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## Food packing: A case study of dining out in Beijing



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### Abstract

Food waste results in nutritional losses, ecological damage, and environmental pollution. This survey is conducted in Beijing and aims to determine whether food waste can be reduced by food packing when leftovers are produced at the dining table and to identify factors that affect food packing behavior and the use of leftovers. Based on statistical and econometric analyses of the relationship between leftovers packing and possible factors, this study finds that the age, educational level, employment status, farming experience, environmental protection consciousness, food saving advertisement, families with old members, and reasons for dining out significantly influence the food packing behavior of the consumers. Moreover, the dining environment plays an important role in leftovers packing. People with intimate relationships, such as families, friends, classmates, or colleagues, are more willing to take leftovers home. Business partners do the opposite. Finally, almost all packed leftovers (91.59%) are eaten by people and animals. Therefore, packing leftovers is an excellent approach to reduce food waste.

**Keywords:** leftovers packing, food waste, leftovers, logit model

## 1. Introduction

More than 62000 restaurants exist in Beijing (NBSC 2013) and produce large amounts of food waste and solid waste such as used toothpicks, chopsticks, and paper napkins

every day (Mekjinda *et al.* 2015). This waste significantly affects air, water, and land in and around Beijing. In fact, food consumption is viewed as one of the most resource-demanding and polluting exercises among the food chains (Carlsson-Kanyama 1998; Silbernagl 2011). Half of the solid waste was generated by food waste (Li *et al.* 2009), which also produced an increasing number of environmental problems such as water, air, and land pollution, and nutritional outflow in China (Mattias 2015). Accordingly, there were many management problems related to collection, processing, and disposal of food waste. Therefore, we need to minimize food waste to help reduce environment pollution and management cost of food waste, meet the increasing food demand, and relieve stress in the food supply. This

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is essential because there are poor people that suffer from hunger and malnutrition, which is the problem that is prevalent all over the world. Additionally, the constant increase of world population means that more food needs to be supplied (Halloran *et al.* 2014).

Given these grim realities, a series of food waste management measures was established to minimize food waste. First, surplus food can be utilized in food recovery (Garrone *et al.* 2014), including food collection for the hungry from retail stores, farming fields, or restaurants. Second, surplus food can be recycled as biodiesel, compost, or livestock feed (Kantor *et al.* 1997; Hazel *et al.* 2005). Moreover, various methods were developed to deal with food waste (e.g., anaerobic digestion, fermentation with a continuous-flow reactor, on-site composting, anaerobic digestion with bacteria, mineralization, hybrid anaerobic solid-liquid, biological solubilization, and digestion with yeast) (Han *et al.* 2002; Hwang *et al.* 2002; Gonzales *et al.* 2005; Cirne *et al.* 2006; Hazel 2006; Zhang *et al.* 2007; Stabnikova *et al.* 2008). Easier and cheaper treatments and microorganisms were applied to break down chemical compounds in the food waste to decrease BOD (biological oxygen demand), COD (chemical oxygen demand), chemical and physical characteristics (Cirne *et al.* 2006; Zhang 2014). Effective approaches were created to break down food waste *via* anaerobic fermentation and non-oxygen producing photosynthesis using a photosynthetic bacterium (Mekjinda 2015). However, the absence of food waste is always better than any technology for breaking it down. The main challenge in the upcoming decades is not to use more investments and greater physical inputs to increase food production or deal with food waste but rather to fully utilize food resources by obtaining leftovers during and after dining (Ventour 2008; Afton *et al.* 2014). All eaten or wasted food needs massive amounts of water, land, energy, and labor to be delivered from the field to the table. If these leftovers are packed for further consumption, the environmental problems, such as carbon dioxide or greenhouse gas emission, can be significantly reduced.

Food waste is a complicated and important problem that is related to nutrition, economics, and the environment (Sobal 2003; Lundqvist 2008). Leftovers from dining out make up a significant portion of food waste that we can no longer ignore. Therefore, these problems prompted the Chinese government to devote efforts to convey hazards of food waste and to strengthen the conservation awareness of citizens through a series of policies and advertisements. For example, the Party Central Committee initiated Eight Rules in the early 2012 and Six Bans in 2013, both of which monitor and prompt food waste reduction (<http://www.panzhuhua.gov.cn/sdzjtjyhdzl/xxzl/tjxxpm/438127.shtml>). The research involved different aspects of food waste in

supermarkets, restaurants, canteens, and in households (Barr 2003; Barr 2005; Berglund 2005). Food waste is determined by food consumption, and food consumption is directly or indirectly affected by many factors such as food expenditure (Munro 1995; Rebecka *et al.* 2004; Anton *et al.* 2012; Robinson *et al.* 2014) and other socio-demographic and economic determinants (Steyn *et al.* 2003; Walker *et al.* 2006; Cuellar *et al.* 2010; Zhu *et al.* 2013). Compared with direct factors, some indirect factors (e.g., discount and sales promotions) significantly affect food consumption and food waste generation (Griffin 2009; Halloran 2014; Ioannis 2014; Minervini *et al.* 2014).

However, few previous studies were conducted to explain the following phenomena in China. Specifically, were the Chinese governmental measures effective in decreasing leftovers and in improving the public conservation awareness? Can food waste be reduced by packing leftovers? What are the uses for doggy bag leftovers? Can the leftovers packing behavior be influenced, and if so, which factors affect it? All questions will be answered in this paper using a case study on dining out in Beijing, China.

## 2. Methods

### 2.1. Definitions and research boundary

Food waste is generated in the entire food supply chain, which includes production, consumption, transport, and storage. Only the food consumption channel can be categorized into household, supermarket, restaurant, school, hotel, hospital, and other catering. In addition, catering can be divided into three types of activities, namely, commercial, non-commercial, and others (Alexandra *et al.* 2015). This research focuses on the commercial food service industry, which only includes restaurants, canteens, and hotels with restaurants.

There are no uniform definitions about food loss and food waste domestically or internationally. This research innovatively distinguished the concepts of food loss and food waste from the entire food chain and determined that food waste was just a part of food loss. The greatest difference between them is that food waste can be avoided, while food loss is inevitable because of the technological and environmental limitations. According to our definitions, food waste can be defined as a waste of the edible part of food, which is normally intended for consumption but can no longer be consumed in restaurants due to quality requirements, technical methods, consumption habits, taste, and other avoidable losses. The uneatable parts of food (e.g., shells, bones, uneaten food, or orange rind) are not considered in this paper. Accordingly, this study defines leftovers packing as taking edible dinner leftovers home by

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