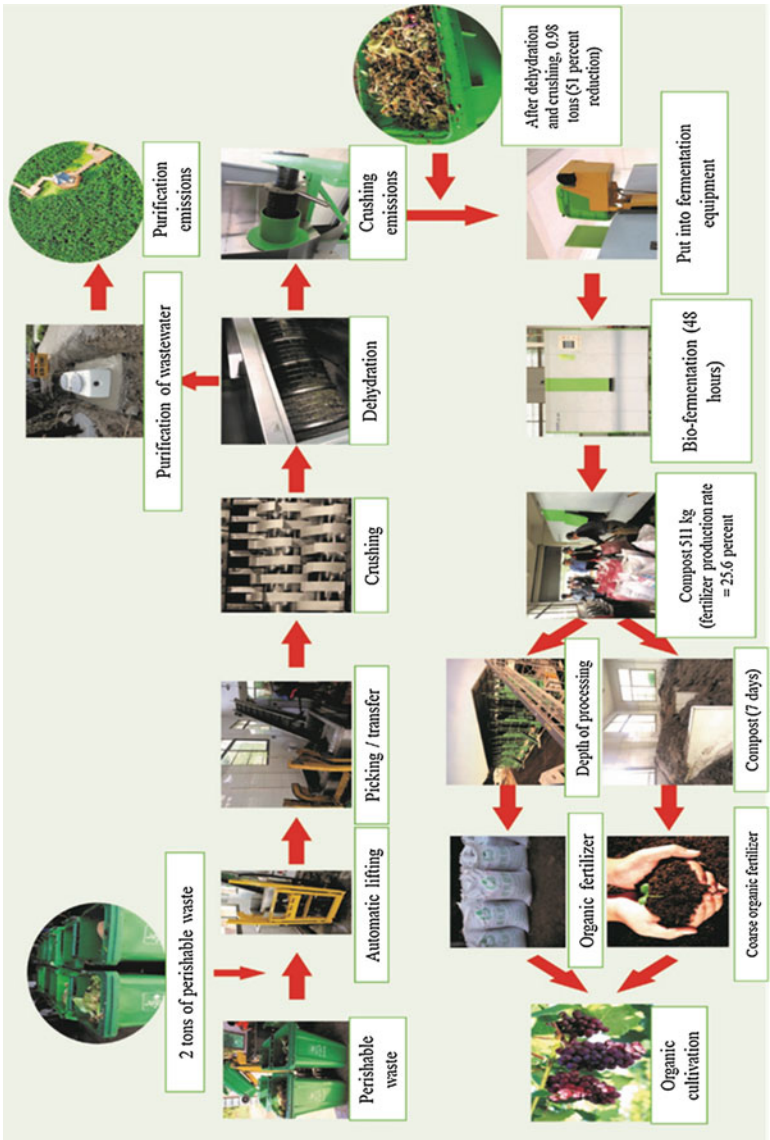

Fig. 18.3 Raw garbage disposal flow in Pujiang Prefecture

recyclable waste is collected each day, worth approximately 400 CNY or 146,000 CNY per year.

The collection and disposal costs before and after separating garbage can be reduced by 9.636 million CNY per year. In addition, an annual profit of 146,000 CNY can be generated from the sale of recyclable waste, enabling the production of organic fertilizer with a total value of three million CNY. Thus, the annual profit obtained by waste separation is estimated to be approximately 12.8 million CNY.

18.4.2.1 Reduction of Financial Burden in Waste Separation Processing

The cost of government waste disposal in rural areas of China has increased sharply since 2013, becoming a heavy burden on local government finance. Until 2013, waste disposal costs were not included in hygiene management costs and were not separately disclosed. The release of separate statistics on these costs since 2013 is an indication of increasing government focus on waste disposal problems. It became clear that the financial burden of waste disposal could be reduced by implementing a new waste separation disposal system in Pujiang Prefecture. Inhabitants could also obtain economic and social benefits by collecting resource waste and receiving organic fertilizer free of charge.

In addition to reducing the financial burden on the government, waste disposal can also benefit private companies and residents. As waste disposal costs are expected to continue to increase in the future, the Pujiang model is expected to be applied to other regions in China.

18.4.3 Environmental Effects of the Pujiang Model

18.4.3.1 Waste Reduction by Intermediate Treatment

In 2016, the total amount of general waste, excluding industrial waste, collected in Pujiang County was approximately 900 tons per day, of which approximately 514 tons was domestic waste. As a result of the separation process, 158 tons of raw garbage is made into organic fertilizer by intermediate disposal of household waste, and approximately 1 ton of resource waste is collected (Fig. 18.4). The amount of waste finally transported to landfill is approximately 355 tons. The reduction of process waste by intermediate treatment is about 31 percent. The amount of industrial waste finally transported to landfill is 95 tons, due to the separate collection of raw garbage and recyclable waste, and the amount of waste finally entering landfill is 450 tons. The rate of waste reduction due to intermediate disposal has reached 50%. This reduction in weight doubles the useful life of the landfill. Since all waste that cannot be recycled is landfilled directly as landfill waste, problems such as soil pollution and wasted land resources remain; therefore an incineration facility was not constructed. It is expected that the rate of waste

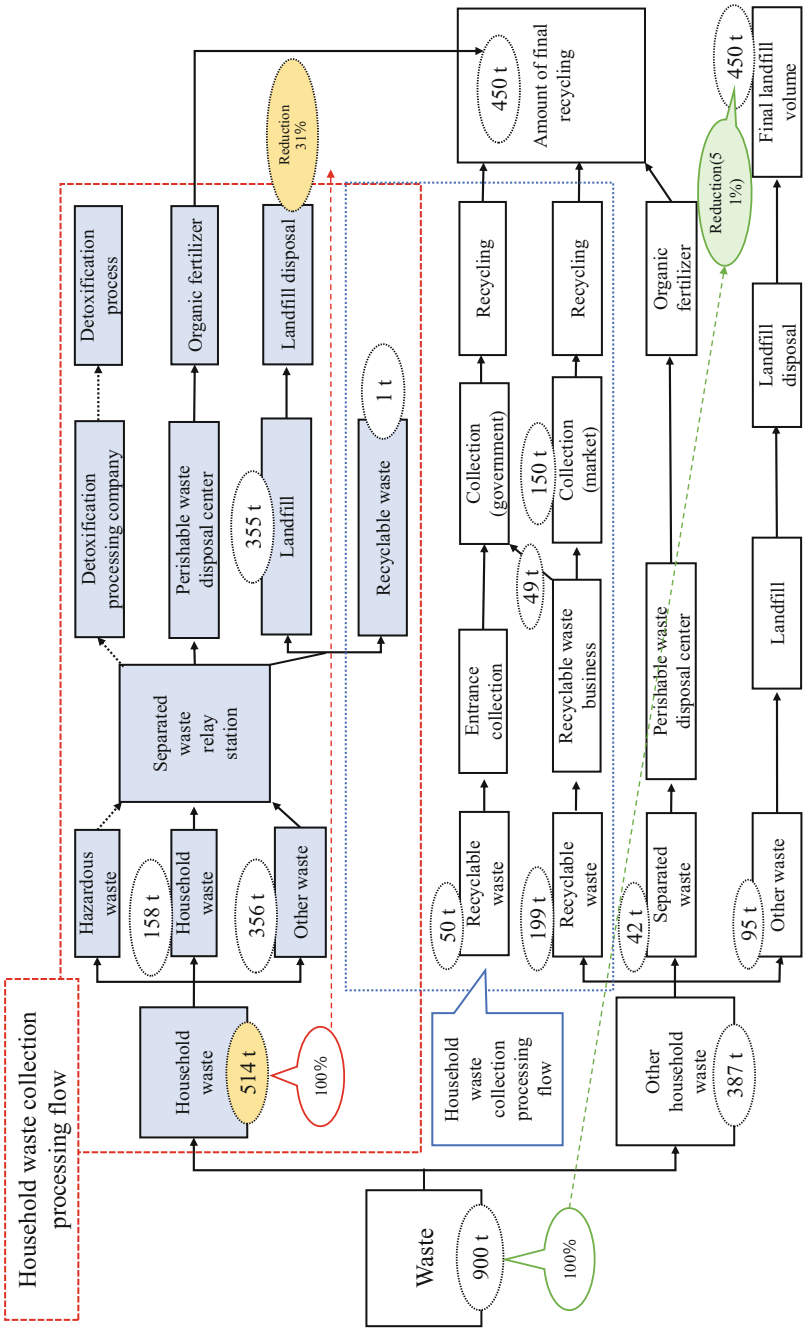

Fig. 18.4 Pujiang Prefecture waste collection processing flow

reduction resulting from intermediate treatment of waste will be further increased by operating the waste incineration facility and using incineration ash and residual heat. Further, a methane gasification facility has been installed, and when the market needs of organic fertilizer are satisfied in future, residual waste can be subjected to methane fermentation, producing biogas for renewable energy.

18.4.3.2 Promotion of Organic Agriculture Through Provision of Organic Fertilizers

Between October 2014 and June 2015, the Gabriel Biotechnology Company tested the effects of organic fertilizers obtained from household waste. Use of the organic fertilizer increased grape production by 17%. Sweetness increased by 2.9 points, there was a clear reduction in the number of cracked grapes, and insect damage was less common. Waste that had previously been illegally disposed of or landfilled plays a major role in organic cultivation of agricultural products by utilizing microbial fermentation technology. In this way, the system is a small-circulation system in which organic fertilizer is produced from raw garbage and farm products are supplied to residents by utilizing the fertilizer.

18.4.4 Societal Effects of the Pujiang Model

18.4.4.1 Toward a Clean and Beautiful Rural Society

Waste separation has already played an important role in improving the rural environment in Pujiang. It also helps improve the environment and landscape of rural areas through separate waste collection. Pujiang was able to greatly improve the living environment of residents by promoting proper waste separation. It has been dubbed "the first prefecture in China to build a national ecological civilization" and "the first prefecture in the country to sort rural household waste." In addition, organic fertilizer, which is recycled from raw garbage, is distributed to local farmers free of charge, contributing to soil restoration and improvement by organic farming. The government hopes to increase the economic power of farmers, create jobs in rural areas, and improve the expertise of farmers to complement development of rural tourism in China based on environmental improvement and organic farming. In addition, the government expects to maintain traditional culture in rural areas, establish infrastructure, and exchange visitors with urban areas.

18.4.4.2 Establishing Trust Between the Government and Residents

Under the party-plus system, party members were able to actively demonstrate exemplary behavior, guiding community residents face-to-face, narrowing the

distance between party members and residents, and overseeing thorough separation of waste. Under its policy of operating a market and dealing with waste, the government is trying to return maximum profits to the people by improving the rate of waste separation by residents. The profits obtained from waste collected by the cleaners in two separate collections provide personal income for the cleaners. Companies also recycle and use collected food waste and give free organic fertilizer to farmers. A street survey of 200 residents showed that 96.2% of respondents agreed to separate waste collection and 81% were satisfied with the clean living environment. Proper waste disposal was found to have improved residents' opinions of the government and promoted trust in the local community.

18.4.4.3 Improvement of Environmental Consciousness

The rate of waste collection compliance (accuracy rate) of residents in Pujiang is very high, at more than 90%. Residents have become more concerned about environmental hygiene. The improved efficiency of waste separation has promoted the use of resources and improved awareness of environmental protection. Since implementation of the Pujiang County and the City Waste Separation and Comprehensive Utilization Plan, the Pujiang government has actively promoted separate waste collection, by fully utilizing media and network platforms and disseminating knowledge about separate waste collection. In addition, a waste segregation duty supervision team was established in 429 villages in all prefectures, allowing women and junior high school students to play a central role. Organizations such as the Communist Youth League and the Senior Citizens' Association also actively participate. A separate promotion group has been created for floating waste. With the production of an animation of waste separation, an atmosphere has been created in which everyone is responsible for separating waste. There are more than 2000 promotional drawings and 120,000 approval signs, which also explain to residents how to separate household waste. Finally, the government has been actively engaged in school education and field trips to waste disposal facilities to further understanding of the segregated collection of waste.

Although separate waste collection has been helpful for improving awareness of environmental protection and rural living conditions, some claim that it has increased the number of public officials and residents. After official implementation of the Rural Waste Separation Management Ordinance in Jinhua, Zhejiang Province, in 2018, the separation of waste was introduced in the evaluation of executives, and fines were imposed on retailers and individuals who did not adequately recycle, causing antipathy among some executives and residents.

18.4.4.4 Promotion of Public-Private Partnerships

In December 2014, the Ministry of Finance in China established the Guidelines for Operating a Model of Government and Social Capital Cooperation Models and

presented concrete public-private partnership proposals in the field of public works. Currently, China has the world's largest PPP market and is known for its large number of state-owned enterprises, including local government-related projects such as sewage treatment, flooding, waste disposal, and infrastructure maintenance, as well as public services. Much attention is focused on waste treatment businesses in rural areas, which lack funds, experience delays in the application of related technologies, and lack human resources. PPP is one way to solve these problems. Developed countries have already introduced the PPP model to the practice of rural environmental governance, such as in agricultural ecosystem management and rural environmental services. In Japan, third-party companies are entrusted with the construction, operation, and maintenance of sewage facilities.

As shown in Fig. 18.5, the new PPP pilot project of Pujiang waste disposal, which started in 2014, is a management contract in which ownership is held by the government, but private companies are responsible for the operation, protection, and customer service of public facilities under a 3-year contract. In the budget set by the Pujiang Prefecture Government for waste disposal, the amount contracted with the enterprise is paid in advance, and the entrusted enterprise manages and operates waste disposal appropriately (collection, transportation of household waste) within the funds paid. Any expenses saved by the company can be retained as profits. In order to ensure reliability, companies are proposing data reporting and management of waste collection processing systems, as well as new policies on waste disposal and the use of related technologies. The advantages of the new PPP model for waste disposal in Pujiang County include improvements in management, such as curbing fiscal spending and using technology related to waste disposal by private companies maintaining management and operation. As a private company, the procedure is less complicated than that of traditional PPP model businesses in China; the procedure to become involved is easy. Start-up companies who may have insufficient funds to launch themselves often have new ideas and new technologies. Business opportunities can be provided, and efficiency can be improved through management by private companies. For residents, it is possible to secure high-quality public services through monitoring, with the expectation of information disclosure by the private companies.

With implementation of the new PPP model, government funds can be used more efficiently, related technology can be introduced, and the quality of public services in rural waste disposal can be improved through the reduction of waste disposal costs to the Pujiang government and the use of private technology. However, the government still has a heavy financial burden, and there are disadvantages, such as increasing the workload of party members by instructing residents to separate waste and the requirement for frequent renewal of short-term (3-year) contracts. Moreover, there are a limited number of private companies that can respond to these requirements, and policies introduced to improve people's awareness of waste problems take considerable time to have an effect, whereas companies need to solve problems and demonstrate their managerial skills over a short period of time. By changing its role from an existing implementer to a supervisor and service buyer, the government may weaken its role of guidance and management in dealing with waste.

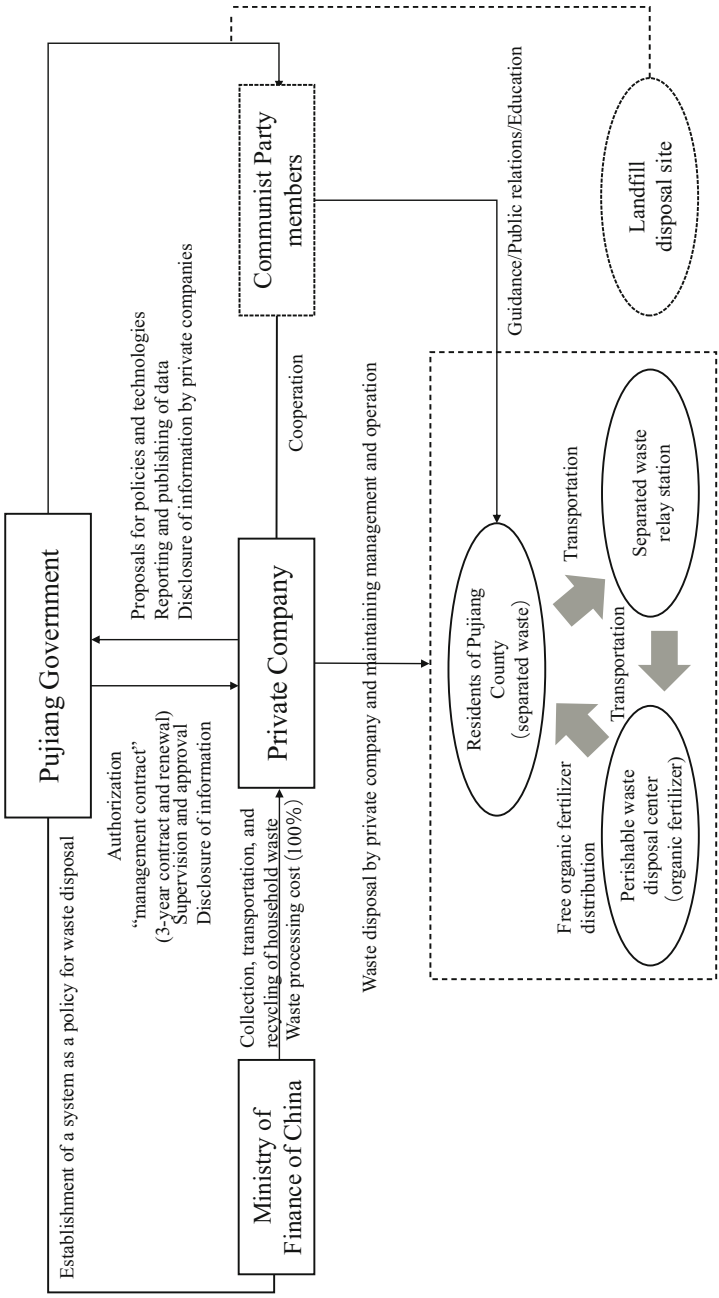

Fig. 18.5 Pujiang as a model of the new public-private partnership (PPP) system for waste disposal

18.4.5 Holistic Construction of the Pujiang Model Household Waste Disposal System

There are three main reasons why waste separation in Pujiang has achieved great results. First, in Pujiang, the PPP model was used to build a public-private partnership system in which the government purchases services from private companies. The government established a recycling recovery system focusing on food waste by securing high levels of waste discrimination and managing private companies. By discriminating and recycling food waste from household waste, the effect of reducing waste by interim treatment was significantly increased, reducing the burden on waste disposal plants, reducing the cost of transportation and disposal of waste by collecting food waste, and reducing the financial burden. In 2014, the Pujiang government set Zhangjiajie as a pilot area for separate waste collection and disposal, distributing to each community (housing complexes in Zhenjiang) in 2016. Coverage of all rural areas reached 100% in 2017. In the same year, Pujiang was selected by the Housing Department of China as a model for the country's first separate collection of rural waste and use of resources. Since 2018, Pujiang has been building a waste collection and processing information system that will allow a move toward a sustainable society of waste reduction and recycling (Fig. 18.6).

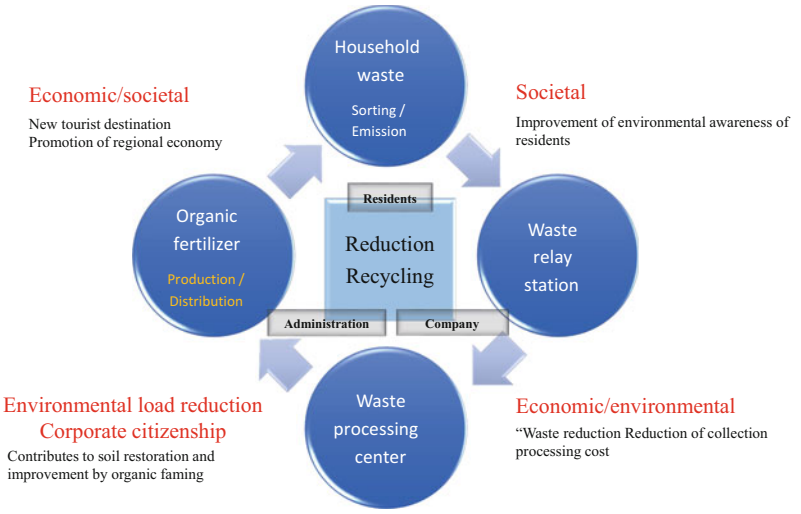

Fig. 18.6 Model of Pujiang household waste disposal circulation system

18.5 Conclusion

The rural economy of China has developed rapidly, consumption has spread to rural areas, and waste is becoming an apparent problem. However, the conventional centralized processing method of "collecting in village, transferring from town, processing in prefecture" has a high transfer cost and does not allow local resource recycling. The current Chinese PPP method is expected to provide a solution to the household waste problem in rural areas because it can utilize the capital of private companies and their technologies. However, the investment required is huge and the cost recovery period is long. Therefore, there are limits to the possible responses from private companies. The Pujiang model utilizes the conventional PPP model and chooses the way the government buys public services from companies to solve the shortcomings of the conventional PPP model. This establishes a government-civilian partnership and a household waste disposal system in which all residents can participate. In this model, the government implements a party-plus system, thoroughly instructing residents on how to separate, supervise, and manage waste, increasing the waste separation rate with a simple and easy-to-understand waste separation method. The company has succeeded in reducing the amount of raw garbage going to landfill. Instead, garbage is recycled; as high proportions of raw garbage characterize household waste in rural areas, the waste collection process centers on raw garbage. The waste disposal method changed from centralized to decentralized due to successful resource recovery from food waste. The life span of the landfill was doubled, and transportation and disposal costs drastically reduced. By providing organic fertilizer produced from raw garbage to residents free of charge, local soil restoration, organic agriculture, and development of the tourism industry have been promoted. (Annual tourism revenue in 2015 was 49.61 billion CNY, an increase of 75.2% on the previous year, and Zhejiang is now in the top ten provinces for tourism.) The Pujiang model has shifted toward recycling of waste by constructing a regional recycling system in cooperation with the government, private companies, and residents.

In the future, this model will be useful as a waste disposal method in both other rural areas of China and other regions. However, the reduction of waste from source is still insufficient in Pujiang, and it is mainly government finance that funds waste disposal. In the future, in order to reduce the financial burden to the government and the environmental load, a volume-rate waste system should be introduced, which can curb waste emissions, overhaul the system of related agencies operating enacted laws, and promote effective utilization of organic resources from food waste (such as using livestock feed or biogas). The continuity of this model from the perspective of economic, environmental, and societal aspects was evaluated by looking at the cooperation of the administration, private enterprises, and residents. Key characteristics of this model, which have implications for policy development in other regions, are (1) waste reduction and recycling (mainly organic fertilizer); (2) reduction of waste collection and processing costs; (3) soil restoration and improvement of agricultural production environment; (4) creation of areas such as new tourist

destinations; (5) improvement of environmental awareness of residents; and (6) presentation of a new waste disposal system based on public-private partnership.

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