

ONE TWO WE—life cycle management in canteens together with suppliers, customers and guests

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Abstract

Purpose Private food consumption accounts for 30 % of total environmental impacts caused by the final consumption of Swiss households. The private expenses for gastronomy and hotels account for another 6 %. Therefore, it is necessary to investigate and better understand the environmental impacts of food consumption and the possibilities for a reduction of these impacts. This was the starting point for the collaboration between the canteen operator SV Group, the life cycle assessment (LCA) consultancy ESU-services, the energy supplier ewz and the World Wide Fund for Nature (WWF) in Switzerland focusing on food consumption in canteens.

Methods In a first step, an LCA study was used to analyse the environmental impacts of about 20 million meals served in 240 canteens in 2011. LCA data for 160 food items were linked to the food amounts of about 10,000 articles purchased in this year. This was supplemented by data on canteen operation and resulted in a full organisational LCA.

Results and discussion The impacts of food purchases are about four times higher than the direct impacts due to the operation of the canteens. The most important product groups are meat and dairy products. Improvement potentials have been identified within 14 different themes by the project group. They include measures in the canteen operation (e.g. reduction of food waste or energy-efficient appliances); measures in the supply chain, e.g. a reduction of vegetables grown in heated greenhouses; or the abandonment of air-transported products. But also dietary choices such as a

reduction of the average amount of meat per meal are considered as an option. The results and recommendations of the detailed LCA as well as information by other partners have been used by the SV Group to develop the programme ONE TWO WE. It assists the customers (companies who commission the operation of canteens in their premises) to reach improved levels of environmental performance. The programme aims for a 20 % cut on GHG emissions after full implementation in the participating canteens.

Conclusions The programme started successfully with many customers positively convinced by the proposed changes in the provision of canteen meals. An initial reduction of greenhouse gas emissions compared to the baseline was achieved. This LCA study is a good example for the value of calculating a full organisational environmental footprint for a company in the gastronomy sector and for using the results of such a study to bring down the overall environmental impacts.

Keywords Canteen · Gastronomy · Life cycle management · Organisational LCA · Organisational environmental footprint · Supply chain

1 Introduction

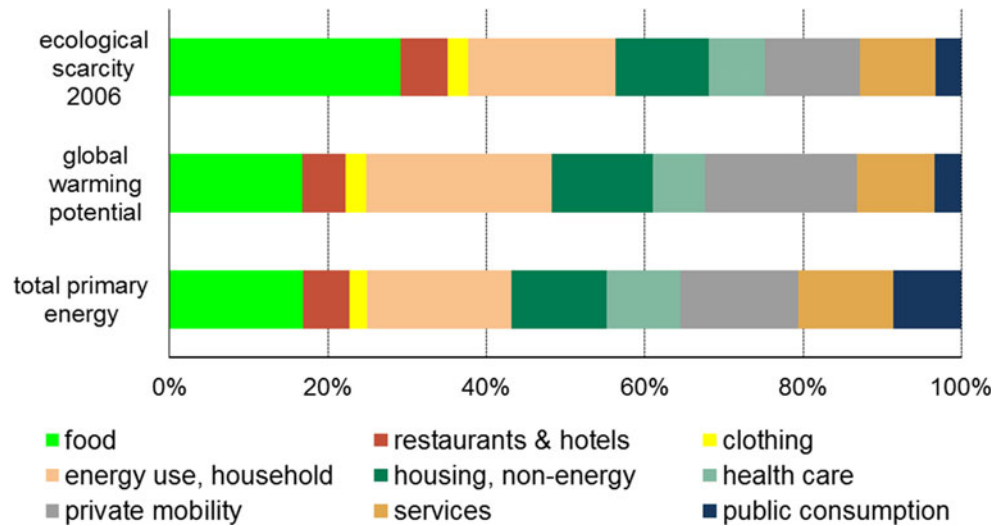
Private food consumption causes about 12 % of total primary energy demand and 18 % of greenhouse gas emissions due to Swiss consumption patterns (Fig. 1). There are many other environmental impacts that should be accounted for in a life cycle assessment (LCA). Here, we use the Swiss ecological scarcity method 2006 which weights different environmental indicators according to the political targets in Switzerland (Frischknecht et al. 2009). Environmental impacts are quantified as eco-points (UBP for Umweltbelastungspunkte). If all types of environmental impacts are included in the analysis

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Fig. 1 Importance of private food consumption in relation to different areas of total final consumption in 2005 in Switzerland (Jungbluth et al. 2011; Jungbluth et al. 2013)



with this method, the share of private food consumption rises to about 30 % (Jungbluth et al. 2011; Jungbluth et al. 2013). This is due to specific environmental impacts caused by agricultural practice such as pesticide use, heavy metal emissions from fertilisers, land and water use as well as problems caused by acidification and nitrification.

The main part of the environmental impact arises from the agricultural production of meat and fish (Fig. 2). In the product group of beverages, coffee and wine are responsible for a relevant share of environmental impacts. These are examples of luxury products which need higher inputs for production than other plant products.

Environmental awareness is increasing in the gastronomy sector. Previous studies showed that the provision of food is also a major source of environmental impacts for the operation of restaurants (Baldwin et al. 2011; Jungbluth and Büsser 2008; Leuenberger and Jungbluth 2009).

One of the first tasks in this project was to elaborate and analyse the total environmental footprint of the organisation including the supply of food items. This type of LCA is also referred to as organisational LCA (Martínez-Blanco et al.

2015). So far, in literature, mainly examples of organisational carbon footprint can be found (Milà i Canals et al. 2011; WBCSD and WRI 2011). The methodology for our analysis follows the methodology formerly used for the assessment of food purchases by a food distributor (Jungbluth 2011).

The LCA results are the basis of the programme ONE TWO WE, which aims to assist the customers of the SV Group with the reduction of the GHG emissions caused by their canteens. The customers are companies that commission the SV Group with the operation of a canteen in their premises. The programme was elaborated in close collaboration with World Wide Fund for Nature (WWF) Switzerland and ewz Zürich (public electricity supply in the Swiss city of Zurich).

This article presents the methodology and results on the organisational LCA. Furthermore, it highlights the way these results were used for defining measures for reducing the environmental impacts. It is shown that for this a close co-operation between canteen operator, clients, guests and food suppliers is necessary.

2 Methods

The environmental impacts of all food purchases in 240 canteens of the SV Group were analysed within an LCA study for the operation in the year 2011. In this year, 19.2 million meals were prepared and sold. The definition of the functional unit is mentioned as a challenge for the organisational LCA (Martínez-Blanco et al. 2015). But, in this case, it was easily defined as an average main meal served in a canteen (including some additional items such as coffee). The use of the unit instead of the total impacts per year makes it easy to compare results over years, between different canteens or with impacts of a specific type of meal investigated in a product LCA.

The SV Group provided a detailed list of their food purchases including weight and costs of the purchased items.

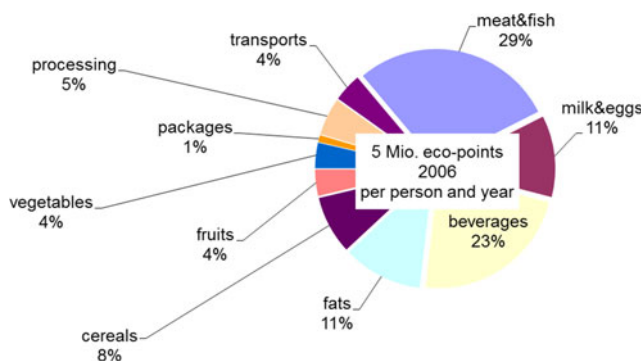


Fig. 2 Importance of product groups in total impact of private food purchases in Switzerland. The total impact is five million eco-points 2006 per capita for the year 2005

More than 10,000 different food and non-food items were listed. For the company, it was the first time to get an overview on the overall amounts of food items purchased and they had to collaborate with different suppliers in order to fulfil this task. Some estimations and extrapolations were necessary for the purchases made from smaller suppliers. About 820 g of food items, 2.2 dl of beverages and 40 g of other materials such as serviettes were used per meal (Table 1). The category “durable goods” includes a mixture of e.g. convenience products, rice, noodles, etc. which could not be assigned to one of the other categories.

In the next step, LCI data for 160 different food items available within the ESU food database (Jungbluth et al. 2015) were linked to the purchased amounts. This database builds on ecoinvent v2.2 data and updates for this database (LC-inventories 2015; Ecoinvent 2010; ESU 2015). For the packaging and transportation, assumptions have been made for each food product. This followed the idea of a modular LCA for the assessment of single food purchases as developed in a previous research work (Jungbluth 2000). Thus, the assessment of purchased food items includes all stages from farm to delivery to the canteen with e.g. the necessary packages and assumptions for previous storage and refrigeration.

Direct impacts for the operation of canteens, e.g. electricity, heat and water use as well as treatment of disposed food waste and effluents, have been investigated with data from the environmental report of the SV Group (SV (Schweiz) AG 2010, 2008). Food waste was already monitored as part of this environmental reporting. Impacts due to its disposal are included in the assessment. The production of the wasted food is included in the figures on total food supply.

Other methodological choices on foreground data have been taken according to the attributional LCA methodology also used for the ecoinvent background data (Frischknecht et al. 2007). This type of LCA is also called organisational LCA. Even if the end results are referred to an average meal, it has to be noted that the scope is not the same as a product LCA for a single meal served in the canteen. The impacts shown

here per meal include also some additional items like coffee, croissant or sweets sold in the canteen which are sold separately e.g. for a breakfast break. But, for analytical reasons and follow-up of the development, it is easier to refer the results to a meal and not e.g. to turnover or total impacts.

The objectives of this part of the project were twofold: to analyse the environmental impacts of food purchases and canteen operations and to identify improvement potentials. In a first step, the most important ingredients were identified and the impacts of the food supply were compared with the direct environmental impacts of the canteen operation. The total impacts have been divided by the number of meals sold as a functional unit. In the second stage of the project, improvement potentials were identified within the supply chain and the operation of the canteens.

The results in this study are analysed across a representative range of impact categories with the ecological scarcity method (Frischknecht et al. 2009) and with global warming potential (GWP) (Solomon et al. 2007).

3 Results

3.1 Global warming potential of an average canteen meal

The food purchases of the canteen operator were summarised in the following categories: meat, fish, dairy products, eggs, vegetables, fruits, bread, sweets, beverages and durable products. Within the group of durable products, a range of different types of food can be found as explained in the previous chapter. The contribution of each life cycle stage to the GWP of all food purchases is shown in Fig. 3. The GWP is expressed per meal, which means that the GWP of all food purchases were divided by the total amount of meals delivered per year. The life cycle includes the production, the processing (e.g. refrigeration), the packaging, the transport of food items to the canteen and the operation (meal preparation at the canteen, cooling, cooking and food waste disposal).

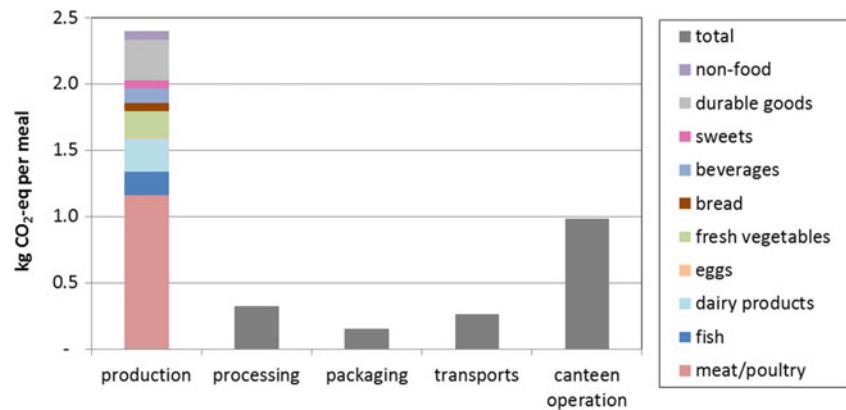
An average meal served in a canteen operated by the SV Group has a GWP of about 4.1 kg CO₂-eq. The agricultural production step is responsible for 58 % of the emissions, the processing of food items 8 %, the packaging 4 % and the transport from farm to the canteens 6 %. The operation of the canteens including e.g. the use of water and electricity as well as disposal of food waste contributes 24 % to the total impacts. The overall GWP of the food supply is dominated by the meat and poultry products (48 %), the dairy products (10 %), the fresh vegetables (8 %) and durable products (13 %).

The impacts can also be compared with the daily impacts of private food consumption in Switzerland which are about 6.3 kg CO₂-eq according to Jungbluth et al. (2012). For the comparison, it has to be considered that this figure does not include the home transportation, storage and preparation of

Table 1 Composition of the average meal in canteens of the SV Group

	Weight in average meal (grams per meal)
Meat/poultry	108
Fresh vegetables	310
Bread	108
Dairy products	135
Eggs	5
Fish	21
Sweets	32
Durable goods	137
Beverages	225
Non-food	42

Fig. 3 Global warming potential of food purchases (“production”), processing of the food outside the canteen, packaging of the food, transport from the country of origin and canteen operation for one canteen meal



the food in the household as these energy uses are assigned to the consumption domains of mobility and energy use, respectively. Furthermore, food consumed in restaurants or paid by the employer is not included. Also, for comparison with other literature data on impacts of food consumption, such system boundaries play an important role. Important questions are e.g. the way with which methodology they have been determined (top-down or bottom-up). For bottom-up, it is relevant how far food waste has been included in the assessment and with which amount of food products the analysis starts: with the recommended, the eaten, the purchased or the available amount. Different consumption or production patterns can lead to quite different results when results from different countries are compared.

The figure calculated in this study for an average canteen meal is higher than figures investigated with recipes for single meals (e.g. Leuenberger et al. 2010; Stucki et al. 2012) as it includes also food products going to waste and thus not sold as a meal. Furthermore, some additional items, e.g. coffee or sweets bought by the guests, are included.

3.2 Environmental impacts of an average meal in canteens of the SV Group

The importance of the production of food products is even more pronounced when total environmental impacts are evaluated according to the ecological scarcity method 2006 (Frischknecht et al. 2009). With this assessment, about 69 % of total impacts of a canteen meal served by the SV Group are due to the production of food products. The impacts per canteen meal are about 9000 eco-points.

The environmental impacts of this meal can be compared with the average impacts due to private food consumption in Switzerland. About 15,300 eco-points per day are caused by the purchase of food products, but not including the consumption of food in canteens and restaurants nor including the home delivery and preparation of food products (Jungbluth et al. 2012). Thus, one canteen meal per day has quite some relevance which can also be partly explained by the higher

share of meat (38 %) for the total environmental impacts than in the average daily consumption basket shown in Fig. 4. One explanation for the higher share of meat in the canteen meal compared to the average daily food basket is that canteens serve the main part of their food products for lunch and only small amounts for breakfast, small breaks or dinner.

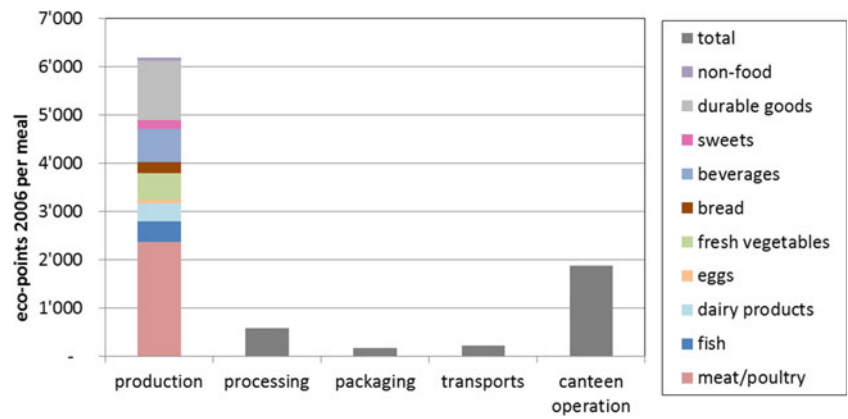
The share of different types of environmental impacts for the different food categories is evaluated in Fig. 5. This illustrates the necessity to include all types of environmental impacts in an assessment. The use of plant protection products, eutrophication and human health impacts due to ammonia emissions are important environmental aspects when evaluating the total food purchases of the canteen operator. A negative impact for dairy products in the category of heavy metal emissions to soil is due to the uptake of heavy metals in certain crops. Some differences between product groups are visible. There is, for example, a relatively high share due to the emissions of plant protection products in the case of vegetables. For dairy products, the methane emissions of cows lead to a relative higher share of the climate change category. The high share of heavy metal emissions to soil for the category of beverages is mainly due to the use of copper in coffee plantations. The same problem occurs in cocoa production for the production of sweets. The use of cadmium in anti-fouling paints used for fishing boats is relevant for the production of fish. The environmental impacts of meat production are dominated by production of fodder and direct emissions of the animals.

3.3 Seasonal calendar to assist supply chain management

Based on the detailed assessment of the total environmental impacts, several improvement options for the supply chain have been proposed and discussed with the canteen operator. Here, we provide one example for the development of such improvement options based on the LCA results.

The detailed analysis of vegetable and fruit purchases has shown that an important part of impacts is due to the heating of greenhouses with fossil fuels when products are bought

Fig. 4 Eco-points according to ecological scarcity 2006 per canteen meal



outside the Swiss season. Therefore, one option is the optimised purchase of fruits and vegetables by avoiding products from fossil-heated greenhouses.

The environmental impacts of vegetable and fruit purchases depend on the production period, the transportation distance and the means of transport. For several fruits and vegetables, all monthly supply routes were assessed in a seasonal calendar in order to provide better guidance for purchases. Two examples are illustrated in Fig. 6. Green colours highlight products that can be ordered by the kitchen chef while red products should be avoided as far as possible in the ordering.

For example, fresh zucchini is supplied from Switzerland, Spain, Morocco and Italy. The fresh zucchini from open ground in Switzerland is only supplied from May to

September, and its GWP is 0.6 kg CO₂-eq per kg. From January to May and from October to December, fresh zucchini is transported in trucks from different countries. According to the supplier of the canteens, the Swiss fresh zucchini is produced in these months in fossil-heated greenhouses. Then its GWP is 3.9 kg CO₂-eq per kg. The use of Swiss zucchini that is deep frozen in order to maintain a supply during the off season generates a GWP of about 0.6–0.8 kg CO₂-eq per kg. The GWP increases with the time of storage after harvesting and is thus highest in April. Deep-frozen vegetables are an interesting alternative to fresh vegetables cultivated in heated greenhouses. The information concerning heating does not necessarily match with information found in literature about this type of vegetables grown in other countries (e.g. Milà i Canals L et al. 2008).

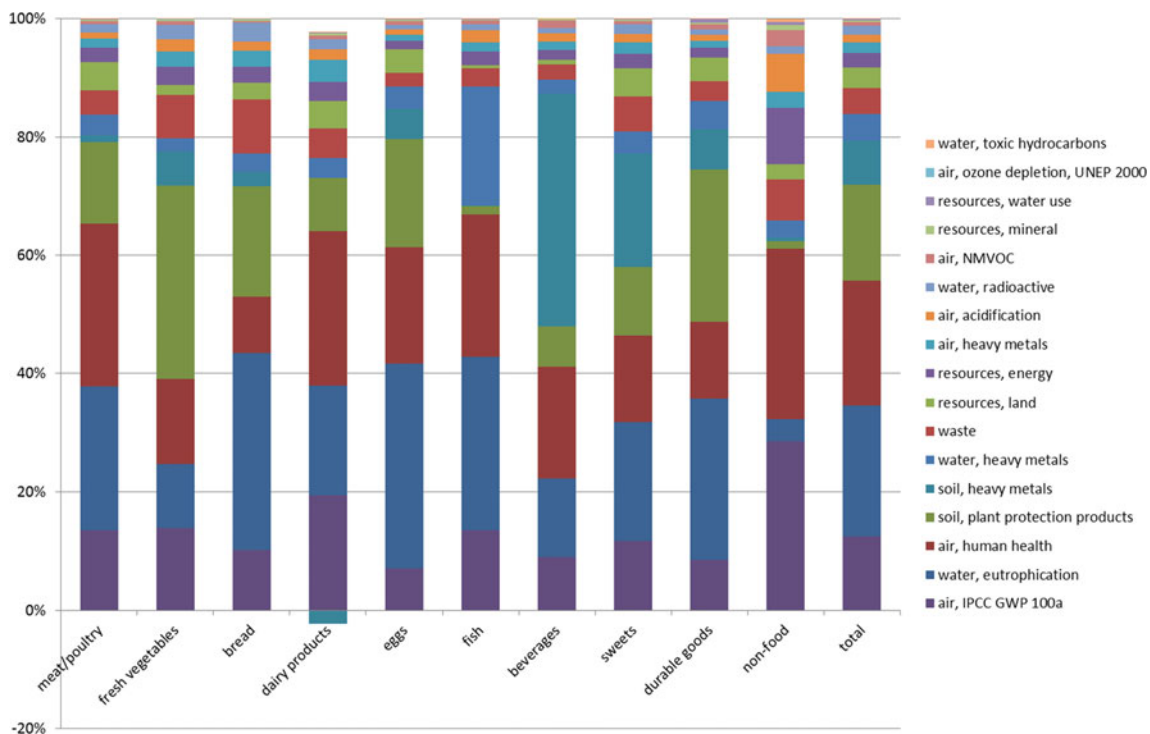


Fig. 5 Share of impact categories according to ecological scarcity 2006 of the food and non-food purchases

kg CO ₂ -eq per kg vegetable		Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Green asparagus	CH-Lorry	n.a.	n.a.	n.a.	1.9	1.9	1.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	ES-Lorry	n.a.	n.a.	n.a.	2.1	2.1	2.1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	MX-Air	22.7	22.7	22.7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
	PE-Air	24.9	24.9	n.a.	n.a.	n.a.	n.a.	24.9	24.9	24.9	24.9	24.9	24.9
	US-Air	n.a.	18.7	18.7	18.7	18.7	18.7	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Zucchini	CH-Lorry	n.a.	n.a.	3.9	3.9	0.6	0.6	0.6	0.6	0.6	3.9	3.9	n.a.
	ES-Lorry	0.9	0.9	0.9	0.9	n.a.	n.a.	n.a.	n.a.	n.a.	0.9	0.9	0.9
	IT-Lorry	0.7	0.7	0.7	0.7	n.a.	n.a.	n.a.	n.a.	n.a.	0.7	0.7	0.7
	MA-Lorry	1.0	1.0	1.0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.0	1.0
Zucchini TK	FR-Lorry	1.8	2.0	2.2	2.3	1.1	1.1	1.1	1.1	1.1	1.3	1.5	1.6
Zucchini TK	CH-Lorry	0.7	0.7	0.7	0.8	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7

Fig. 6 Global warming potential per kilogram of zucchini and green asparagus as an example for the creation of the season table (country codes, CH Switzerland, ES Spain, FR France, IT Italy, MA Morocco,

PE Peru, US United States). Green colours highlight products that can be ordered by the kitchen chef while red products should be avoided as far as possible in the ordering

Another interesting example is the supply of green asparagus. From July to February, green asparagus cultivated in Peru and transported by air cause a GWP of 24.9 kg CO₂-eq per kg. For the calculation of this figure, additional impacts of aircraft emissions are taken into account (Jungbluth 2013). Green asparagus cultivated in Switzerland or Spain and supplied from April to June have an average GWP of about 2 kg CO₂-eq per kg. Only about 0.5 % of the total food purchases are transported by airplane, but this small share is responsible for about 30 % of all transport-related emissions. This is another example where a small change in purchase decisions can have an important contribution to the reduction of impacts.

The cooperation with the wholesale dealer for vegetables shows that so far they often do not know about the origin and way of production in detail. Such information is also not available on the order forms or in their electronic bookkeeping systems. A system to better monitor the important factors such as type and amount of heating for greenhouses for a given vegetable in a given month shall be built up in future.

For each improvement option, measurable criteria have been set. In this case, three measurable indicators were identified: the share of fossil-heated greenhouses for the supply of fruits and vegetables, ordering according to the seasonal calendar and the share of air-transported goods. If a canteen purchases only 0.1 % of goods transported by airplane and only buys “green” products according to the seasonal calendar, it fulfils the target for best practice for these two improvement options (SV (Schweiz) AG 2013).

Business relationships have been established with vegetable growers using waste heat or renewable energy for heating their greenhouses. Other interested suppliers are asked to provide a carbon footprint study for their production patterns.

4 Discussion and follow-up

The programme ONE TWO WE was elaborated based on the results of the LCA and further collaborations. It consists of a set of 14 improvement options in four fields namely logistics,

canteen operation, food supply (purchase) and food range (see Fig. 7 and more details on the programme at SV (Schweiz); AG 2013). Targets on certain key performance indicators have been set by the SV Group for each option.

The programme can only be successful if the canteen operator collaborates with its food supplier, the customer setting general boundaries for the canteen operation and the guest choosing attractive and environmentally friendly menus.

The environmental performance of logistics shall be improved by reducing the share of air-freight. The optimisation at the canteen includes, for example, the amount of food waste and energy efficiency (cooling, lighting, cooking and ventilation). Food waste mainly increases the amount of purchased food items and thus leads to higher environmental impacts. It was not possible to quantify this impact in detail and per product group. Nevertheless, it has been seen as an improvement option to reduce e.g. avoidable waste at salad bars.

The mitigation of the environmental impacts of the food supply relies on the reduction of fruit and vegetables cultivated in heated greenhouses based on a seasonable table which calculates the carbon footprint per month of different

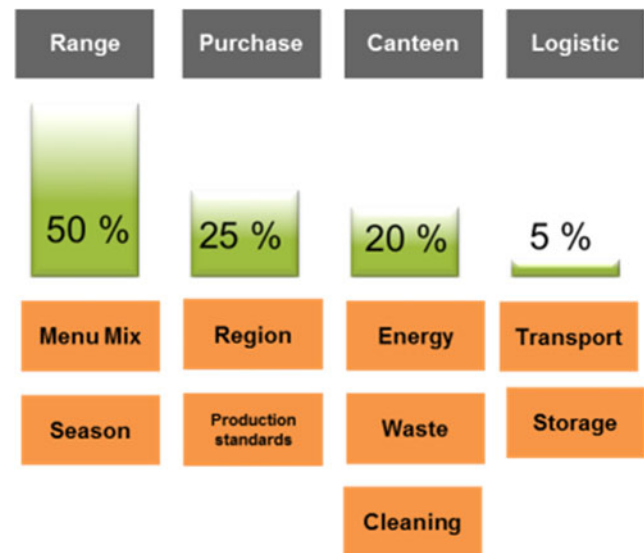


Fig. 7 The programme ONE TWO WE is structured in different steps

products. Furthermore, suppliers producing in greenhouses heated with renewable energy sources are preferred in the acquisition. Another important measure is the reduction of the average quantity of meat per meal by offering attractive vegetarian meals and meals with a lower amount of meat per serving. Therefore, an education programme has been initiated in order to teach the cooks attractive ideas for vegetarian meals that can be prepared in canteens.

The main focus of the ONE TWO WE programme is on environmental improvements. Social aspects in the supply chain are mainly covered by targets regarding the share of fair trade products to be purchased for the preparation of meals. Economic aspects are covered by targets regarding the share of Swiss products in the total portfolio. The following 14 indicators are monitored according to the targets set by the SV Group:

- Share of air-transported products
- Share of green electricity used for canteen operation
- Share of energy-efficient lighting, cooling, ventilation and cooking devices (four indicators)
- Food waste per meal
- Share of up-to-date cleaning equipment
- Share of poultry from Switzerland
- Share of vegetables from heated greenhouse
- Share of labelled products (Fairtrade, Marine Stewardship Council (MSC) for fish)
- Amount of meat per average meal
- Implementation of seasonal calendar and purchase of “green”-marked products
- Information of guests

A good communication with the guests and customers should explain the background of this programme while at the same time allowing the guest to choose from attractive menus. Furthermore, collaboration with the suppliers of food is necessary in order to get the relevant information concerning environmental aspects when ordering the food supply. Thus, it is necessary that also suppliers provide real-time information regarding air transports, origin or type of heating in greenhouses while offering the food products to the chefs in the canteens. Another part of the programme is the training of the canteens’ own staff. Thus, courses were offered to the chefs of the canteen in order to learn how to prepare attractive vegetarian meals which so far had only minor importance in the education for this occupational group. The programme ONE TWO WE thus goes beyond what a single company can do and covers the whole life cycle from agricultural production until final consumption.

The SV Group aims not to increase the costs of the menus as these are highly competitive. Some improvement options can lead to lower costs, e.g. the reduction of meat per meal. On the other side, it might be necessary to pay higher prices in order to mitigate the environmental impacts for the vegetables.

Nevertheless, organic products, which are normally more expensive, play only a minor role within this strategy.

The programme ONE TWO WE aims for a reduction of 20 % in greenhouse gas emissions in those canteens that follow all suggestions for improvements. This target should be achieved in 2015 compared to the situation in 2012. The SV Group aims to find enough canteens participating in this programme in order to reduce the total greenhouse gas emissions in 2015 by 10 % compared to the situation in 2012. The achieved reductions are documented transparently. Therefore, a simplified Excel tool has been elaborated which allows an easy calculation of greenhouse gas emissions per meal. The calculation is based on some key environmental performance indicators, and the data can be entered by the canteen operator. Thus, the initial full LCA also helped to set the baseline for monitoring the achievements of the programme.

The decision to use the global warming potential as key indicator has been taken together with the partner WWF Switzerland that established the WWF climate group. Nevertheless, it has been checked that the improvement options align also with results of a full LCA as presented in this article.

The findings of this project are only partly valid for other sub-sectors in the food industry, distribution and consumption. The investigation has only been made for a typical canteen operator which provides mainly meals for lunch. Thus, food items mainly consumed during breakfast and dinner are underestimated compared to the average overall food consumption. An important difference compared to restaurants is the very low selling of alcoholic drinks like beer and wine. These products are much more important for normal restaurants. As meals in canteens are more at the lower level of prices paid for a lunch meal, they might also not include as many exotic items as a meal taken in a high-level restaurant. Therefore, it is expected that average environmental impacts for a meal served in a restaurant are higher (own calculations with inventory data investigated by Schori 2011).

5 Conclusions

The article shows that an in-depth LCA is one of the prerequisites to develop a strategy for reducing total environmental impacts in a food company. It is not sufficient to base such a strategy on generic evaluations of the food sector as each company has a specific profile of food items purchased. Therefore, improvement options might be very different if looking at food distributors, restaurants, canteens or coffee bars.

The project also showed that it is not possible to achieve a substantial reduction of environmental impacts caused by canteens without taking other stakeholders on board. Only looking at reducing environmental impacts of the canteen’s own operation is often the starting point of an environmental management.

But, it is not sufficient as upstream and downstream emissions of bought or sold products are quite important and as they can also be influenced by the business owner. Therefore, it is necessary to have a close cooperation with the suppliers but also with the customers in order to reduce the environmental impacts.

The programme ONE TWO WE started successfully. Many customers reacted positively to the proposed changes in the provision of canteen meals. The programme was launched in October 2012 in Zürich. In 2013, the initiative ONE TWO WE was awarded with the Zurich Climate Prize 2013. Until the autumn of 2014, it was implemented in 100 restaurants. The future will show whether also the guests in the canteens support the changes.

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