

# Identifying key causes of food waste generation in the Slovenian food supply chain

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**Abstract** - The causes of food waste are linked to each link of the food supply chain (production and processing, distribution and retail, HoReCa and other food service, final consumption) resulting in complex financial, social and environmental consequences. In order to prevent food wastage, it is crucial to understand its causes. Initially, the main causes of food waste in each link in the food supply chain were described. The causes of food waste are relatively well known for the consumer level, but not as well for the rest of the food supply chain. For that reason, additional semi-structured interviews with key stakeholders in the Slovenian food supply chain prior to the consumer phase were conducted. The interviews showed key causes in agriculture, food industry, retail, HoReCa and other types of food serving. The findings were validated with a national expert workshop.

## INTRODUCTION

The amount of food waste (FW) in Slovenia increased from 118 thousand tonnes in 2013 to 143 thousand tonnes in 2020, representing a 19% increase (SI-STAT, 2021). Half of this was from households, a third from the HoReCa sector, one tenth from retail and one tenth from primary production and processing. FW is directly related to food supply, food safety and environmental protection. By shifting to a responsible food culture and linking stakeholders, FW could be reduced throughout the food supply chain. Unconsumed food bears the imprint of all previous processes (from production to final consumption), and has many adverse environmental, social and economic effects. To reduce FW, it is necessary to identify its causes. In order to understand the causes of FW in the Slovenian food supply chain, this study focuses on the generation of FW prior to the consumer level, where the causes of FW generation are less known. For this, a participatory approach with the key stakeholders in the food supply chain was employed.

## METHODS

In the first stage, a review of the available scientific and expert literature in the field of FW was performed, drawing from own and other ongoing project work, as well as several good practices in surplus food reduction.

For the semi-structured interviews, key stakeholders with established engagement in the FW field were identified in coordination with national sectoral institutions and branch organisations. In total, 31 interviews with organisations were conducted, with 20-25 interviewees from each food supply phase. Interviews were conducted simultaneously with several people from the same organization. The first paragraph under each 'phase of food supply' includes 'aggregated' findings from all sources, while the second paragraph only includes findings from interviews.

## RESULTS

### Primary production (n=20)

Primary food production is highly dependent on climatic and seasonal conditions, location and production technology. Furthermore, in agriculture,

both food losses and FW occur. In recent years, there has been increasing FW due to more **frequent extreme weather events**, which destroy the crop to the extent that it is not suitable for the market due to not meeting minimum quality and cosmetic standards (MKGP, 2020). In agriculture, food losses occur due to **inflexible production planning options**, resulting in the production of larger quantities of produce than required, and market fluctuations (Osojnik Črnivec et al., 2021). FW can result from rejection due to quality requirements of the buyer, **order cancellation and unrealistic requirements** regarding visual standards and shelf life. Poorly developed production techniques, seed selection, technical equipment, lack of infrastructure, global trends and the demand for certain products throughout the year increase the amount of FW.

According to interviewees from primary production, more incentives for reducing food losses and for donating surplus food (removal of administrative barriers and minimalizing delivery costs) are needed. For example, the costs for the preparation of the crops are the same when surplus is provided for donation or when the products are sold on the market. Policy incentives and more stakeholder initiatives are important here. Moreover, awareness-raising and cross-chain coordinated actions are needed, such as fairer relations legislation.

### Processing – food industry (n=25)

The causes of FW in the food industry are numerous and often intertwined (MKGP, 2020). FW is generated in three phases of the food processing process - pre-processing, production and packaging, and after the production process (i.e. storage and transport) (Dora et al., 2020). The main reasons for FW in this sector are **underutilized inedible food fractions** and **by-products**, as well as **inadequate storage** of raw materials impacting the quality and **shelf life** (Dora et al., 2020; MKGP, 2020). Most of the **inedible part** of FW are generated in pre-processing, e.g. due to peeling or bone removal. The proportion of this FW is difficult to reduce; if it was not formed in this part of the food supply chain, it would be generated later on (Gunders, 2012), with a lower separation efficiency (Osojnik Črnivec et al., 2021). FW also can be generated due to **exceptional circumstances** and **technical issues** (Dora et al., 2020). In addition to generation of FW due to **improper handling** of food during storage and distribution (inappropriate conditions, improper handling) FW is also generated due to specific requirements of the market and customers (Dora et al., 2020; MKGP 2020).

According to the interviewees, general incentives for FW reduction are less effective for the food industry, an immensely diverse sector. They believe that it would be good to financially encourage stakeholders in the food supply chain who are already active and to offer promotion of stakeholders which are not recognisable. Furthermore, FW is regularly monitored at least from the point of financial losses, and used for continual optimization of production. According to

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the representatives of the food industry, these financial losses also occur due to various equipment maintenance, production line start-up, as well as subsequent recalls and withdrawals.

#### *Retail (n=26)*

Retail is the first link in the food supply chain in direct contact with the consumer (Gunders, 2012). Some FW can be generated due to **inadequate inventory management** and **poor ordering strategies**. **Improper storage** in warehouses and on store shelves, damage to packaging due to **improper handling** can lead to deterioration of product quality (MKGP, 2020; Pfeifer et al., 2016). A large quantity of products may be **recalled** due to established health inadequacy when it is already on the shelves and thus FW may be generated (MKGP, 2020). With the increased supply of prepared meals in stores, the amount of discarded food is also increasing. This can be exacerbated by the policy that the shelves should be full at all times, including just before closing (Gunders, 2012). In addition, FW can be caused by **offering a range of similar products** and **internal sales deadlines** that can cause withdrawal of items from shelves before their actual expiration date. (Osojnik Črnivec et al., 2021).

Retail (and other sectors) can also benefit from networking among stakeholders, and own initiative of individual retailers is already showing promising results. According to interviewees, interventions in food surplus prevention need to overcome strict regulations, social responsibility and systemic solutions for food surplus donation, and pose a huge challenge for actors already active in these practices. Disposal of FW in retail represents financial losses, which are partly reduced by food surplus donation and claiming VAT relief on donated quantities.

#### *HoReCa and other types of food serving (n=20)*

FW from the HoReCa and other types of food service is mostly caused by **food business management** and **guest preferences**. Insufficient training of staff can contribute to **poor kitchen practices** resulting in large amounts of FW (Gunders, 2012). **Ordering practices** (adjusting to demand vs. purchasing larger quantities of food in stock) and inadequate **stock planning** (MKGP, 2020) and **stock cooking** importantly affect FW generation. The amount of FW in restaurants can also be affected by the **season** (more FW generated during the off-season) (Filimonau and Sulyok, 2020). **Portion sizes** and **types of service** also increase FW generation (Osojnik Črnivec et al., 2021). E.g. flexible portion sizes and self-service cafeterias in public institutions have shown to lead to smaller amounts of FW (Osojnik Črnivec et al., 2021) as compared to fixed portions.

In this sector, the main challenges lie in organising proportional stock cooking, understanding guest preferences, staff training and guest education. Individual actors have identified practices of financial loss monitoring that can be successfully used in planning for FW reduction. An obstacle in surplus donation is demanding food safety and logistics due to variable quantities.

#### *Households (n=21)*

According to the Statistical Office of Slovenia (SI-STAT, 2021), most FW is generated by final consumers. The main causes of FW here include: (i) the level of awareness and habits of consumers when planning food purchases, (ii) sales promotions and wide ranges of similar products, (iii) lack of consumer knowledge about food preparation and storage, (iv)

insufficient planning of meal preparation, (v) low food culture and the knowledge on how food is produced, (vi) poor knowledge on expiration dates (poor distinguishing of the quality related "best before" and safety related "use by" dates) (Osojnik Črnivec et al., 2021).

#### CONCLUSION

FW is steadily increasing in Slovenia. Its causes differ in each link of the food supply chain: **Production** (poor production planning options, poor crop quality, market fluctuations), **food industry** (quality of raw materials, by-products, inedible parts), **wholesale and retail** (storage, packaging, promotions, expiration dates), **service** (planning and preparation, guest type, portion size), **consumption** (lack of knowledge about food preparation, storage, too much choice). Based on the identified causes of FW, suggestions for reducing or even preventing FW can be made. Cross-cutting factors driving FW reduction along the food supply chain are horizontal and vertical cooperation, involvement of stakeholders in policy making and multi-level education.

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