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Food loss rate in food supply chain using material flow analysis

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ABSTRACT

The food loss rate is a factor that represents food consumption efficiency. To improve food consumption efficiency, we need to fundamentally quantify food loss at national and global levels. This study examines food and food waste flow and calculates the food loss rate in the food supply chain by targeting Japan. We analyzed inedible food waste and avoidable food losses in wholesale, manufacturing, retail, food services, and households and considered different supply chain pathways, different food categories representing whole Japanese meals, and weight changes after cooking. The results are as follows: (1) Japan has an overall rate of avoidable food losses of approximately 15% for meals (excluding agricultural losses), (2) the supply sector with the highest food loss rate is food services, and (3) the food category with the highest food loss rate is vegetables. Finally, we proposed a model for calculating food loss rates that could be used for future analysis in Japan or other countries.

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1. Introduction

Food consumption has changed to a more convenient style as people receive higher incomes but have become busier in modern society. More and more people do not want to spend much time cooking or even eating, which has led to the acceleration of dietary externalization. In particular, the convenience food market is becoming more popular worldwide (Jabs and Devine, 2006; Vermeir and Verbeke, 2008). However, some researchers have indicated that a highly industrialized and centralized modern food system can cause more energy consumption and also more waste generation (FAO, 2011; Dutch Ministry of Agriculture-Nature and Food Quality, 2010; McMichael, 2007; Carlsson-Kanyama et al., 2003).

To improve the efficiency of the food system, we need to think about the “food waste” issue. Food waste can be divided into two parts: inedible part and food loss. Inedible waste is unavoidable. However, food loss is caused by a deficient system or individual carelessness. In developed countries, 30% of supplied food is wasted as food loss (FAO, 2011). Many thousands of people die from starvation every year, while millions of tons of food continue to be discarded as waste in developed countries. The Brown University Faculty (1990) argued that reducing food loss is a potential solution for overcoming hunger.

Bender (1994) concluded in his paper that food system efficiency is also closely related to the issue of food security. Especially in Japan, the self-sufficiency rate of food has decreased (see Fig. 1). However, the calorie loss between food supply and food consumption has increased (see Fig. 2), even though many foods are imported. From the national point of view, this is not an efficient system and food loss is related to a decrease in the country's rate of self-sufficiency.

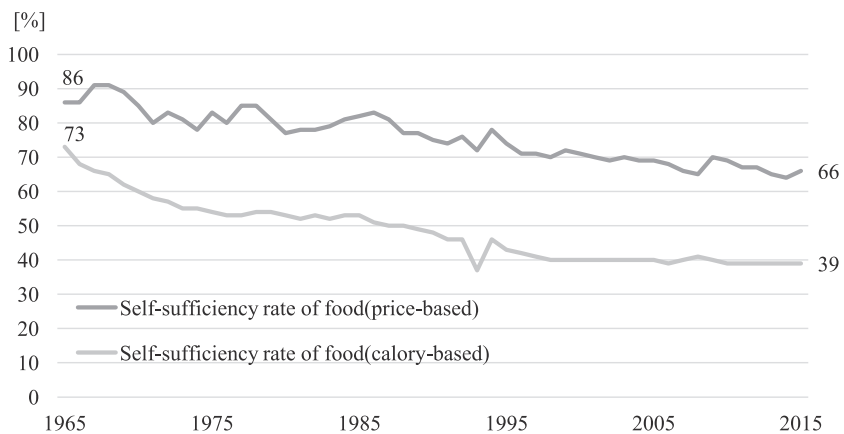
Food loss occurs in every food supply chain sector along the distribution route. At this time, food loss rates vary according to the supply chain sectors, processing level of food, kind of food and place of consumption (household or restaurant), etc. Food consumption styles determine the reasons for and amounts of food waste. The treatment methods for food waste are different in the food industry, restaurants, and households.

Japan Organics Recycling Association (2011) explains the reasons for food loss generation in manufacturing and distribution in Figs. 3–5. Not only manufacturing and distribution, but also restaurants and households generate food loss. Engstrom and Carlsson-Kanyama (2004) summarize the cause of food loss as follows:

- Storage losses**, which occur because of improper storage
- Preparation losses**, which are mostly seeds, peel, etc. from fruits and vegetables
- Serving losses**, which are left on serving dishes and in canteens and bowls

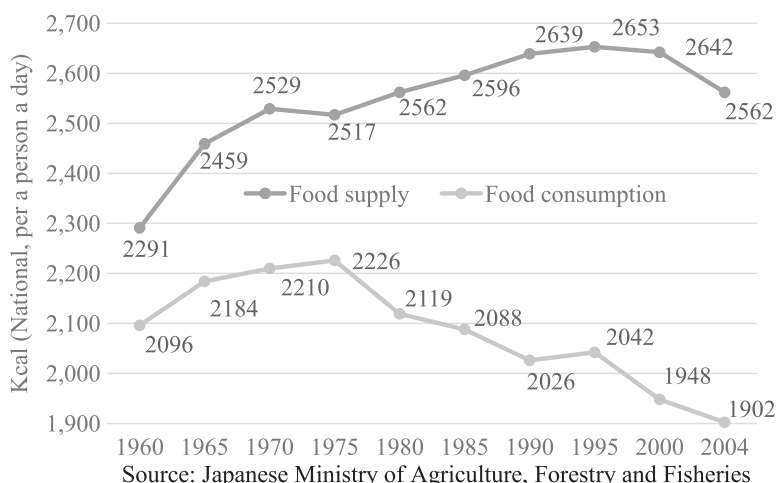
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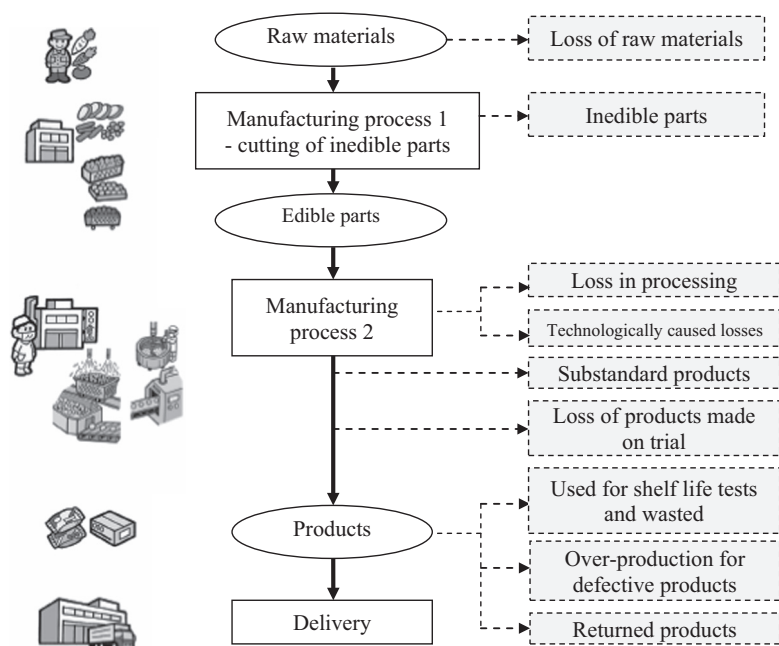
Source: Japanese Ministry of Agriculture, Forestry and Fisheries

Fig. 1. Self-sufficiency rate of Japan.



Source: Japanese Ministry of Agriculture, Forestry and Fisheries

Fig. 2. Calorie supply and calorie consumption of Japan.



Source: Japan Organics Recycling Association, 2011 - translated by author

Fig. 3. Origin of food loss in the processing industry.

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