



Food loss reduction from an environmental, socio-economic and consumer perspective – The case of the Swiss potato market



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ABSTRACT

Potatoes are one of the commodities with the highest loss shares along the entire supply chain. In the present study, we analyzed six potential loss reduction scenarios concerning their environmental-socio-economic sustainability compared with the current situation by using the “SustainOS” methodology. For this purpose, life cycle assessments, full-cost calculations and an online consumer survey were conducted. Environmental improvements through loss reduction were rather small and did not cross limits of significance, but the socio-economic performance of the entire supply chain can be improved considerably. Pearson correlation coefficients and linear regression analyses were used to predict the influence of specific subjective items like the intention to avoid food loss, knowledge related to food loss and consumers’ price sensitivity on the assigned preference. Results show that perceived risks, perceived inconvenience and the general acceptance of loss-reducing instruments influence consumers’ preferences. Altogether, only three out of six tested scenarios seem realistic: selling unwashed potatoes in a lightproof box, selling unpacked potatoes, and improved quality sorting at farms. For two of the other scenarios, consumers significantly indicated their refusal even if losses decreased considerably, whereas the sixth scenario was unfavorable from a socio-economic perspective.

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1. Introduction

Food losses not only lead to a waste of economic resources (de Lange and Nahman, 2015; Giuseppe et al., 2014; Katajajuuri et al., 2014; Venkat, 2011) but also to a waste of natural resources (Akkerman and Donk, 2008; FAO, 2013; Garnett, 2011; Richter and Bokelmann, 2016) and have ethical implications (Laroche et al., 2001; Stuart, 2009). Because of the complex consequences of food loss reduction strategies, they are often linked to the three parts of sustainable development: economics, social issues and environmental impacts (Eriksson et al., 2015). But empirical studies on sustainability improvements caused by food loss reduction strategies are rather scanty or mainly focus on just one dimension of the problem. To our best knowledge, there is no study published yet, that investigates the consequences of food loss and food loss reduction from the environmental, socio-economic and consumer perspective simultaneously. The present study tries to close this gap and considers all three perspectives as we expect them all to

be essential for the feasibility of food loss reduction. The necessity of a multi-dimensional view while searching for realizable loss reduction measures will be demonstrated with the aid of a previous study (Willersinn et al., 2016), in which the authors introduced six potential potato loss reduction scenarios and assessed them just from the environmental perspective. However, they neglected the socio-economic perspective and whether consumers might accept the measures suggested by the reduction scenarios. This might lead to decisions which could have undesired consequences for the socio-economic performance of the entire supply chain or which are not accepted by consumers. Therefore, the aim of the present study was to assess the overall sustainability from all three dimensions of the six food loss reduction scenarios which have already been environmentally assessed within Willersinn et al. (2016). For that purpose, we applied the SustainOS methodology (Mouron et al., 2012), which enables combining environmental and socio-economic attributes on various aggregation levels to an overall sustainability index (Bockstaller et al., 2008; Sadok et al., 2009). Furthermore, we evaluated consumers’ preferences concerning the loss reduction measures with the aid of a consumer survey. In addition, we assessed factors which might influence con-

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sumers' preferences of specific loss reduction scenarios in order to get a feeling for feasible measures from the consumer perspective.

We chose fresh potatoes as an example as recent studies identified them to be one of the commodities with the highest loss rates (Beretta et al., 2012; Kranert et al., 2012; WWF, 2014). A previous study found that in Switzerland, 53% of all fresh potatoes produced for direct human consumption get lost somewhere on their way from agricultural production to final consumption (Willersinn et al., 2015). In comparison, WRAP (2012) estimated for the UK that up to two-thirds of all produced fresh potatoes would not be consumed by humans.

From 2011 to 2015, the average Swiss potato production destined for human consumption was 438,132 tonnes per year, matching approximately domestic demand. Circa 54% of the potatoes produced for human consumption are fresh potatoes, whereas 46% are processing potatoes (Swisspatat, 2015). In Switzerland, the average annual potato consumption per capita is circa 45 kg and relatively stable for the last 15 years (Swisspatat, 2015). However the world's average annual potato consumption in 2005 was with 31 kg per capita below the Swiss potato consumption but the European average was 88 kg per capita which was the highest proportion of all continents (FAO, 2015). Although the consumption in Switzerland is smaller than in many other European countries, potatoes are still the most favorable side dish compared to pasta (35–40 kg/(capita * year)) and rice (20–25 kg/(capita * year)) (Swisspatat, 2015).

Both SustainOS methodology and consumer survey are described in detail in the following section of this article. Results of the sustainability assessment and the factors influencing consumers' preferences are presented within the third section. Afterwards, the main findings are discussed and conclusions are drawn.

2. Methods

2.1. Fresh potato losses and potential loss reduction scenarios

Fig. 1 shows a typical Swiss potato supply chain and demonstrates the mass flow of initially 100 kg fresh potatoes at farm stage including all losses and the reasons for their occurrence based on Willersinn et al. (2015). This current situation, which leads to a loss of 53 kg from 100 kg fresh potatoes, was used as the reference for our analysis.

Based on expert interviews with various stakeholders of the Swiss potato supply chain, Willersinn et al. (2016) defined four scenarios (A1, A3, A4, A5) consisting of several measures that might reduce potato losses. In addition, they included one scenario

(A2) that might hold total losses constant but could improve the environmental performance of the whole supply chain. Furthermore, they combined four out of these five scenarios (A2 and A3 were conflictive) to get the most powerful loss reduction scenario (Mix). The six potential loss reduction scenarios are described in Table 1.

2.2. Environmental-socio-economic sustainability assessment methodology SustainOS

For investigating the environmental and socio-economic consequences of the potato loss reduction scenarios simultaneously, the SustainOS methodology (Mouron et al., 2012) was applied which combines different attributes to an overall sustainability index. This methodology was developed to compare several plant protection strategies in fruit production (Mouron et al., 2012), but Mouron et al. (2016) already demonstrated that the method can also be applied for arable crops such as potatoes or wheat. The approach basically consists of five elements as described in Fig. 2. In the following sections, we describe these five steps in detail with respect to the potato production system.

2.2.1. System description (step a)

For the assessment of realistic loss reduction scenarios, agromonic context parameters and production targets needed to be fixed (Table 2). The functional unit in the present study was 1 kg of consumed (boiled) fresh potatoes including all losses occurring on the way from agricultural production via wholesalers and retailers to private households. All inputs during an average production year were considered including fresh potato storage, transportation and meal preparation. The system boundary was the entire fresh potato supply chain excluding potential loss treatments as the aim of this study was to investigate the effect of loss reduction on the overall sustainability of the supply chain. We assumed an average fresh potato yield of 39.5 tonnes/ha (Agridea and FiBL, 2015) and the loss rates described in Table 1 to translate those parameters at agricultural production that initially refer to 1 ha potatoes into parameters referring to 1 kg of consumed fresh potatoes.

The costs of the scenarios described in Table 1 were estimated with the aid of Swiss-specific standard calculation data (Agridea and FiBL, 2015), cultivation details (Keiser et al., 2007), and manufacturer's data (e.g., Heger et al., 2010).

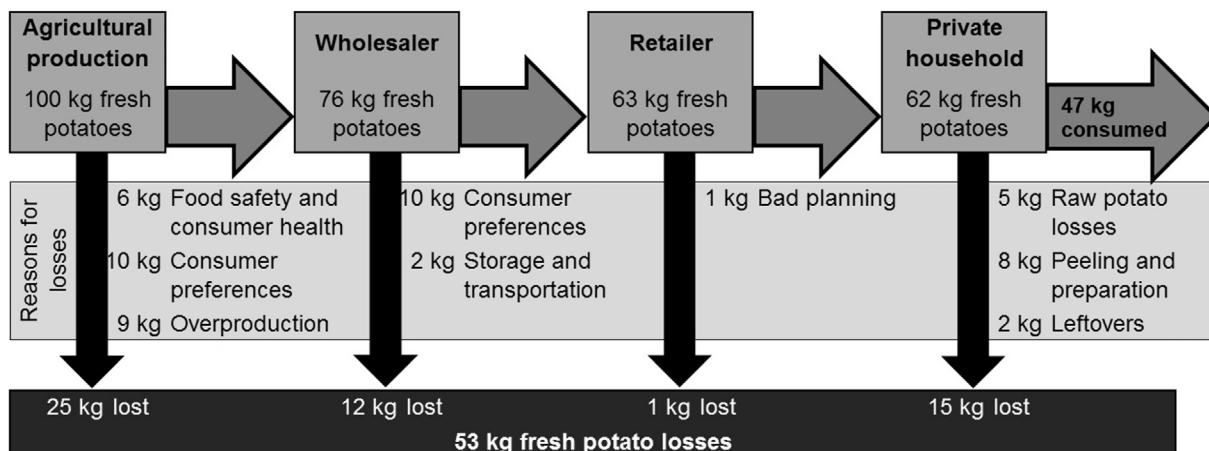


Fig. 1. Typical Swiss fresh potato supply chain and the mass flow of initially 100 kg fresh potatoes harvested at farm stage (Willersinn et al., 2015).

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