Approaches to Reducing Food Losses in German Fruit and Vegetable Production

Sabine Ludwig-Ohm, Kathrin Klockgether, Walter Dirksmeyer
Thuenen-Institute of Farm Economics

1 Introduction

An important aspect of the 2030 Agenda for Sustainable Development is to ensure sustainable consumption and production patterns. Goal 12.3 of this action plan calls for halving per capita global food waste at retail and consumption levels and reducing food losses along production and supply chains, including post-harvest losses by 2030 (UN, 2015, S. 22).

In Germany, between 15 (Kranert et al., 2016, p. 21) and 18 million tonnes (Noleppa and Cartsburg, 2015, p. 43) of food are disposed as waste every year. Food losses occur in all agricultural value chains. Although vegetables and fruit are particularly susceptible to food losses due to the rapid perishability detailed information on the quantity lost and the causes is lacking at the different stages of the value chain.

Against this background the collaborative research project "Pathways to Reduce Food Waste (REFOWAS)" was designed which is funded by the German Federal Ministry of Education and Research. The main objectives of REFOWAS are to quantify food losses in the agricultural sector and to identify measures to reduce food losses in order to achieve more sustainable production and consumption patterns in Germany. The project combines a holistic, sectoral analysis ("top-down" approach) to address food waste in agricultural production and food consumption and case studies for selected fruits and vegetables, bakery products and school catering ("bottom-up" approach).

2 Research Question and Approach

According to Kranert et al. (2016, p. 19) it is useful to differentiate between food waste and food losses. Food waste occurs at the consumer level. Food waste can be avoided in case of edible products that are disposed of or may be inevitable in case of non-edible parts of products, such as peel of bananas or chicken bones. Food losses arise at the production level and in the downstream value-added chain stages (processing and trade including logistics) and can be reduced by system optimization. However, reducing food losses requires quantifying them and identifying the reasons for their occurrence.

In this paper an approach to study the food losses in the production of vegetables and fruits is described and first results are presented.

The main objectives of this study are

- to identify main reasons for food losses occurrence,
- to quantify food losses along the value chains of vegetables and fruits
- to develop efficient measures to reduce food losses and
- to assess the costs and conditions of implementing these measures.

Four case studies on fruits and vegetables have been conducted in collaboration with practice partners from regional horticultural advisory services. Interviews and discussion workshops with producers, traders as well as representatives of producer organizations and the food retail were and will be carried out. The aim was to identify options for reducing and avoiding food losses at the production level and at the different downstream marketing stages of the value chains.

Fruits and vegetables vary in storage suitability. For this reason one product with a long and another with a short shelf life was selected for each category. Hence, the fruit case studies are carried out focusing on apples and strawberries and the vegetable ones with carrots and lettuce as the research subject. Each product is investigated in two important production regions in Germany.

Table 1: Number of interviews with producers and other actors in the value chains for each case study

2016			Number of producers				Number of other actors in the value chain
Case study	Crop	Shelf live	Lake Constance	Lower Saxony	North Rhine-Westphalia	Rheinland-Pfalz	
Vegetable	Lettuce	short		8	7		5
	Carrot	long		9		11	4
Fruit	Strawberry	short		10	7		2
	Apple	long	5	8			7
General experts for the fruit and vegetable sector							4

So far, 69 expert interviews have been carried out in four study regions. Some of them were able to contribute to more than one of the case studies. Hence, the number of interviews for the lettuce case study is 20, for carrots 24, for strawberries 19 and for apples 20. They were able to provide information on 87 cases (Table 1). Most of the respondents were producers, some of them also act as direct marketers. Additionally, managers of producer organizations for fruit and vege-

tables, large carrot packers and processors as well as specialised vegetable and fruit traders were consulted. Experts' talks with the processing industry and food retail are still pending.

First results are already available for the vegetable case studies. The results for fruits as well as general recommendations to reduce food losses will be made available in May 2018.

3 Results and Discussion

3.1 Quantification of food losses in vegetable production

For these case studies food losses are defined as the quantity of products, suitable for consumption that have reached a minimum size and are undamaged but

(1) are disposed of because of noncompliance with marketing standards or quality demands of the food retail e. g. because of size, shape, colour,

(2) are not harvested due to oversupply on markets and too low prices,

(3) go into secondary (lower value) uses, such as juice production, animal fodder or biogas

(4) are spoiled after harvest.

Products that show a strong rotten or pest level before reaching the minimum size are not considered as food losses.

Table 2: Harvest rate for lettuce in 2015

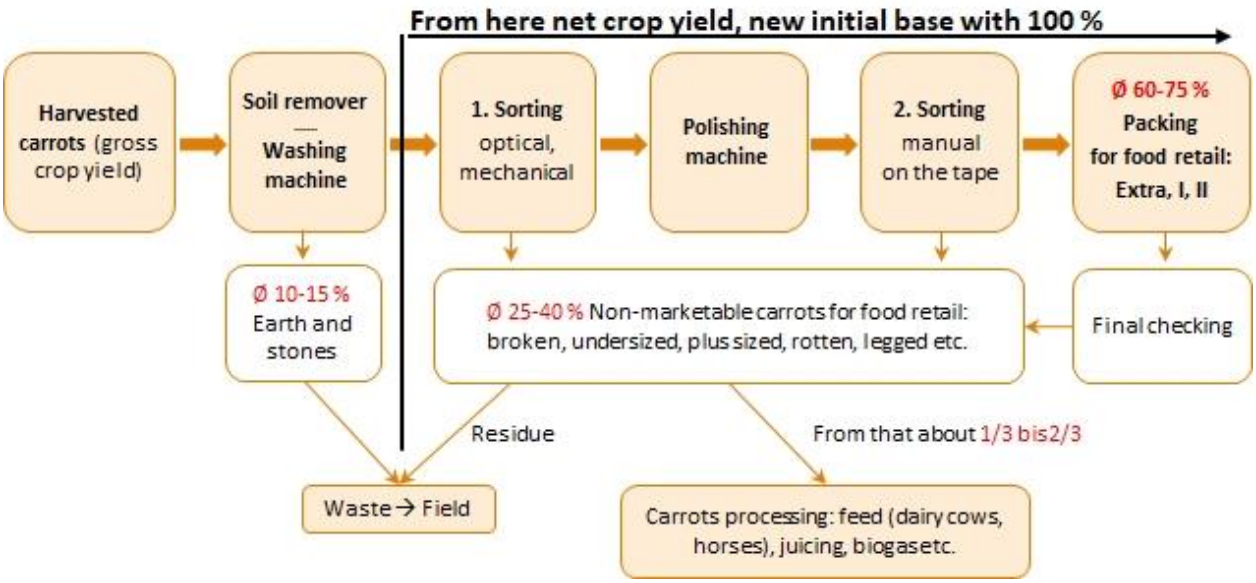
	Maximum	Average over all crop batches
Iceberg lettuce	75 – 99 %	68 – 80 %
Organic iceberg lettuce		41 % long-term mean: 60 %
Other lettuce	80 – 95 %	75 – 85 %

Source: Own investigations.

Lettuce is harvested and prepared for marketing immediately on the field so that food losses on the production level arise on the field. Therefore the harvest rate, the share of planted lettuces that are actually harvested, can be used to estimate the amount of food losses (Table 2). Iceberg lettuce is more difficult to manage compared to other lettuces and typically yields lower harvest rates. 2015 was reported as characterized by difficult weather conditions. There were still low night temperatures at the end of June and at the beginning of July the temperatures quickly rose to more than 35 °C. Thus, growth conditions were unfavorable, leading to particularly low harvest rates in organic iceberg production. Respondents pointed out that 2015 was a particularly bad year with a harvest rate of only 41 percent, while the long-term average was reported to be

about 60 percent. Lettuce is hardly storable. Hence there fresh market sales are the only possible use.

The carrot case study focuses on the leafless carrots because they represent a major proportion of the fresh carrots on the German market. Carrots go through a multi-stage harvesting and market preparation process (harvesting, washing, sorting, polishing and packing) during which non-marketable products will be sorted out. The net crop yield is defined as washed carrots which are free from earth and stones. Between 25 and 40 percent of this net crop yield is not suitable for the fresh market, because they are broken, under and oversized, rotten or legged carrots (Figure 1). Up to two-thirds of these non-marketable carrots flow into secondary use as feed and juicing or in biogas plants – with significantly lower prices.



Source: Own investigations.

Figure 1: Estimated losses for leafless carrots

In summary, the results of the vegetable case study show that up to one third of the planted lettuce plants are not harvested and up to 40 percent of the net crop yield of leafless carrots is not marketable. It is important to note that these empirical results still include production related losses, such as rotten and pest-attacked products, which are not defined as food losses. However, based on the available data from farmer interviews, it was not possible to distinguish between production related losses and food losses in the strict sense of the definition. Beausang et al. (2017, p. 181) also found that farmers usually do not differentiate between these two types of losses.

3.2 Causes for food losses in vegetable production

When analysing the causes of food losses common and product specific reasons for lettuce and carrots could be identified:

- The main reasons for food losses at the production level are weather conditions, pest and disease infestation as well as economic reasons (low producer prices).
- In order to comply with planned sales volumes, production volumes include safety margins to compensate possible production losses. If these buffers are not needed, overproduction and – if these cannot be marketed – food losses will occur.
- The market situation has a great influence on the amount of food losses, particularly in the case of lettuce with its short shelf life.
- Cosmetic specifications (shape and size) due to the prevailing quality demands are the key cause of food losses in carrots.

Potential measures to decrease food losses in the vegetable sector should be targeted specifically to the producer level and to the downstream value chain actors:

- Efficient measures for the production level are geared towards extending the shelf life. This will require additional investments in technical equipment, for example for cooling the products as soon as possible after harvest.
- An improved handling of carrots to reduce the rejects, the search for further marketing channels and for new production methods as well as ways to reduce the structural overproduction are also discussed to reduce the food losses on the production level.
- If food retail could agree to accept the maximum residue levels for pesticides as established in the legal framework, food losses could efficiently be reduced on the production level.
- Food losses in the value chain could be reduced by cooling systems and/or humidification devices in food retailers and in the storage center. Supply contracts for the fresh market sale or the sale of lettuce by weight could be another way to reduce food losses.

The chances of implementation the measures affecting the downstream stages of the value chain, in particular the food retail, are unclear and require further investigations.

4 Conclusions

The presented results show that (1) the food losses at the production level are significant depending on the current conditions (weather, market situation) and can greatly vary as well as (2) the use of technical progress to avoid food losses, for example ice water or vacuum cooling, is often limited because expensive technical equipment is needed. Lettuce and carrots are low-priced products so that the profitability of such technology will depend on farm size.

The usual planned safety margins in vegetable production in order to be able to meet supply obligations and to avoid the risk of becoming delisted by the food retailer will often lead to overproduction and edible vegetables left in the fields. These buffers may need to be considered inherent in the system (Hafner et al., 2013, S. 606).

It is expected that the results from the vegetable case studies and the forthcoming results from the fruit case studies will help to identify a range of potentially efficient measures to reduce food losses in the value chains of storable and perishable vegetables and fruit. The project design with workshops with farm managers, managers of producer organizations and farm consultants ensure the direct transfer of the project results to the production level. The advisory organizations which are involved in the project act as multipliers for the project results in order to reach the sustainability targets.

Literature

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