



## Packaging waste from food delivery in China's mega cities

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### ABSTRACT

Door-to-door fast food delivery service has become increasingly popular in cities due to the fast development of e-commerce and the fast-paced life in China. This in turn has resulted in significant environmental concerns for the waste packaging materials. We have therefore estimated and predicted the volume and composition of food delivery packaging waste in China. The results show that the total amount of packaging waste surged from 0.2 million metric tons in 2015 to 1.5 million metric tons in 2017. Accordingly, we have provided several policy suggestions to tackle this pressing issues, particularly using the Reduce, Reuse and Recycle environmental friendly practices.

The rapid development of e-commerce and the fast-paced modern life in China has made the food delivery service ('Waimai' in Chinese) increasingly popular in cities, particularly high-populated mega cities. In the first half of 2017, 4.6 billion orders were made, totaling 28 billion USD in sales (Big Data Research, 2017). This in turn inevitably generates significant environmental concerns for the sheer size of disposable plastic containers, bags, and utensils that come with each order.

We estimated and forecasted the volume and composition of food delivery packaging waste in China based on quarterly sales data (Big Data Research, 2017) and our own field survey. As shown in Fig. 1, the total amount of packaging waste from food delivery surged in China from 0.2 million metric tons (Mt) in 2015–1.5 Mt in 2017. While the food delivery packaging waste only accounts for approximate 1% of the annual municipal solid waste (MSW) generated in China, it concentrates in a few mega cities and is comparable to the annual MSW generated in many second tier cities such as Taiyuan, Dalian and Xiamen. Specifically, plastic containers made by polypropylene (PP) and polystyrene (PS) foam account for approximately 75% of the total food delivery packaging waste in weight, followed by wood chopsticks and plastic bags. In contrast, plastic spoons and paper order slips only accounts for 5% in weight.

Because food packaging wastes are normally contaminated by food residues and have low residual values, they are mainly mixed up with other MSW and disposed by sanitary landfilling (62% in 2016, national average), incineration (32%), and illegal dumping and open burning (6%) (NBSC, 2016). While landfilling and incineration can be properly done to minimize environmental impacts, illegal dumping and open

burning can cause significant environmental problems. Some ecosystems, such as the coastal system, can be significantly affected by dumping plastic waste. Jambeck et al. (2015) estimated that 275 Mt of plastic waste was generated in 192 coastal countries, with 4.8–12.7 Mt entering the ocean in 2010. China is ranked the first by mass of mismanaged plastic waste. Meanwhile, there is increasing evidence that plastic waste from MSW may endanger marine wildlife (Rochman, 2013). More broadly, whatever is not recycled or recovered from MSW implies a loss of non-renewable natural resources (e.g. fossil fuels and forests) and other inputs used in the lifecycle of the packaging materials. Environmental impacts from the overall lifecycle are greater than those from the waste treatment stage alone.

The increasing amount of food delivery packaging waste presents a significant challenge for MSW management in mega cities. So far, there is no regulation in China to address this issue. Here we provide several policy suggestions.

- Minimize illegal dumping and open burning of food delivery packaging waste. Stringent regulations should be developed in place and enforced. Consumers should be educated to raise their awareness on the impacts of illegal dumping and open burning. The government can also consider collect disposal fees from consumers ordering food delivery to subsidize MSW management.
- Promote recycling and reuse behavior among consumers. Develop education materials to guide separation and cleaning of food containers. Incentivize both consumers and food delivery companies for recycling and reuse of food packaging.

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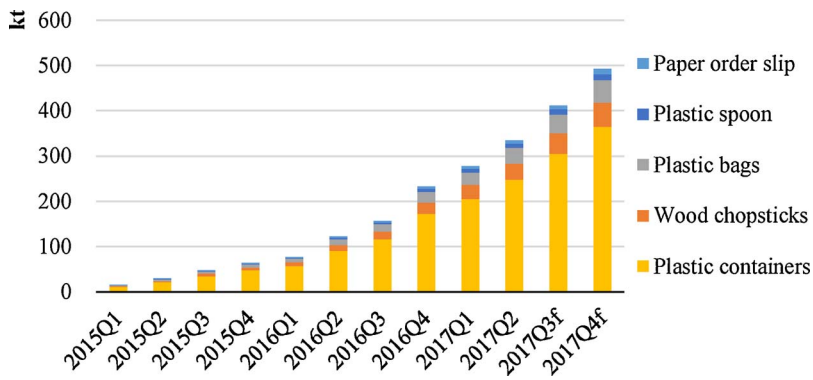


Fig. 1. Food delivery packaging waste volume and composition in China (by quarter, from 2015 to 2017, forecasted data for Q3 & Q4).

- Enforce ecological design of food packaging to promote the reduction of material use, the use of reusable containers, the use of less toxic materials, and the use of biodegradable and compostable materials. Innovative design of environment-friendly food packaging to allow easy, sanitary reuse is urgently needed.
- Subsidize or incentivize the development of automatic cleaning technology or equipment. This helps separate food residues which have less heating value for incineration from packaging materials, which have less recycling value but higher heating value

## References

- Big Data Research, 2017. Report on Chinese Fast Food Delivery Sectors (from the 1st quarter 2015 to the 2nd quarter in 2017). (In Chinese). <http://www.bigdata-research.cn/content/201606/280.html>.
- Jambeck, J.R., et al., 2015. Plastic waste inputs from land into the ocean. *Nature* 347, 768–771.
- NBSC, 2016. Chinese Statistic Yearbook. National Bureau of Statistics of China (NBSC). <http://data.stats.gov.cn/easyquery.htm?cn=C01>.
- Rochman, C.M., 2013. Policy: classify plastic waste as hazardous. *Nature* 494, 169–171.