




# Study on the Status and Problems of Domestic Waste Management in China

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**Keywords:** Waste Management, Domestic Waste, Waste Disposal Capacity, Ecological Environment.


**Abstract:** **Objective:** This study aims to present publicly available data from the 2011-2020 China Statistical Yearbook, analyze the status of domestic waste management in China, and create a prognostic model based on the data analysis. **Methods:** By consulting the 2011-2020 China Statistical Yearbook results, this paper analyzes the domestic waste collection and disposal in the recent ten years. A prognostic model is established to study and identify the development trend of China's domestic waste collection gap and disposal capacity gap in the next five years. **Results:** China's domestic waste output increased gradually from 2010 to 2019. In 2019, the domestic waste output increased by 508.9 million tons compared with 2010, with an increased rate of 147%. In 2019, China's domestic waste collection gap was 612.8 million tons, with an increased rate of 144.9% compared with 2010. In 2010 and 2019, China's harmless disposal capacity gaps were 56.0 tons/day and 147.2 tons/day, respectively. Through the establishment of the prognostic model, the domestic waste collection gap and harmless disposal capacity gaps in China are expected to reach 823.7 million tons and 196.2 tons/day by 2024. **Conclusion:** The annual increase of waste output in China is related to the increase of per capita GDP. The waste collection and harmless disposal capacity gaps in China may continue to grow.


## 1 INTRODUCTION


Waste is produced by humans in their everyday life. Due to its large discharge, complex and diverse composition, it will pollute the environment and affect environmental health (Xiaoyu L et al.,2019). Waste disposal is to remove the waste quickly, carry out harmless disposal, and finally make rational use of it. The data from the Annual Report on the Prevention and Control of Solid Waste Pollution in China in 2019 shows that Shanghai has the largest domestic waste output, with the output of 10.768 million tons, followed by Beijing, Guangzhou, Chongqing and Shenzhen, with the output of 10.012 million tons, 8.088 million tons, 7.381 million tons, and 7.124 million tons, respectively (China Waste Official report,2020). In recent years, in the more developed cities, urban domestic waste has also been rising. It is of great significance to enhance the

capacity of waste collection and disposal in China, to strengthen the conservation of China's (Yujun Y et al.,2020) ecological environment, beautify the living environment and improve population health.

Although domestic waste management has achieved certain results in the context of the 13th Five-Year Plan for Economic and Social Development of the People's Republic of China (The 13th five-year plan of the people's Republic of China,2016). However, there is still a management gap (Zongguo W et al.,2021) for domestic waste collection and disposal in China. The key to solving domestic waste output (Hua Z et al.,2021) in China is to control the growth of waste output and strengthen the effective disposal of waste. On the one hand, with the development of China's economy and the growth of per capita GDP, although the consumption level of residents continues to improve, the output of domestic waste also increases; on the other, there is a

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phenomenon that the output of domestic waste is far larger than the amount of waste collection and disposal (Xiangru L et al.,2019), and that the domestic waste in China has not been collected and disposed of effectively, so the gap of waste collection and disposal increases. Few scholars study waste collection and disposal to identify the pain point and the difficulty of the current waste management from a macro perspective.

Therefore, based on the current situation of the growth of domestic waste in China and the analysis of the insufficient waste collection and transportation (WCT) and harmless disposal capacity (HDC) of domestic waste, to review and find out waste collection gap (WCG) and harmless disposal capacity gap (HDCG) of domestic waste in China (Maarten D,2021) is conducive to the effective management of domestic waste and environmental protection.

## 2 METHODS

This study obtains data from the public data sources from the China Statistical Yearbook 2011-2020. Domestic waste in China is described by the data of the population, GDP, waste collection, and waste harmless disposal capacity in the China Statistical Yearbook. Through research on previous literature (George H et al.,2020) on domestic waste, we get the decision coefficient between per capita GDP of China and waste output per capita which is 0.086 (Statistics of domestic waste treatment industry,2020); based on this decision coefficient, the waste output per capita (WOPC) can be calculated directly. It means that every 0.086 tons of waste can be produced by RMB10,000 per capita GDP. We construct the following three related formulas (Table 1.) to do the calculation with the specific multiplying the population at the end of the year, the annual per capita GDP, and decision coefficient (Formula 1).

Meanwhile, Formula 1 shows that the domestic waste collection in China is less than the output, so there will be a difference between the domestic waste output and the collection amount. Therefore, the annual waste collection gap (WCG) can be calculated (Formula 2). Based on the AAWO, the daily waste output can be obtained by dividing the number of days of the corresponding year. It is found that the waste output is also different from the harmless disposal capacity of domestic waste. The gap of harmless disposal of waste can be calculated (Formula 3). Based on formulas 2 and 3, the gap of waste collection and the harmless disposal capacity gap are dependent variables. Taking the annual unit

time as the independent variable, the general time series prediction model is constructed with the application of SPSS 21.0 to forecast the trend of the WCG and HDCG in the next five years.

Table 1. Related calculation formula.

Formulas	Variables(10 <sup>4</sup> people, ¥10 <sup>4</sup> ,10 <sup>4</sup> ·tons,tons/day	Interpretation of variables
(1) $AAWO=0.086 \cdot PL \cdot GDP$	PL	PL=population
(2) $WCG=AAWO-WCT$	AAWO WCG	AAWO=average annual output of waste WCG=waste collection gap
(3) $HDCG=(AAWO/YDAY)-HDC$	WCT HDCG	WCT=waste collection and transportation HDCG=harmless disposal capacity gap
	HDC	HDC=harmless disposal capacity
	YDAY	YDAY=days corresponding to the corresponding year

## 3 RESULTS

We can see from table 2 that from 2010 to 2019 China's total population increased by about 60 million, with a population growth rate of about 4.5%. China's per capita GDP was RMB30,000 in 2010 and RMB71,000 in 2019, an increase of RMB41,000 in 10 years, with a growth rate of 136%. With the growth of population and GDP, we can see that the waste output per capita (WOPC) and average annual waste output (AAWO) gradually increase. At the same time, we can see that China's WCT also grew rapidly. In 2010, China's domestic WCT and HDC were 15804.8 tons and 38.8 tons/day, respectively. In 2019, China's

domestic WCT and HDC were 24206.2 tons and 87.0 tons/day, respectively. Compared with 2010, the amount of waste collection and transportation in 2019 increased by 84.014 million tons, with a growth rate of 53.2%. The efficiency of harmless disposal capacity of waste in China in 2019 was about 2.2 times greater than that in 2010.

Table 2. Waste collection and disposal capacity.

Year	Populations (10 <sup>4</sup> )	GDP (10 <sup>4</sup> ·¥)	WOPC (tons)	AAWO (10 <sup>4</sup> ·t·ons)	WCT (10 <sup>4</sup> ·ton·s)	HDC (tons/day)
2010	134091	3.0	0.25	3459	15804.8	38.8
2011	134735	3.5	0.30	4055	16395.3	40.9
2012	135304	3.8	0.32	4421	17080.9	44.6
2013	136072	4.2	0.36	4914	17238.6	49.2
2014	136782	4.7	0.40	5528	17860.2	53.3
2015	137462	5.0	0.43	5910	19141.9	57.7
2016	138271	5.4	0.46	6421	20362.0	62.1
2017	139008	6.0	0.51	7172	21520.9	68.0
2018	139538	6.5	0.55	7800	22801.8	76.6
2019	140005	7.1	0.61	8548	24206.2	87.0

With the growth of WOPC, China’s WCT also increases gradually. By using Formula 1, the AAWO from 2010 to 2019 was calculated, and the data shows that the index increases year by year. Then, we can see from Figure 1 that the WCG between 2010 and 2019 was calculated by using Formula 2. In 2010 and 2019, China’s waste collection gaps were 187.9 million tons and 612.8 million tons, respectively, with an increased rate of 144.9%. Similarly, Formula 3 can calculate China’s waste HDCG in 2010 and 2019, which were 56.0 tons/day and 147.2 tons/day, respectively. They were presented in figure 2. In the past ten years, the growth rate of HDCG was 162.8%.

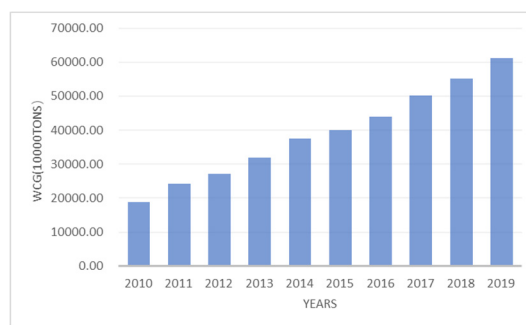


Figure 1. Waste collection gap(WCG 10<sup>4</sup>·tons).

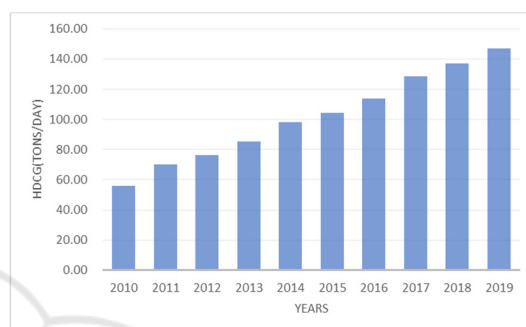


Figure 2. Harmless disposal capacity gap (HDCG tons/day).

The general prognostic model was used to prognosticate the WCG and HDCG of domestic waste by SPSS 21.0. The period from 2010 to 2019 is regarded as ten single time units, represented by the number “1-10”, and the next five years from 2020 are regarded as the prognostication time units, which are represented by the number “11-15”. The gaps between waste collection and waste harmless disposal capacity are on the rise through the observation model. It can be seen from figure 3 and figure 4 that by 2024, the gaps between waste collection and waste harmless disposal capacity in China will be 823.7 million tons and 196.2 tons/day, respectively.

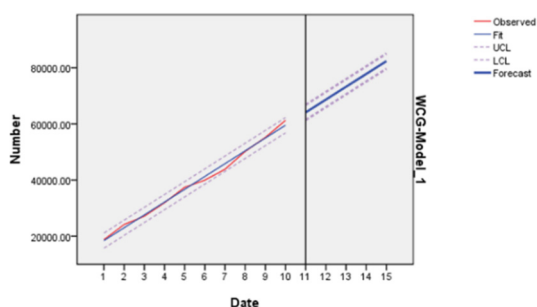


Figure 3. Prognostic of waste collection gap(10<sup>4</sup>· tons).

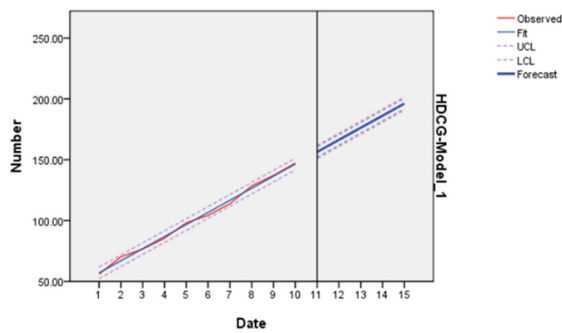


Figure 4. Prognostic of waste harmless disposal capacity gap(tons/day).

## 4 DISCUSSION

This study found that the more developed the city is, the more waste is produced. Previous studies have shown that Beijing, Shanghai, Guangzhou, and Shenzhen are first-tier cities with tight working schedules. With the increase of per capita GDP, the consumption demand of residents is greatly stimulated. With the rapid popularization of takeaways, fast food, and online shopping, plastic waste, meal waste, and packaging waste increase significantly. Especially in today's increasingly popular online shopping advocated by Chinese people, the domestic waste generated by extravagant packaging increases at an alarming rate.

For example, despite a small-sized product, it is put in an elegant package, often a medium-sized carton box full of bubble wraps and airbags. The improvement of per capita GDP leads to the change of living standards and consumption structure, affecting domestic waste production. In 2019, China's population reached 1.4 billion, with the per capita GDP of RMB71,000 and the WOPC 600 kg. However, China's large population, online shopping, express delivery, takeout, and other service industries may produce more waste than other countries, and the decision coefficient of waste may even exceed 0.086. In 2019, China's AAWO was 854.9 million tons, but the WCT was 242.1 million tons. In this case, the amount of waste collection is far behind waste output, increasing the WCG. At the same time, the HDC was 87.0 tons/day, but the HDCG was 147.2 tons/day. The pollution is more serious in places where the amount of domestic waste is large, and the growth rate of WCG and HDCG are also faster. On the one hand, because of the enhancement of consumption ability, residents increase the output of personal waste, but they do not have a strong sense of personal waste

management, which leads to the imbalance of waste generation and transportation at the individual level, resulting in the increase of WCG. On the other, many cities in China do not have a standardized domestic waste disposal industry chain. Due to the lack of adequate final-phase disposal and utilization in the whole process of waste disposal, only simple landfill cannot genuinely achieve harmless disposal or the growth rate of waste disposal stations are not enough, which leads to a higher growth rate of domestic waste, resulting in the increase of HDCG. Waste disposal is not only a criticism of the traditional single economic index pursuit model, but also a concrete practice of China's proposed goal of curbing the aggravation of environmental pollution, which will be conducive to searching for countermeasures.

Therefore, based on the above situation, which is more likely to expand the WCG and HDCG. We can see that the WCG and HDCG are still growing in the next five years through the prognostic model, the growth rate of WCG and HDCG will be 34.42% and 33.29%, respectively from 2020-2024. According to the general prognostic model for data prognostication, the short-term effect is still reasonable, but with the extension of time, the prognostication error may be significant, so this study only prognosticates the next five-year period. Nonetheless, we can still conclude that there are still many disadvantages in China's waste collection and disposal industry chains. In the future, with the growth of population and the improvement of per capita income, the WCG and HDCG may be further expanded.

## 5 CONCLUSION

The coordinated development of waste disposal and economic development has become an important economic and social problem that has aroused widespread concern. The output and growth rate of domestic waste in China are growing rapidly in recent years. The growth of domestic waste in China is closely related to the increase of per capita GDP. Furthermore, as domestic waste collection and harmless disposal capacity cannot catch up with output of domestic waste, resulting in the growth of WCG and HDCG. Although China's per capita GDP level has increased in recent years, in the long run, the output of large amount of waste stimulated by GDP growth has not only increased the gap of waste management, but also hindered the sustainable development of the ecological environment.

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