

# Environmental impacts of food consumption and its reduction potentials

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## ABSTRACT

Nutrition accounts for 30 % of environmental impacts caused due to the final consumption of Swiss households. Therefore, it is necessary to investigate possibilities for the reduction of these impacts. We developed a general framework for such an analysis. Based on a more detailed analysis of this consumption domain, it is investigated, for which percentage environmental impacts can be reduced by a certain change in consumer behaviour. Finally, the resulting values are used to estimate the potential reduction compared to the total environmental impacts. With a combination of different measures such as less meat and luxury products, no products grown in heated greenhouses and reduction of obesity and wastages, it would be possible to reduce the environmental impacts of nutrition by two thirds and the total household consumption by more than 10%. The most promising single change in behaviour is a vegetarian diet.

## 1. Introduction

Nutrition accounts for about 30 % of environmental impacts caused due to the final consumption of Swiss households (Figure 1, Jungbluth et al. 2011). This value does not even include meals consumed in restaurants, hospitals and retirement homes. It is thus the most important consumption domain from an environmental point of view. Therefore, it is necessary to investigate and understand the environmental impacts of food consumption and possibilities for the reduction of environmental impacts.

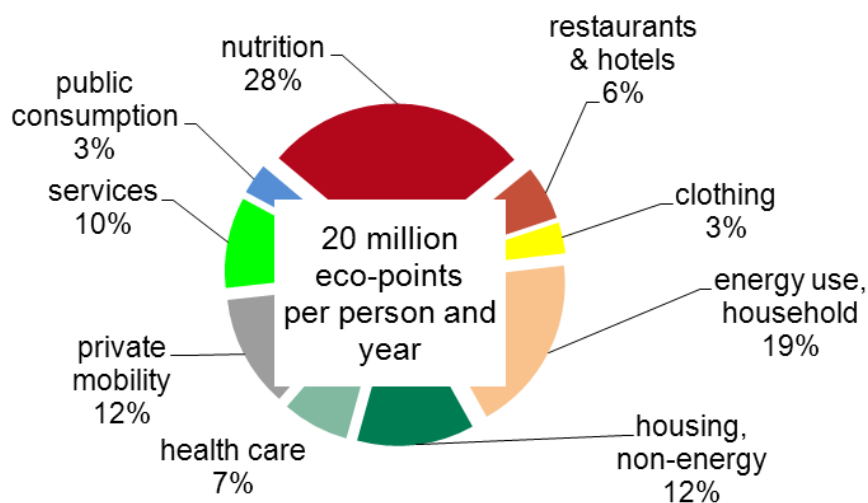


Figure 1. Environmental impacts of different household activities Jungbluth et al. 2011.

## 2. Methods

Several options for reducing environmental impacts were compared within a general framework. Besides the consumption of food products also reduction potentials for impacts due to energy use in households and private mobility were investigated (Jungbluth et al. 2012a; Jungbluth & Itten 2012).

The ecological scarcity method was used as a key indicator for the impact assessment (Frischknecht et al. 2009), but the results were also compared with respects to greenhouse gas emissions and energy use. A single indicator summarizing all relevant environmental impacts is seen as a necessity for the communication of results to the consumers (Jungbluth et al. 2011a).

In a first step of analysis the share of the environmental impacts related to food consumption was investigated (as shown in Figure 1) with a top-down approach using an environmentally-extend Input-Output-Analysis (EE-IOA) for Switzerland (Jungbluth et al. 2011).

In a second step the consumption sector of nutrition was split up into different categories of products consumed. This calculation is based on food consumption statistics (Schweizerischer Bauernverband 2007) and life cycle assessment (LCA) data (Jungbluth et al. 2012b).

The contributions to the total impact of the different food items for the second step (bottom-up approach) are shown in Figure 2. Meat and fish account for about one quarter of the environmental impacts due to food consumption. Together with milk and eggs, animal products account for nearly half of the environmental impacts. Coffee and alcohol are the most important single products within the category of beverages. This is due to the pesticides and copper applied during the growing of the basic agricultural products. Transports, packages and processing are of minor importance for the overall environmental impacts.

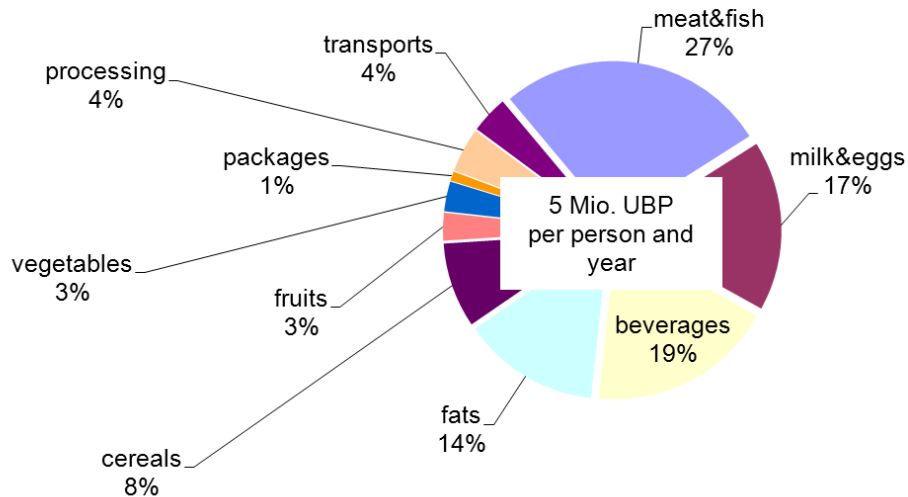


Figure 2. Importance of product groups in total environmental impacts of nutrition

The results for the top-down (share of nutrition in Figure 1) and bottom-up approaches (Figure 2) are compared in Figure 3. The overall differences are small. For some impact categories results differ because of the more general allocation schemes used in the EE-IOA.

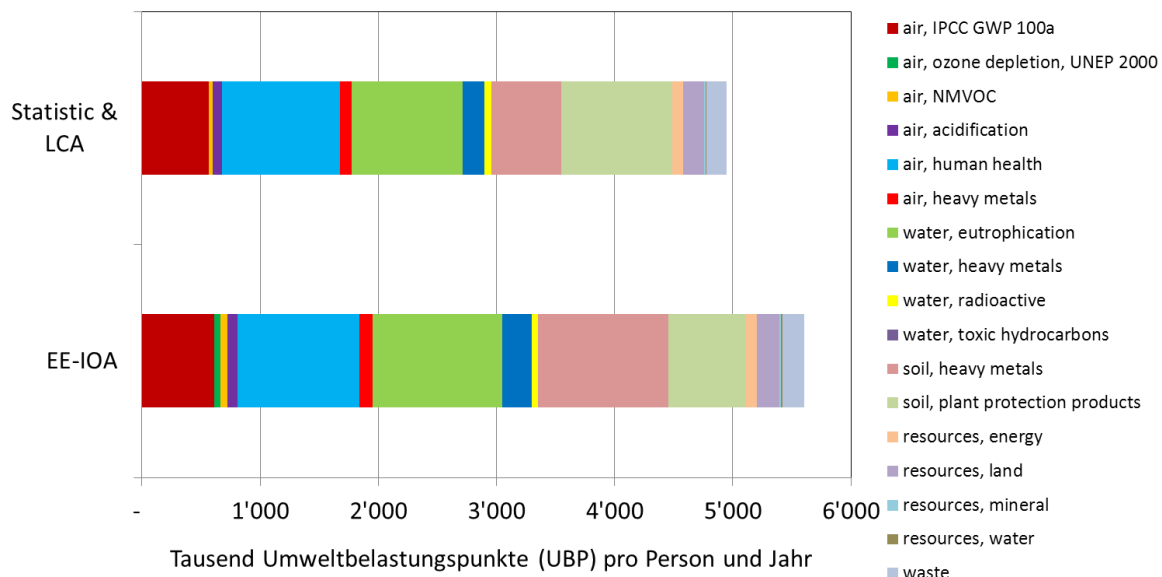


Figure 3. Comparison of top-down and bottom-up approaches according to single impact categories in the ecological scarcity methodology. Total eco-points according to the ecological scarcity method 2006 per person and year.

Based on the detailed analysis of this consumption domain, it was investigated, by which percentage environmental impacts can be reduced due to a certain change in consumer behaviour. In this paper we highlight and compare the reduction of total environmental impacts, if all consumers would:

1. Buy locally
2. Buy seasonally
3. Eat vegetarian
4. Buy organic food
5. Resign on luxury food (coffee, alcohol)
6. Reduce food wastes
7. Reduce obesity to normal weight
8. Combine different changes in a healthy and environmentally friendly diet

Several assumptions were necessary in order to model these scenarios.

Ad 1: Buying locally should reduce the environmental impacts due to transportation. However, some restrictions have to be considered. Switzerland is only 50% self-sufficient with respects to food production; the rest has to be imported as long as consumption patterns do not change. Buying exclusively locally would only be an option for all consumers if meat consumption is reduced considerably in parallel (Würtenberger 2003; BWL 2011). Thus, here we assume only that air-transported products are avoided. It was not possible to model the change of environmental impacts due to a variation of production patterns in different countries including a potentially increased share of greenhouse products which might be bought as regional products.

Ad 2: The main aim of buying seasonal fruits and vegetables is reducing environmental impacts due to the production in heated greenhouses. In the calculation this was considered by reducing the amount of fruits and vegetables produced in heated greenhouses by 90%. Not considered is the possible reduction of transport distances if only seasonal products from the region are bought.

Ad 3: A vegetarian diet includes several alimentary changes in order to replace meat products with milk and eggs and other foodstuffs. The assumption that environmental impacts can be reduced by about 30% is based on a literature review (Faist 2000; Jungbluth 2000; Kramer 2000; Leuenberger & Jungbluth 2009; Seemüller 2001; Taylor 2000; Uitdenboerd et al. 1998).

Ad 4: In the scenario for organic food it is assumed that all products are produced in organic agriculture. For most of the food products we had organic datasets for the calculation at our disposal (Jungbluth et al. 2012b). For some imported food products, e.g. rice, there was no LCI data on organic production available and thus no change has been considered. Furthermore it is considered in the calculation that the Swiss regulations for most organic labels prohibit the production in heated greenhouses and aircraft transport.

Ad 5: Luxury food (sometimes also called stimulants) is defined as food products which are not necessary from a nutritional point of view or which might even be unhealthy. Here we assume that Swiss consumers cease drinking alcohol and coffee. Further issues would be the reduction of sugar containing products such as cake and chocolate and the reduction of fatty snacks. This has not yet been considered in the modelling.

Ad 6: Consumers also throw away food which would have been perfectly fit to eat, e.g. because they buy or cook too much. About 15% of the food products produced undergo this fate (Gustavsson et al. 2011). Here we assume that the consumers don't waste any food. However the wastage in other parts of the life cycle was not altered for this calculation.

Ad 7: Obesity is a serious health problem in many wealthy countries. In 2007 about 37% of the Swiss adults had a body mass index (BMI) higher than 25<sup>1</sup>. Here we assume that food consumption is reduced by all consumers to a level that they do not reach a BMI of over 25. This would lead to a reduction of the average body weight of about 3.7 kg (or 10 kg for overweight people). The calculations for the reduction of food consumed are based on a conference paper (Cordella et al. 2009).

Ad 8: For the last scenario an environmentally friendly and healthy diet is assumed. Here meat consumption is reduced to about 2 portions a week. This corresponds to the amount recommended by health specialists. Furthermore different options mentioned before are combined in order to assess a realistic scenario that can be followed by all consumers. The assumptions are based on the previous assessments and a review of relevant literature (Carlsson-Kanyama et al. 2003; Fazeni 2011; Griebhammer et al. 2010; Jungbluth 2000; Kramer 2000; Meier & Christen 2012). This option is also promoted by nutritionists (von Koerber et al. 1999).

A ninth interesting option for impact reduction would be a smoking stop. (Tabaco products also fall in the consumption sector nutrition.) Due to lack of data this scenario could only be investigated qualitatively.

The approach taken in order to assess the reduction potentials is explained here with an example for option 4, which assumes the purchase of organically produced food items (Figure 4). The latter would reduce

<sup>1</sup> [http://www.bag.admin.ch/themen/ernaehrung\\_bewegung/05207/05218/05232/index.html?lang=de](http://www.bag.admin.ch/themen/ernaehrung_bewegung/05207/05218/05232/index.html?lang=de), 12.9.2011

the total impacts of food consumption by about 15%. The detailed analysis with the ecological scarcity method shows that impacts of organic products are considerably lower with regard to the use of plant protection products. On the other side there are higher impacts due to heavy metal emissions to soil in organic agriculture which is mainly due to the use of copper as a plant protection product. For many other impact categories the average impacts according to the food basket are comparable.

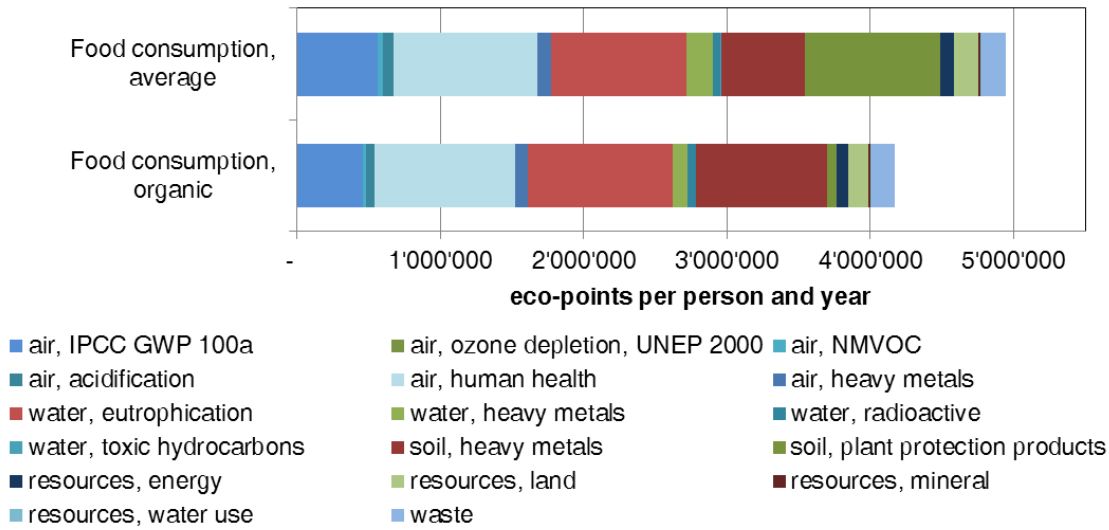


Figure 4. Comparison of the average diet with a diet based on organically grown products

### 3. Results

The reduction potentials for the different scenarios described before are shown in Figure 5. The highest potential reduction was calculated for a combination of different measures. Within the healthy and environmentally friendly diet, it is assumed that meat consumption is reduced to two portions of meat a week instead of six. Furthermore, air-transported products are avoided and only seasonal fruits and vegetables are bought. These measures lead to a reduction of the environmental impacts of domestic nutrition by two thirds and total household consumption by more than 10%. The most promising single change in behaviour is a vegetarian diet. On the other side a change to merely a regional or seasonal choice of products does not show a high potential for reducing environmental impacts. The choice for seasonal products is only relevant for fruits and vegetables, which make up a small share of the total environmental impacts. Buying locally is a restricted option in Switzerland due to the insufficient production capacities within the country.

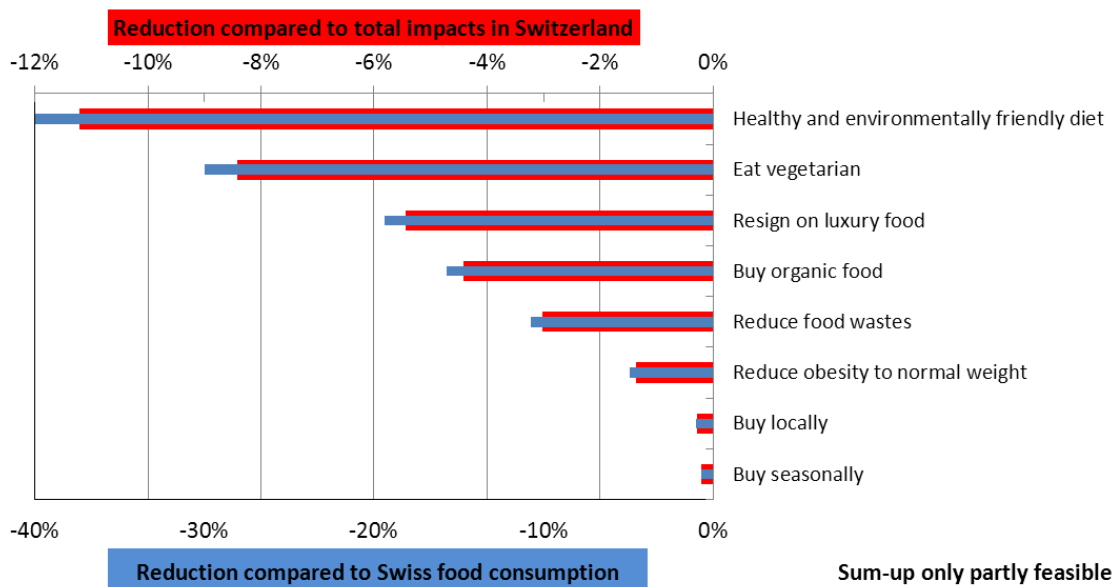


Figure 5. Reduction potentials for the total environmental impacts due to behavioural changes in food consumption

## 4. Discussion

The approach developed in this research project allows a comparison of different options for the reduction of environmental impacts due to food consumption patterns or within other fields of consumption. The research focuses on the options that can be followed up by private food consumers. An additional reduction of environmental impacts is possible if further measures are taken within the production chain. Such options would be for example the reduction of wastes throughout the production chain or the improvement of farming practices from an environmental point of view.

Furthermore also reduction potentials in the consumption domains of mobility and energy use in private households were evaluated, but are not focussed on in this paper.

## 5. Conclusion

This research project shows that in order to reach a healthy and environmentally friendly consumption pattern several nutritional adjustments should be combined. Nevertheless, the reduction of meat and animal products is the most important issue from an environmental point of view. The second most promising approach is the reduction of luxury food.

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