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Development of a Climate Choice meal concept for restaurants based on carbon footprinting

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Abstract

Purpose Significant reductions in greenhouse gas emissions from food production and consumption can be made at the level of individual diet. Together with the food and beverage sector, consumers could play a significant role by making informed choices that benefit the environment and their own health. Communicating information on carbon footprints to consumers is challenging and should be made very simple, yet reliable. This sector is showing interest in using eco-design tools to decrease climate change impacts of their meals.

Methods A long-term concept for communicating information on carbon footprints associated with meals was developed in Finland. The criteria for a Climate Choice meal were created through stakeholder dialogue, and three restaurant operators piloted the concept in 25 restaurants. In addition to climate change impacts, possibilities to include other sustainability criteria were reviewed. The concept was based on simplified carbon footprinting of raw material production and processing of ingredients for 105 commonly selected lunches. The carbon footprint calculations allowed the development of the Climate Choice meal concept, its criteria, and piloting the concept. Based on experiences from restaurants and consumers from the pilot phase, final criteria were developed.

Results and discussion The Climate Choice meal concept was created using two alternative climate criteria: one for immediate implementation and another for future implementation, in cases where carbon footprinting is feasible for restaurants. The criteria for immediate implementation include a list of mainly plant-based ingredients with low carbon footprint. Regarding future criteria, it should be made easy enough for restaurants to estimate the carbon footprints of their meals, allowing labeling of meals when their carbon footprints are at least 25 % smaller than for an average meal. In addition to the two climate criteria, Climate Choice meals need to follow Finnish public catering nutritional recommendations, taking into account that fish species on the Red List of WWF's Finnish seafood guide are prohibited.

Conclusions To promote climate-friendly eating, a long-term concept rather than a short-term campaign is needed. There is interest among consumers and restaurants for information on food carbon footprints and sustainability. Lunch is regarded as a good opportunity for consumers to learn about climate-friendly eating. The main challenges are to produce sufficiently reliable background data and to raise consumer and the food and beverage sector interest and understanding of carbon footprints associated with food.

1 Introduction

Twenty to thirty percent of climate change impacts, i.e., greenhouse gas emissions, associated with consumption come from food production and its consumption (Tukker and Jansen 2006; Seppälä et al. 2011), yet consumers do have neither enough information nor sufficient understanding to make climate-friendly choices about the food that they eat (Hartikainen et al. 2014). Significant reductions in greenhouse gas emissions can be made at the individual diet level

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(Carlsson-Kanyama and Gonzalez 2009; Saarinen et al. 2012). Not all the responsibility can be placed on consumers, but they could play a significant role by making informed choices that benefit the environment and their own health.

According to results of a Finnish consumer study, consumers do not perceive food consumption as being a significant source of environmental impacts (Hartikainen et al. 2014). Consumers also struggle to understand carbon footprints and what climate-friendly food consumption is (Gadema and Oglethorpe 2011; Upham et al. 2011; Spaargaren et al. 2013; Hartikainen et al. 2014; Tan et al. 2014), even though large scientific studies on food systems and climate change impacts have been conducted at various levels (Tukker and Jansen 2006; Carlsson-Kanyama and Gonzalez 2009; Dalgaard et al. 2011; Virtanen et al. 2011; Berners-Lee et al. 2012).

Environmental benefits from carbon labeling are likely to occur both upstream, by enabling the food and beverage sector to eco-design its meals, and downstream, by giving consumers the possibility to choose climate-friendly options. In addition, Spaargaren et al. (2013) suggested that the indirect impacts of labeling to promote consumer learning might be even larger than the direct impacts. Also, according to a consumer focus group study by Upham et al. (2011), consumers might still be unwilling to use carbon labels in actual product selection.

Different types of campaigns in restaurants and canteens have been used to raise general public awareness of environmental and ethical aspects of food consumption (see, e.g., Meatless Monday 2014; Barilla 2014). Typically, campaigns have addressed environmental and nutritional aspects very generally, most commonly by promoting consumption of vegetables or vegetarian meals. It seems that climate change impacts have not usually been the focus of these campaigns in restaurants.

In Denmark, the Green Commerce Department of Copenhagen City Council (2014) created a concept termed *Klima+* or *Climate+* for restaurants. They formulated a set of criteria to be applied at the level of an entire restaurant and at the level of a single menu. The criteria of the *Climate+ Menu* address the issue by listing general advice, e.g., to reduce the use of meat, increase the use of vegetables, and minimize food waste. They also promote other issues, not solely climate change impact, such as organic and local products and products that are less intensively processed (Copenhagen City Council 2014).

Consumer interest in carbon and other environmental labels in products has been studied in many countries (Vanclay et al. 2010; Hartikainen et al. 2014; Spaargaren et al. 2013; Tan et al 2014). Among other things, key issues include lack of knowledge by consumers, challenges in providing reliable carbon footprint data, and limitations to only a single environmental impact as the main challenges limiting the use of carbon labels. Scientific literature, in particular from restaurant settings, seems to be lacking, with the only exceptions being Gössling et al. (2011), Spaargaren et al. (2013), and Jungbluth et al. (2014).

Among the few restaurant studies, only Spaargaren et al. (2013) reported carefully the lessons learned from creating a carbon labeling scheme in a canteen environment. They established that even when the consumers were likely to be more environmentally aware than average consumers, they preferred general communication measures. Thus, it is crucial that communication of climate change impacts, i.e., carbon footprints for food, to consumers is made very simple yet reliable.

Gössling et al. (2011) studied how food-related greenhouse gas emissions could be reduced in the tourism sector and created a list of recommendations. They, as well as Tan et al. (2014), concluded that there is a need to produce reliable carbon footprint data.

The objectives of this study are to present the development process of the Climate Choice meal concept and to evaluate future possibilities and challenges of communicating climate change impacts to consumers in a restaurant setting. The concept was developed to raise consumer awareness about carbon footprints associated with food in restaurants by offering a climate-friendly meal alternative among other options.

Climate change has been identified as one of the most serious problems facing humankind that needs to be addressed in the near future (Rockstrom et al. 2009; Foley et al. 2011). Global warming potential is one of the best established and most common impact categories in life cycle assessment (LCA). While planning a concept aimed at raising awareness about environmental impacts of food, it was realized that most quantitative information on various environmental impacts addresses climate change impacts. Focusing on the concept of climate was seen as being both justifiable and practical, but inclusion of other impact categories was also assessed.

The aim was to develop a concept that differs from other campaigns on climate-friendly eating in that it is planned to be long term and is based on quantitative assessment of climate change impacts, i.e., carbon footprinting. Also, a maximum limit of carbon footprint for promoted meal is defined, and also, other sustainability and nutritional criteria were considered. Efforts were made to make sure that all the criteria would be acceptable to all stakeholders in the Finnish food sector.

2 Methods

2.1 Defining criteria for Climate Choice meals through stakeholder dialogue

Even though carbon footprint was chosen as the focus of the concept, it was recognized that promotion of non-sustainable choices in other impact categories should be avoided.

Therefore, readily available tools and criteria for assessing nutrition and other sustainability issues were investigated. This mainly included issues of social responsibility, such as animal welfare, working conditions, product safety, and environmental impacts (eutrophication and acidification). The importance of including different impacts in the concept was considered. It was also discussed whether unsustainable food ingredients, food production systems and technologies, etc. should be included in the concept.

Consensus for inclusion of other sustainability criteria and maximum carbon footprint of a Climate Choice meal were set through stakeholder dialogue with restaurants, government representatives, health organizations, environmental organizations, etc. Reviews were made of campaigns similar to the developed concept and of the possibilities to include other sustainability criteria. Several rounds of comments between researchers and the stakeholders were addressed in reviewing the criteria.

After the learning experiences were gathered during the weeks of the pilot program, the final criteria for the concept were defined in collaboration with stakeholders and discussed further in a seminar held in autumn 2014 with the food and beverage sector and its stakeholders (see 3.4).

2.2 Quantitative assessment of carbon footprints of lunches

A simplified carbon footprint assessment was conducted based on researchers' previous LCA studies, literature reviews, and new scientific literature. From the beginning, it was clear that greenhouse gas emissions for all ingredients from different production systems and countries, as used by the restaurants involved, could not be assessed by detailed product and supply chain-specific LCA. That would have required more resources than what is available for this project, and such resources would not be required in the future from restaurants applying such concepts.

The aim of the simplified assessment was to understand the magnitude of emissions of different meals and the contribution of different ingredients to the total climate change impacts of meals. At this point, this estimation would only allow development of the Climate Choice meal concept but not the actual implementation and carbon footprinting required for the final concept.

There was no intention of conducting a detailed assessment, but some methodological aspects, such as system boundaries, land use changes, etc., were looked into where they were considered important for the goal of the project. While there are several publications on food item carbon footprints, the methodologies used and other study settings (e.g., representativeness of a sample) vary greatly among publications. The variation creates problems for making comparisons and harmonization between different studies. The lack of

comparability further creates challenges and limitations for using data from published literature for communicating carbon footprints for food to consumers.

Considering the limitations of the data, the best available representative data from previous LCA projects and literature were used. Finnish data were available for many of the most commonly used ingredients in Finnish restaurants and for the most common ingredients with high carbon footprints, i.e., animal products.

Carbon footprints for raw material production and processing of 105 common lunches from three types of restaurant were estimated, comprising around 200 different ingredients. System boundaries could not be harmonized completely between different products. As the major share of a meal's climate change impact comes from primary production of ingredients, and due to limited resources of the project, mainly emissions readily available in the LCA literature, such as those from the agricultural stage and input production (energy, fertilizers, etc.), were included in the system boundaries.

Emissions for processing, packaging, transportation, and storage were usually included in the system boundaries, but no systematic efforts were made to verify them. Emissions were calculated based on recipes from restaurants, and therefore, cooking losses in meal preparation were automatically included. When restaurants used ready-made food products, such as fish fingers, their ingredients were looked into to assess the actual raw material use. In addition, it was known that emissions from meal preparation in restaurants would be significant, but the restaurants involved did not record enough information on their energy consumption, which could have been allocated to different kinds of meals. Handling of waste was not included in the assessment. A general overview of idealized system boundaries is presented in Fig. 1.

The estimation was not made according to actual meal sizes in different restaurants but made to allow comparisons of different meals from different restaurants; estimations were in line with the standardized meal composition as defined in the Finnish public catering nutritional recommendations (Ministry of Social Affairs and Heath 2010). Therefore, the functional unit is a single meal consisting of a main course, a side dish (except for casserole and soups), 200 g of side salad, 170 ml of milk, 30 g of bread (60 g when the main course is soup or salad), and 5 g of margarine (10 g when the main course is soup or salad). The serving sizes of the various main courses and side dishes are shown in Table 1.

2.3 Piloting the Climate Choice meal concept

To ensure practicability and to pilot the developed concept, three types of restaurants were included in the process. All restaurants offered a buffet lunch with three to six options per day, including at least one vegetarian option. Two of the

Fig. 1 General overview of idealized system boundaries for developing the Climate Choice meal concept

25 restaurants were office canteens, on the premises of an industrial company, and one a canteen in an environmental institute. One restaurant was a public canteen mainly for office workers and students, and this was the only one outside the main metropolitan area of Helsinki. The three were allied with the leading Nordic catering company. One restaurant was owned by a catering school and is used to train students. The remaining 21 restaurants belonged to a chain of canteens for students and offered government-subsidized lunches.

Based on the initial assessment, most of the restaurants needed to make changes in their recipes to lower carbon footprints to have at least one Climate Choice or Better Climate Choice meal available on their menus every day during the pilot week. Restaurants planned their own communications for the pilot weeks based on a common layout and logo created in the project (see Fig. 2). After the pilot stage, restaurant staff gave valuable feedback on the practicality of the concept.

Simple, label-based communication was considered the best way to communicate the issue to most consumers. Most of the restaurants differentiated Climate Choice meals from other meals by labeling the dishes in the buffet. One restaurant marked Climate Choice meals solely on the menu available at the beginning of the buffet. In addition, some restaurants informed about the Climate Choice week on tables where clients ate and in posters around the restaurant.

The aim of the consumer studies was to have information on consumers' first impressions of the concept: if they liked the idea or not, why they chose a Climate Choice meal if they did, and whether they would choose it again. Consumer studies were conducted in two simple ways. A one-page paper survey was available to be filled in voluntarily in restaurants on Thursdays or Fridays, after 4 or 5 days of the pilot phase. In addition, on Wednesday and Thursday of the pilot week, interviews of randomly chosen customers were carried out in four different restaurants. In all restaurants, a short electronic survey was conducted also among restaurant staff about their experiences related to the concept and the pilot week.

3 Results

3.1 Results from stakeholder dialogue for criteria development

Carbon footprint was chosen as the key impact category for consideration already during the planning phase of the project, but other impact categories were considered that could be included in the concept. Focusing on carbon footprints was widely acknowledged as being useful. Utilization of the

Table 1 The serving sizes of various main courses

	Weight (g)
Soup	400
Casserole	300
Meat sauce or equivalent	150
Meatballs, patties, and similar + sauce	120+50
Meatballs, patties, and similar without sauce	170
Side dish with all others than soup or casserole	Potatoes 150
	Rice 100
	Pasta 120

Fig. 2 Logos for Climate Choice (*one leaf*) and Better Climate Choice (*three leaves*) meals

readily available WWF Finnish seafood guide and Finnish public catering nutritional recommendations was accepted by the food and beverage sector and its stakeholders. Fish on the WWF Red List were prohibited, and the meals had to fulfill nutritional recommendations. The recommendations defined minimum fiber intake per meal and maximum total and saturated fat and salt intake per meal.

Regarding other environmental impacts of food ingredients, such as eutrophication and acidification, we found that there were insufficient data in the literature to require their quantitative assessment in the concept. While looking at other sustainability criteria, it was also noted that there were insufficient easily available, science-based criteria for many aspects of sustainability, such as animal welfare, working conditions, etc. It was also noted that some of the impact categories conflicted, which was a challenge, in particular in the case with the chosen key factor, climate change impact. For example, animal welfare often conflicted with climate change impact. Therefore, except for fish on the WWF Red List seafood guide, we did not find enough information to make justified exclusions of specific ingredients based on other environmental or sustainability criteria.

Different stakeholders exhibited differing preferences on the ambitiousness of the concept. The restaurant and food industries were much more careful in setting the greenhouse gas emission reduction target than were NGOs, which were more courageous. Ultimately, two levels for labeling, Climate Choice (standard) and Better Climate Choice, were suggested for the pilot phase. Two levels of labeling were considered more complex for consumers but were thought to be crucial to the concept, being both credible and ambitious enough in the eyes of environmentally aware consumers while also being of general interest (for people wanting to eat at least some animal products). The limits for the meals were defined for the meal components for which restaurants could make significant changes to recipes and thus to carbon footprints: main course, possible side dish (pasta, rice, potatoes, etc.), and side salad.

The limit for piloting the Climate Choice meal was defined as 15 % emission reduction compared with an average meal, which means that it could still include some ingredients of animal origin, and for the Better Climate Choice meal, 30 % less emissions than average. This means that the maximum climate change impact of a Climate Choice meal was 0.8 kg CO_2-eq. per main course, side dish, and side salad and for a Better Climate Choice 0.65 kg CO_2-eq. per main course, side dish, and side salad, based on the quantitative assessment of climate change impact of lunches (see 3.2). Thus, in the pilot phase, the Better Climate Choice meals were almost all vegetarian, except for some herring, saithe, and salmon dishes. Climate Choice meals were also mainly vegetarian, with some fish dishes and a few pork or broiler dishes. Generally speaking, meat dishes needed to have a side salad with very low climate change impact and less meat and more vegetables compared with average meat dishes to be a Climate Choice.

After the experiences of the pilot weeks, the final criteria for the Climate Choice concept were defined together with stakeholders (see 3.4).

3.2 Results of quantitative assessment of carbon footprints of meals

Mainly raw material production and processing stages were included for the simplified carbon footprinting. The carbon footprints of meals ranged between 0.6 and 2.8 kg CO_2-eq. per meal, the average being 1.2 kg CO_2-eq. per meal or 0.95 kg CO_2-eq. per main course, side dish, and side salad. According to the results, the carbon footprints of main courses and side salads varied greatly. On average, a main course with side dish accounted for 45 % of the impact of a meal, a side salad almost 30 %, milk 20 %, and bread less than 10 %. By composing a meal differently, or even just changing the recipe of the main dish or side salad, climate change impact could be decreased significantly.

Vegetarian meals usually had significantly lower emissions than average meals. Vegetable soups and curries and tofu, bean, and lentil dishes had the lowest emissions. For example, two vegan soups had 75 % lower emissions than an average main dish. Meanwhile, creamy soups and lasagna with cheese had impacts around the average of all meals. The highest emissions of vegetarian dishes had Greek and goat cheese salads because, in addition to cheese, they consisted of vegetables grown in greenhouses during the winter season. Thus, the climate change impacts of meals that included a lot of cheese, cream, or northern European vegetables grown in greenhouses during the winter had impacts above the average. Fish main courses generally had low impacts, except for a few salmon dishes. Whether a fish-based meal was below or above the average depended greatly on the impacts of the side salad. The emissions associated with meat dishes were at or above the average. Moderate meat consumption as a part of a well-composed meal can keep the impact at the average level. For example, a pork stew with a side salad, which has low climate change impact, can be below the average. Examples of results are shown in Fig. 3.

3.3 Results of piloting the Climate Choice meal concept

Motivation of restaurant staff to ensure survey responses from consumers was very important, and in this project, it was successful in some restaurants but not in all. Therefore, not as many responses were received as was hoped for. In total, 307 paper responses were received, which was a rather small sample considering how many customers restaurants had. It should also be reminded that the sample was skewed, as the responses were based on voluntary participation.

Among the respondents, the most important criteria for choosing a meal in general were the attractiveness and
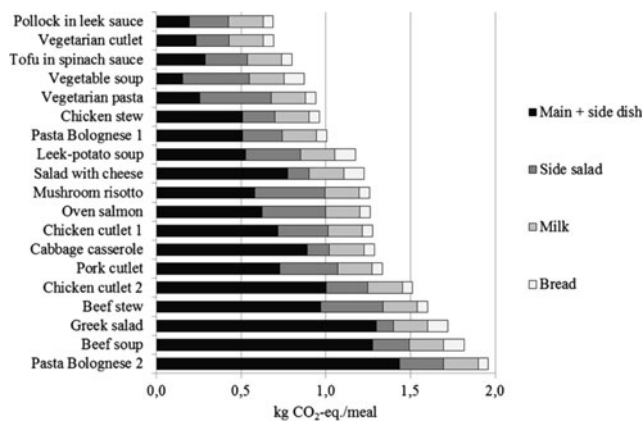
Fig. 3 Examples of carbon footprints for lunches (mainly raw material production and processing, not meal preparation)

expected taste of the dish. Consumers, who chose a Climate Choice meal, stated that they chose it because of the expected healthiness of the meal more often than for environmental reasons. Forty percent of the 307 respondents in the paper survey stated that they would choose a Climate Choice meal at least often, if not always. Fifty-four percent stated that they would choose it at least every now and then.

Based on the 33 in-depth interviews, only around half of the customers seemed to notice piloting of the Climate Choice meal. Information given on the tables where people were eating was noticed best among interviewees. Labels that were placed on the buffet, where people chose their main course and which was thought to be the most noticeable and important site for communication, were actually noticed the least. A few customers stated that they were too hungry and busy to notice any information given when they were queuing or at the buffet. Some customers noticed the labels on the menus before the buffet. Only a few customers noticed that there were two levels of Climate Choice meals. Interviewed customers also automatically thought that all vegetarian meals would be climate friendly: Many of them that had chosen the vegetarian meal thought that they would have opted for the Climate Choice, even if that was not the case for vegetarian dishes with lots of cream, cheese, or greenhouse-grown vegetables.

It seemed that during a short campaign, as represented by this pilot phase, people who reacted quickly to communication and chose the climate-friendly meal did so because they had already thought about the environment when making decisions on consumption. Few customers admitted that the idea of thinking about climate change impacts during lunch was new to them, even though they might have thought about it when grocery shopping. Consumers who had noticed the campaign, and were probably more environmentally aware, wanted more information on why specific meals were Climate Choices. Even if the sales of Climate Choice meals

did not increase compared with a standard week, the response was positive: The respondents appreciated that the information given was directly associated with their meal choices. They thought that it gave them information in a very simple way and which they could use to make better choices.

According to the survey conducted among the restaurant staff, they seemed to feel very positive about the new concept. Extra work was needed mainly from the staff that planned the new recipes, but canteen staff did not seem to mind the little extra work as most were interested in and felt engaged with the concept.

3.4 Results of concept development

It was recognized that the climate friendliness of a meal can be accurately evaluated through LCA. The LCA approach can point out differences in meals even when it is only the amounts of different ingredients used that change or the origin or production type of ingredients. Creating a list of climate-friendly ingredients proved to be challenging and less reliable for achieving significant emission reductions. In the development process, it was decided that Climate Choice meals should be determined by assessing the carbon footprints of the production of ingredients used in meals. Climate change impact assessment allows restaurants to provide versatile meals, including limited amounts of ingredients of animal origin as there is not a list of allowed and disallowed ingredients. Restaurants can also reduce carbon footprints of all their meals for which impact assessment is made, not only Climate Choice meals. Restaurants seemed to be very keen to design their recipes to decrease their carbon footprints.

A maximum level of climate change impact was defined for Climate Choice meals as originally planned. Because during the pilot phase it was acknowledged that the two levels of Climate Choice, ordinary and better, were not noticed, only one level was used. Finally, it was decided that a Climate Choice meal's climate change impact should be at least 25 % less than average meals' assessed in the project (0.95 kg CO_2-eq.).

Even though it was noted that Climate Choice meals should be determined by carbon footprinting, it was admitted that assessing meals' impacts is still practically impossible for restaurants in the absence of a databank or set of LCA-related data to facilitate the assessment. The estimations done in this project would only allow the development of the Climate Choice meal concept, but not the carbon footprinting, which would be needed if the quantitative criterion of the maximum limit was applied. Among the stakeholders, there was substantial interest to make the concept applicable immediately after the project, and therefore, also, use of very simplified criteria based on those ingredients which have the lowest carbon footprint were developed. These were seen as secondary criteria,

to be used only before carbon footprinting is possible in restaurants.

The purely qualitative criteria based on ingredients with the lowest climate change impact differ between main dishes and side salads and for side dishes. For main dishes and side salads, all plant-based ingredients are allowed with few exceptions. Rice is not allowed due to its higher climate change impact compared with other carbohydrate sources. Vegetables grown in greenhouses are also allowed only from June to August or from Mediterranean or other countries where they are grown without significant heating or lightning year round or from greenhouses using renewable energy. Also, milk, sour milk, and yogurt are allowed, but because of nutritional recommendations, only as non-fat varieties. Also, fishes with the lowest climate change impact, such as saithe, roach, mackerel, perch, and herring, are allowed when they are not on the Red List of WWF's Finnish seafood guide. In side dishes, the concept allows for potatoes and other root vegetables and barley, oat, rye, and wheat.

In addition to either of the climate criteria, the meals needed to fulfill the Finnish public catering nutritional recommendations, and no fish from the Red List of WWF's seafood guides are allowed. Until the concept has become somewhat familiar to consumers, one level of criteria and one logo will be used for meals that fulfill all criteria. It is recommended that different components of the meal (main dish, side dish, and side salad) will be marked with the concept's logo on menus and by the buffet. Additional communication on climate-friendly eating is also recommended, e.g., at tables.

At the final seminar, the food and beverage sector and its stakeholders agreed that simplified, purely qualitative criteria be useful before carbon footprinting and application of final criteria. Communicating climate change impacts of meals is considered challenging but very important. It was emphasized that communication is the responsibility not only of the food and beverage sector but also of society as a whole, i.e., schools, teachers, ministries, etc.

4 Discussion

4.1 Possibilities and challenges in consumer communication

Several studies (Berry et al. 2008; White et al. 2009; Upham et al. 2011; Tan et al. 2014) analyzed the possibilities and challenges associated with carbon labels on products. Many of the challenges seem to be similar in restaurant settings, such as lack of consumer understanding, routines and lack of time, and attitude-behavior gaps, but more research in restaurant settings is needed.

In this study, customers gave positive responses to climate labeling in a restaurant setting. Also, Jungbluth et al. (2014) reported initial positive response by Swiss canteen customers and Spaargaren et al. (2013) positive responses among consumers of a university canteen. The results are in line with positive consumer response toward product labeling (Beattie and Sale 2009; European Commission 2009; Hartikainen et al. 2014; Tan et al. 2014), but for now, it is too early to ensure that the positive response will be reflected in behavioral change. In Spaargaren et al. (2013), some indications of change were recorded, but more research is needed.

The struggle experienced by consumers to understand climate change impacts and whether good stated interest will affect actual behavior has been discussed in many studies (Gadema and Oglethorpe 2011; Hartikainen et al. 2013). As observed also in Spaargaren et al. (2013), changes in customer behavior seem to require appreciation of a long-term concept with adequate information in restaurants and an increase in consumer understanding of climate change impacts of food. Also, Jungbluth et al. (2014) called for good communication of background information in canteen settings.

Many customers seemed to value Climate Choice meals for their healthfulness. In fact, de Boer et al. (2013) specifically argued that reductions in meat consumption should not be justified to consumers using arguments connected with climate change mitigation only but rather with multiple values such as health or a broad range of environmental values. Nutrition was a starting point for restaurants designing Climate Choice meals in the project, but nutritional issues could have been given more emphasis regarding communication. In the future, the value of simultaneous communication of health and climate change impacts should be studied in more detail.

There are challenges in communicating carbon footprints in the food and beverage sector, but as the number of people having meals outside home daily is large and as people are likely to be open to new information in, e.g., canteens, it has the potential to be an efficient way to inform consumers. Consumers have stated in this and previous studies that information on carbon footprints could influence their buying decisions when alternatives are otherwise equal (Hartikainen et al. 2014). Therefore, as concluded also in the study of Jungbluth et al. (2014), climate-friendly meals have to be made as attractive as conventional meals if they do not contain meat. Other criteria such as taste, attractiveness of the dish, and price are still at the top of the list of purchasing criteria.

4.2 Possibilities and challenges of carbon footprinting in the hospitality sector

This study supports the discussion of Spaargaren et al. (2013) that environmental benefits arising from concepts promoting climate-friendly eating, such as labels, can be achieved in two ways: via selection of meals associated with lower emissions by consumers, as initially thought, or via reducing emissions

upstream by restaurants. Still, Upham et al. (2011) argue that the benefits of carbon labeling of products are likely to be incurred upstream via manufacturers rather than via consumers, and indeed, restaurants involved in this study showed broad interest in eco-designed meals, and their interest is very likely to result in a decrease in climate change impacts immediately when eco-design of recipes is implemented.

Based on the Finnish experiences, we argue that there are several reasons why restaurant concepts promoting climate-friendly eating should be based on carbon footprinting in the future. It would enable restaurants to assess carbon footprints for all their meals, decrease their climate change impact, and label Climate Choice meals in a consistent and accurate way. However, to require carbon footprinting in a concept like Climate Choice, development of sufficient comparable and reliable databases for carbon footprints is needed. The need for better data was raised also by Gössling et al. (2011).

To ease the work of the food and beverage sector, databases for carbon footprints should be integrated with restaurants' existing IT systems, which can already assess nutritional levels of meals. Restaurants could use such programs as simple eco-design tools for meals and could verify climate friendliness with them. Carbon footprinting would also enable reliable limited use of ingredients of animal origin, which could make meals more attractive to many consumers.

As such, a databank does not make carbon footprinting automatically easy for all restaurants. Restaurants would still need to find out the origin of their ingredients or, in certain cases like beef, know the production system from which raw material comes from (combined milk and meat production or beef production).

In this work, only an approximate climate change impact assessment of ingredients was made, and it is apparent that creating more detailed, comprehensive, and harmonized carbon footprint databases based on results of LCA is challenging and requires further research. Some secondary data can be collected with rather limited resources from the LCA literature and databases, but validating, harmonizing, and reporting data and ensuring the quality of the data and filling data gaps require multiple efforts. The work that is being done for producing the World Food Database in an intensive 3-year project demonstrates those challenges (Peano et al. 2014).

Moreover, Peano et al. (2014) emphasized the need to develop detailed, well documented, and reliable data for increasing the quality of LCAs. Creating a database requires harmonization of methodologies used in different LCA studies, including system boundaries, and also of practical calculation procedures and consideration of regional production circumstances. Many databank and climate change impact communication initiatives have started with developing a common methodology for LCAs, such as the World Food Database and the French Grenelle environmental product labeling initiative (AFNOR 2014; Peano et al. 2014).

Fifty percent of the carbon footprints of lunches (raw material production and processing) assessed in this study ranged between 0.94 and 1.37 kg CO_2-eq. per meal. The range shows that the definition of whether a meal is climate friendly or not is very sensitive to small changes in the ingredients used and amounts of ingredients. Thus, data quality, representativeness, uncertainties, and variability among carbon footprints or LCA results arising from different ingredients should be assessed to allow reliable differentiation between climate friendly and other meals. Additionally, reliable estimates to convert results of LCA results into edible and cooked foods need to be made carefully to include wasted shares of raw material or raw material yields and weight losses in cooking.

Creating a reliable database requires more research, but other options have their limitations. In the absence of a reliable database, simplified lists of climate-friendly ingredients can be used by the food and beverage sector, and such lists have already been used (Copenhagen City Council 2014). Based on the experiences from carbon footprinting in this pilot program, it was attempted to create a rather strict list compared with those used in previous campaigns to ensure significant emission reduction. Still, the list is by no means exhaustive and cannot guarantee absolute emission reductions in all cases. In the end, to make a difference between a climate-friendly meal and others is very sensitive, as evidenced by the small range of climate change impacts based on the meals discussed.

The use of qualitative criteria, i.e., lists of climate-friendly ingredients, should be limited until more reliable carbon footprinting for restaurants becomes possible. The use also restricts design of recipes, and if significant emission reductions are expected, that practically leads to restricting the options for plant-based ingredients. As reported in several studies (Latvala et al. 2012; Schösler et al. 2012; de Boer et al. 2013), there are difficulties in making consumers interested in reducing meat consumption. Offering near-vegan meals can be expected to reduce the interest of consumers in this concept and also that of restaurants to implement such a policy.

The lack of harmonization and incompleteness of system boundaries are the major drawbacks in the simplified carbon footprint of the present study, in particular, systematic inclusion of processing and raw material and processing losses and exclusion of meal preparation. According to Jungbluth et al. (2014), meal preparation can account for up to 25 % of greenhouse gas emissions associated with an average meal. As processing losses can also be significant and directly cause increases in emissions during raw material production, it appears that the impacts of both meal preparation and losses are significant at the meal level and should be given emphasis in the future.

Developing climate concepts further, inclusion of other dimensions of sustainability (such as animal welfare, water footprint, etc.) should be studied. It will though create challenges for communication of different impacts to consumers and

place additional pressure on resources needed to create a reliable database.

5 Conclusions

Consumers show positive interest in receiving information on climate change impacts associated with food consumption. Climate change impacts of food consumption could be decreased by enabling the food and beverage sector to eco-design its meals and by allowing consumers to choose climate-friendly options. The pilot phase confirmed that promoting climate-friendly eating in a campaign is insufficient; a long-term approach is needed.

There is interest in the food and beverage sector to decrease climate change impacts of meals upstream and to inform consumers about climate-friendly options. To enable simple and reliable carbon footprinting of meals, a transparent database of climate change impacts of food needs to be created and integrated with restaurants' current IT systems. Carbon footprinting allows design of versatile meals, including small amounts of ingredients of animal origin that are more attractive than vegan meals for many consumers. Development of a sufficiently reliable database of LCA results needs further research and should be given enough attention before restaurant purchases are guided by the information.

The interest of consumers and the food and beverage sector in understanding carbon footprints associated with food should be promoted. Offering information together with lunches is challenging but if successful could be a very successful way to communicate to consumers.

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