LCA Food 2018 and LCA AgriFood Asia 2018: *(1-A) LCA Methods; (1-B) From Farm to Table; (1-D) Ways towards SDGs*

SDG 12.3 – Ecological effects of halving food losses and waste, the German food sector case

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Abstract

The food sector is diverse and is a complex value-added chain. How considerable are the impacts on the environment with regard to food consumption and food waste, and how comprehensive are the ecological effects of reaching the Sustainable Development Goal/Target 12.3 of the United Nations – to halve food waste? The overall goal of the sustainability assessment in the REFOWAS (REduce FOod WASte)-Project was to create a consistent and complete LCA model of the German food sector including previous processes and food waste to answer such questions.

Environmental impacts of the German food intake in 2010 are calculated at 38 million hectare agricultural land use in Germany and abroad. A total of 177 million tons CO_2-equivalents of greenhouse gas emissions are attributed to the eaten and spoiled food products and the cumulative energy demand is about 3,700 PJ. Therefore 19 % of the whole greenhouse gas emissions of Germany belong to consumed food, and 4 % to food waste. The total saving potential amounts to nearly -10 % for each impact category if avoidable food waste is halved according to SDG 12.3. This corresponds to two percent of all German greenhouse gas emissions.

Keywords: *SDG 12.3; food waste; Germany; hybrid LCA; ecological effects; sector analysis.*

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1 Introduction

With the Sustainable Development Goal (SDG) ´Responsible consumption and production´ and its Target 12.3, the United Nations pronounces the ambition *"By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses"*. Generally, food waste reduction is regarded as having great potential to improve resource efficiency and reduce environmental impacts caused by food production (FAO, 2013). The REFOWAS-project addresses the environmental impacts of food waste, food waste reduction potentials and waste reduction activities and focuses the SDG 12.3 on a case study for Germany (https://refowas.de/en/).

2 Material and methods

A mass balanced material flow model of the German food sector was created to assess environmental impacts of the food sector and food waste. The model includes all supply chain steps from agricultural production, trade, processing to consumption and disposal. It differentiates between twelve food product groups including drinks. Material flow data is mainly based on official statistics (BMEL, 2016; Destatis, 2010) and representative studies on food consumption (Destatis, 2016; Kersting and Clausen, 2003; Krems et al., 2013; Mensink et al., 2007), supplemented with data on food waste (Hafner et al., 2013; FAO, 2013; Hic et al., 2016).

Environmental information was added to the material flow data. Foreground processes were taken from Schmidt and Osterburg (2008) for agricultural production; from the German Environmental input-output-accounts (Destatis, 2018) for the life cycle steps trade, processing and out-of-home consumption, and from the multi-regional input-output-database EXIOBASE 2 (Tukker et al., 2013) for import processes. Environmental data for cooking, cooling and transport in private households was taken from different studies (Sima et al., 2012; BVEW, 2013). Environmental data on background processes was used from the LCA-database ecoinvent 3.3. The environmental impact assessment focusses on agricultural land use, greenhouse gas emissions and cumulative energy demand. All calculations were performed with the software openLCA (Di Noi, 2017). The functional unit is the German national food intake of 2010.

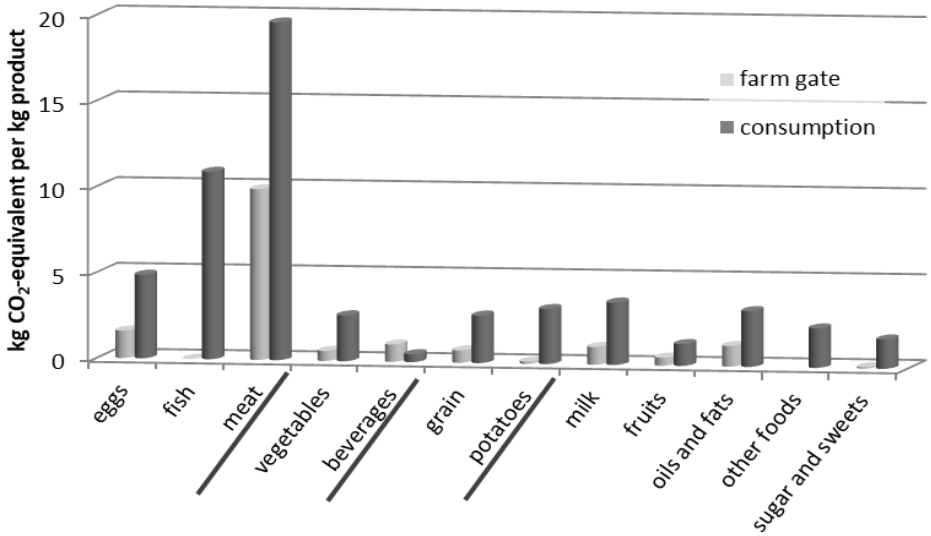
First we defined 500 activities in 12 groups of food products that represent the German food sector (comp. Fig. 1). Using this model we calculated the environmental indicators ´land use´, ´CO_2-equivalents' and the cumulative energy demand (CED) that reflect the resource use of the whole supply chain from primary production to consumption within the losses on each step. We calculated the environmental burdens of the entire German food intake and also coefficients for the twelve product groups for different supply chain steps in two scenarios. The scenarios are defined as halving the food losses and waste on the retail and consumer level as the SDG 12.3 suggests, and as reducing the total food losses and waste at each step, see Figure 2.

3 Main results

3.1 Coefficients per kilogram product

Figure 1 shows the discrete results of food production and food processing from twelve product groups and two subsectors for the example of the greenhouse gas emissions. The results refer, on the one hand, to one kilogram agricultural product (farm gate) and on the other hand, to one kilogram of food ready to consume (consumption). Therefore all categories include not only the raw product but also finished products, e.g., the product group "grain" also contains bread and other grain products. The production of meat engenders very high ecological damage/stress per kilogram. A lot of beverages consist of sugar and water. Hence the starting product (e.g., fresh juice) causes higher negative impacts of CO_2 on the environment per kilogram than the final product. Whereas the potato primary production causes low negative impacts per kilogram, but the processing (e.g., frying) causes high impacts due to used oils and the cooking.

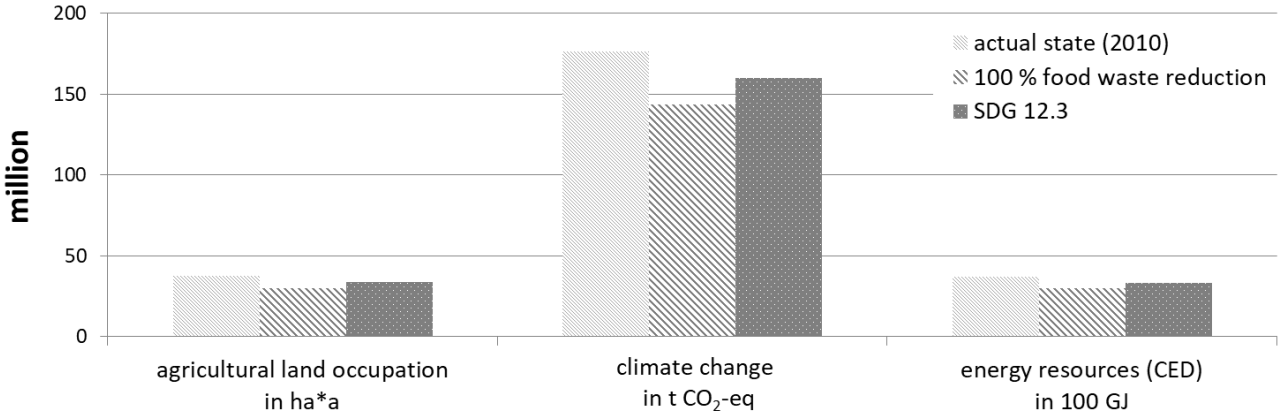
Figure 1: Greenhouse gas emissions per kilogram food product (Source: own calculations)



3.2 Whole food sector in Germany

A view on the whole German food sector shows that 38 million hectares of agricultural area were occupied worldwide for the food consumed in Germany. A total of 177 millions of tons CO_2-equivalents were emitted and a cumulative energy demand of 3.727 PJ can be calculated (whereas the animal products cause the highest negative impacts, about half of all emissions).
Fig. 2 shows this actual state of the ecological impacts of the food consumption as well as two reduction scenarios. The total saving potential amounts to 4 million hectares of agricultural land use, 17 million tons CO_2-equivalents of greenhouse gas (GHG) emissions and 370 PJ cumulative energy demand if avoidable food waste is halved according to SDG 12.3. This corresponds to 10 % of total use-related GHG emissions.

Figure 2: Ecological impacts of the food consumption and reduction potential in Germany, actual state and two scenario analyses (Source: own calculations).



Furthermore the product category has to be taken into account when it comes to reduce not only mass but also environmental burdens, because the coefficients (climate change and energy resources) of animal products are greater than of herbal ones (comp. Figure 1).

4 Discussion

Meat has a high protein content, so it cannot be totally omitted without replacing the proteins with other products. Reducing food waste is similarly a question of food diets, which cannot be changed freely. Changes have to take the nutrients into account and can therefore cause more environmental burden than before (Poore and Nemecek, 2018).

Jepsen et al. (2016) also developed a material flow model of the German food sector and calculated the environmental impacts of food waste. However, the results of this more aggregated model differ from our calculations with 20 % more greenhouse gas emissions and 40 % less land use. While food waste rates are comparable, the absolute value of environmental effects is consequently disparate. Other results by Eberle und Fels (2016) belong to the same reference year, and also to the German food consumption including food waste, but calculated higher impacts: 21 % more CO_2-equivalents and 19 % more hectares of occupied agricultural area.

The FAO (2013) estimates the global footprint of food produced but not eaten as 3.3 Gt of CO_2 equivalents and 1.4 billion hectares of land use. Hence, German food waste comprises a share of approximately 0.5 % of the global greenhouse gas emissions and 0.3 % of the land use.

5 Conclusions

The great potential of food waste reduction and reducing environmental impacts seems an easy solution for a complex problem. But reduction activities and their environmental impacts should be considered as well. The benefit of the SDG 12.3 in terms of sustainability remains unanswered.

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