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FUTURE OF THE CONSUMER SOCIETY

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ENVIRONMENTAL IMPACTS OF A LUNCH PLATE – CHALLENGES IN INTERPRETING THE LCA RESULTS

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ABSTRACT – The challenges of the project were to reveal and interpret complex and contrasting environmental issues associated with food by consumers, in order to build up more comprehensive understanding on LCA results as measures of sustainability.

This approach was linked to the specific example of lunch plates. Expertise from various scientific fields was used to identify the key environmental issues; food chain stakeholders to provide appropriate environmental data for LCA, consumer researchers to link that with the food consumption framework, and teaching experts to introduce pedagogic aspects into the lunch plate presentation.

Regarding differences in the environmental impacts, animal-based food versus vegetable food was assumed to represent a basic contrasting alternative in LCA results for a lunch plate. Other aspects dealt with included domestic versus imported food, home cooking versus ready-to-eat products and lunchroom kitchen products, seasonal diet versus non-seasonal diet, and cultivated versus wild raw materials.

The basic issue arising from the investigation is that lunch is a nutritional whole, for which changeability of components is restricted, and changes of components are environmentally sensitive. We assessed the functional components of whole food systems and measured combinations of single LCA impacts. In such a context, environmental contrasts should be sufficiently generic to concretize key impacts, and not be confounded by missing data or variability of practices. On the other hand, one can claim that only process-based (i.e. trademark based) LCA data are valid for every-day choices that consumers make in the markets. We already know that for a comprehensive view, hybridizing LCA with the input-output approach is needed. Failures and successes in the interpretation of the LCA impacts are presented.

The project was entitled 'Environmental impacts arising from consumer choice among daily foodstuffs – and associated communication', funded by the Ministry of the Environment and Food Enterprises.

INTRODUCTION AND BACKGROUND

The role of food production-consumption processes as a source of environmental impacts ranges from 20–30%[1]. In addition to the extent of the impact, the frequency of decision-making concerning food is high; we make a food choice every day whereas it is perhaps only once a month that we take a flight or a little more frequently purchase electronics.

"The Consumer is king" is a common slogan. Food is, however, the most regulated area of the economy, and in Europe and many other countries, is also the most highly subsidized. Many of the environmental decisions made by society are made at the level of government, especially regarding environmental issues. Citizens make decisions through political processes as to how much of the cost of the external impact of the food chain will be represented in the price of a product. This easily creates conflict between economically rational and environmentally responsible decisions made by an individual consumer.

Social and cultural involvement in the use of natural resources was previously much stronger than today. No doubt, environmentally destructive interventions have been made in the past, such as clear felling forest, but local cultivation and fishing practices have been often based on sustainable principles that have been passed down from father to son and mother to daughter.

The issue of seasonality has been evident and has survived up to the present in the value attached to the first early potatoes and the first early strawberries. However, even these old customs have become somehow eroded as attempts are made to enhance marketing through inducing the season to arrive prematurely. Such actions can sometimes be questioned in terms of environmental impacts. Greenhouses are used for producing the first early strawberries and early plantlets, and irrigation is used to prevent frost damage. For this reason, some of the joy associated with eating such early-season produce is reduced for some present-day consumers, even though the products are reasonably priced and easily available.

Consumption of domestic products has been favoured for many different reasons. Moreover, assumptions concerning putative environmental impacts have been used to argue on behalf of a preference for domestic products. Unfortunately, in some cases, this has been done in the absence of data in support of such reasoning.

We should be able to establish a basic context and a unit for a more comprehensive approach to assessing the relationships between food consumption and environmental impacts. A substantial challenge is to assess the accumulated values associated with different categories of environmental impact as was done by the Eco-benchmark project, which produced a tool for this[2].

Individual impacts of specific food items do not necessarily provide a representative background for comparisons to be made. Papers discussing environmental impacts of various dietary patterns have been published[3, 4, 5, 6, 7, 8] but very little has been published on more general consumer behaviour in relation to an environmental approach to food production, even though the linkage between consumption, obesity and global warming has been discussed[9].

A suggestion has also been made to use a quality corrected functional unit (QCFU) [10]. In principle the QCFU accounts for all the nutritional values of food. This method has been outlined in the scientific literature, but does not, at least yet, meet with widespread international approval.

MATERIAL AND METHODS

The impacts of food portion components were assessed through the food chain. ISO 14040 and 14044 standards represented the sources of general principles and the framework for LCA applications. The developmental framework for the assessments is described in a methodological review article[11]. Specific methods for LCA, with results of environmental impacts for separate food items, will be published separately.

In this project, a standard nutritional portion for a lunch plate was regarded as a functional unit for calculating the environmental impactsv. Thus the nutritional function of eating began from a firm starting point. The lunch plate model includes the principle of dividing the plate into three parts; half of the plate comprises vegetables, one quarter the protein source and the remaining quarter comprises the carbohydrate source. The plate is completed with a portion of bread and milk. The composition of the dishes took into account the intake of energy (740 cal), fat (25 –35%), protein (10 –20%) and carbohydrates (50 –60%) in relation to the total energy intake represented by a portion. The serving sizes for different food items were adjusted according to Finnish nutrition recommendations[12, 13] for some lunch plates, fat content tended to rise too high, but balance was restored by adjusting the amount of bread. The quantity of bread was quite high and varied among the plates (30 –100g). The amount of vegetable spread (70% fat) on the bread was 10% of the quantity of bread. For some plates the spread was left out if the ready-made salad accompanying the ready meals contained a fatty dressing. Serving size of salads was 150g for each plate.

Two example portions from the complete array of lunch plates were selected to be representative for calculation of environmental impacts. An animal-based lunch portion was a ham casserole, including: 350g of ham casserole, 150g fresh vegetable salad, 80g whole wheat bread, 8g of vegetable oil spread and 200g of fat free milk. A plant-based portion was a beetroot patty with barley: 160g beetroot patty, 170g of boiled pearl barley, 150g Chinese cabbage and blackcurrant salad, 70g of whole wheat bread, 7 g vegetable oil spread and 200g of fat-free milk. Even though bread was included in both lunch portions, its envi-

ronmental impacts were not included in the assessment. The relationships were expressed in relative values only to stress the importance of making choices.

Regarding differences in the environmental impacts, animal-based food versus vegetables was assumed to represent a basic contrasting alternative in LCA results for a lunch plate. This difference was considered inevitable.

Expertise from various scientific fields was used to identify the key environmental issues, the first of which concerned the impact on water. In Finland, agriculture is responsible for approximately 52% of nitrogen and 60% of phosphorous emissions that cause eutrophication of waters, which is a serious problem in Finland[14] due to the natural characteristics of the inland waters and the Baltic Sea.

Assessment of the impacts on global warming occurs at a time when the carbon footprint model is commonly used, global climate change representing a current, major problem.

Considering the carbon footprint or other LCA-based impact assessments, two different approaches can be taken: 1) to learn and optimize a production process and 2) to steer consumers towards sustainable choices in their food purchasing. For the first we need specific process-based data, for the second we would need representative data to allow the critical differences to be revealed, without adversely affecting consumption. The aim here is to provide consumers with appropriate data on which to make choices in their consumption patterns.

School lunches are an excellent context for experiential education on food consumption[15]; discussing food downstream of a production chain and upstream creates a new educational package. Teaching experts have been used to introduce pedagogic aspects into the lunch plate presentation. Thus the project focused on consumption throughout the school system[16], especially in connection with a ready-planned follow-up project to with assessing the potential for procurement of public catering to enhance sustainability.

Comparing home-cooking with ready-to-eat products and the lunchroom kitchen represents a new opening in LCA. The main factors involved are raw materials for meals, and energy and water use in preparation of the meals. Regarding raw materials, it is essential to consider material efficiency as well as food items from which the meals are prepared. Losses from pre-processing vegetables, for example, could be as high as 25 –70% [17] depending on the season and raw material quality. Energy use is probably a factor that differentiates results of different production places and methods because quantities and equipment differ among homes and factories. Water use is not so crucial because waste water from most of the component processes goes to operationally effective sewage plants. In the following comparisons home cooked food portions are used as an example. Home-based activities have been presented in more detail elsewhere[18].

RESULTS

When comparing the two dietary regimes, representing a plant-based lunch portion and an animal-based portion, it becomes very clear that regarding global warming potential, the animal-based portion has much higher impact that the plant based one. In this case the impact of the animal-based portion is nearly three times higher (Figure 1 a): ham casserole 1.53 kg CO_2 –eq, beetroot patty with barley 0.61 kg CO_2 –eq.

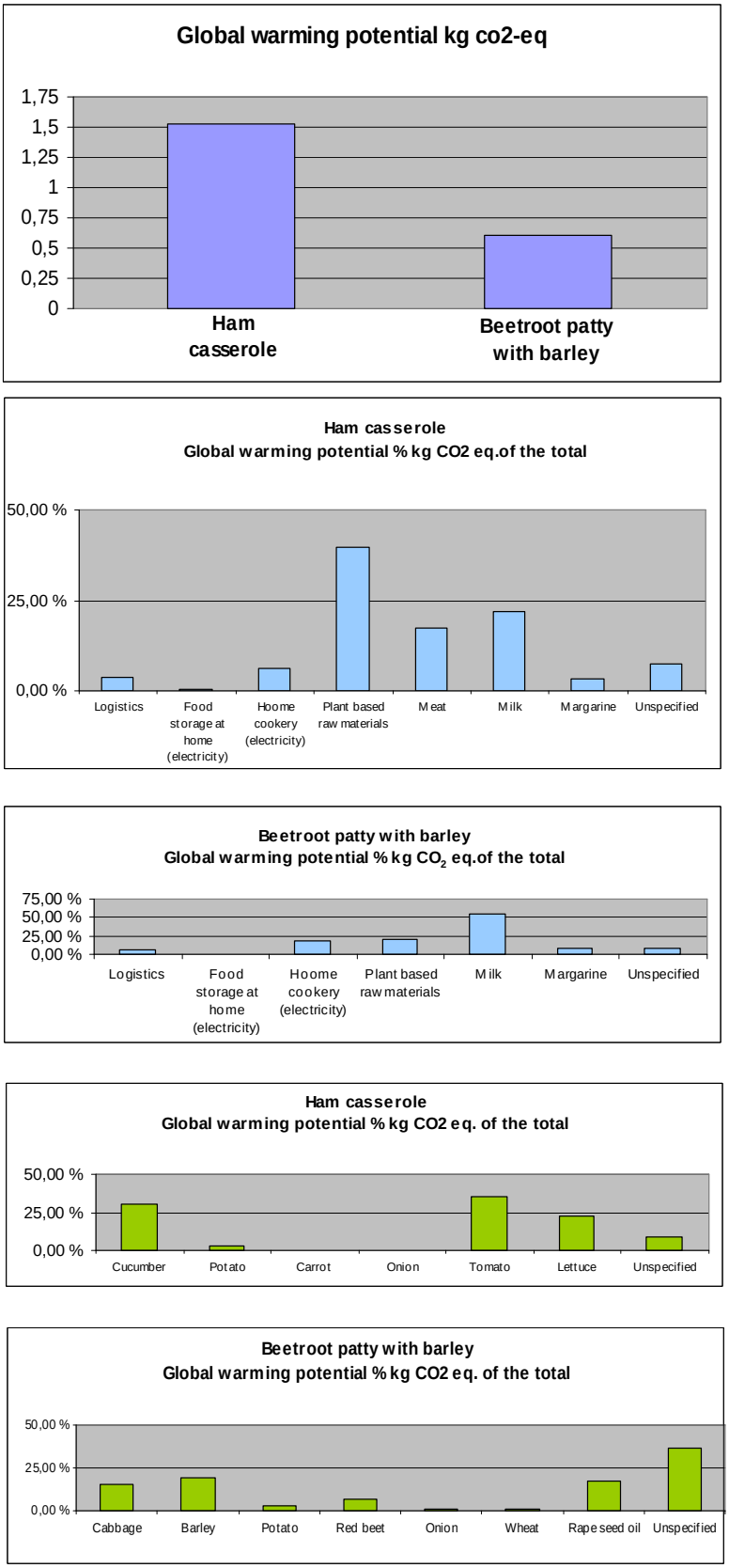

Figure 1. *Global warming potential: from above a) the two lunch portions in relation to the mean, b) proportionate profile of impacts for the ham casserole portion, c) proportionate profile of impacts for the beetroot patty portion, d) proportionate impacts attributable to the plant raw materials in the ham casserole, e) proportionate impacts attributable to the plant raw materials in the beetroot patty.*

For a portion of ham casserole the highest single impact (36% of the total impact) originates from the combined plant-based materials in the portion. Investigation of the plant raw materials reveals that a major impact (96% of the total impact from plant-based materials) comes from fresh greenhouse vegetables. In the ham casserole, meat and milk together represent about 40% of the total global warming potential.

In the plant-based portion, the global warming potential impact of milk (two decilitres per portion) is highest (over 50% of the total). For the plant-based materials, the highest impacts originate from white cabbage, barley and rapeseed oil. But these impacts are one tenth of the impacts of plant-based materials in the ham casserole portion.

The ham casserole with a fresh vegetable salad is a typical lunch portion like the beetroot patty. In this combination, not only the animal-based raw material of the portion, but also the choice of plant based material for an additional salad component causes the enhanced potential for a global climate change.

For both lunch portions, raw materials had more significant impact in terms of global warming than the food preparation activities associated with home cooking.

In terms of eutrophication, the relationship between the two lunch portion alternatives follows the same trend as for global warming; the potential eutrophication impact of an animal-based product diet is 40% higher than the impact of the beetroot patty. In absolute values: ham casserole $1.03E^{-03}$ kg PO_4-eq, beetroot patty $0.58E^{-04}$ kg PO_4-eq.

In ham casserole the highest impacts are caused by the ham and milk. Impacts of these were higher than the impact of the sum of all animal raw materials.

In the beetroot patty, milk had the highest impact in terms of eutrophication potential; it was about twice that of plant-based raw materials added together.

The eutrophication impacts of plant-based materials are similar for ham casserole and beetroot patty as those for global warming impacts. Potato has the highest impact of a single product in both portions. However, fresh greenhouse vegetables represent a major impact; about 60% of total eutrophication impacts arising from consumption of plant materials.

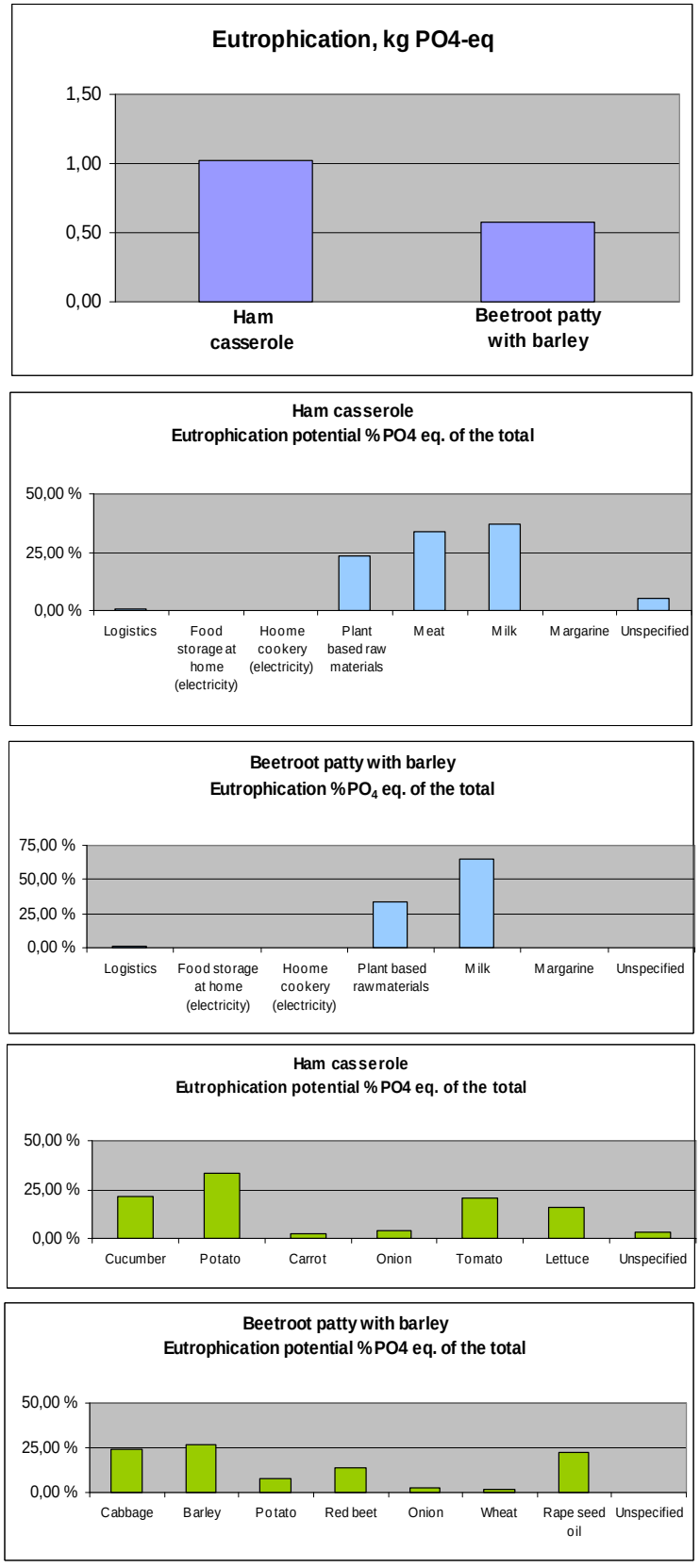

Figure 2. *Eutrophication potential: from above a) the two lunch portions in relation to the mean, b) proportionate profile of impacts for the ham casserole portion, c) proportionate profile of impacts for the beetroot patty portion, d) proportionate impacts for the plant raw materials in ham casserole, e) proportionate impacts for the plant raw materials in beetroot patty.*

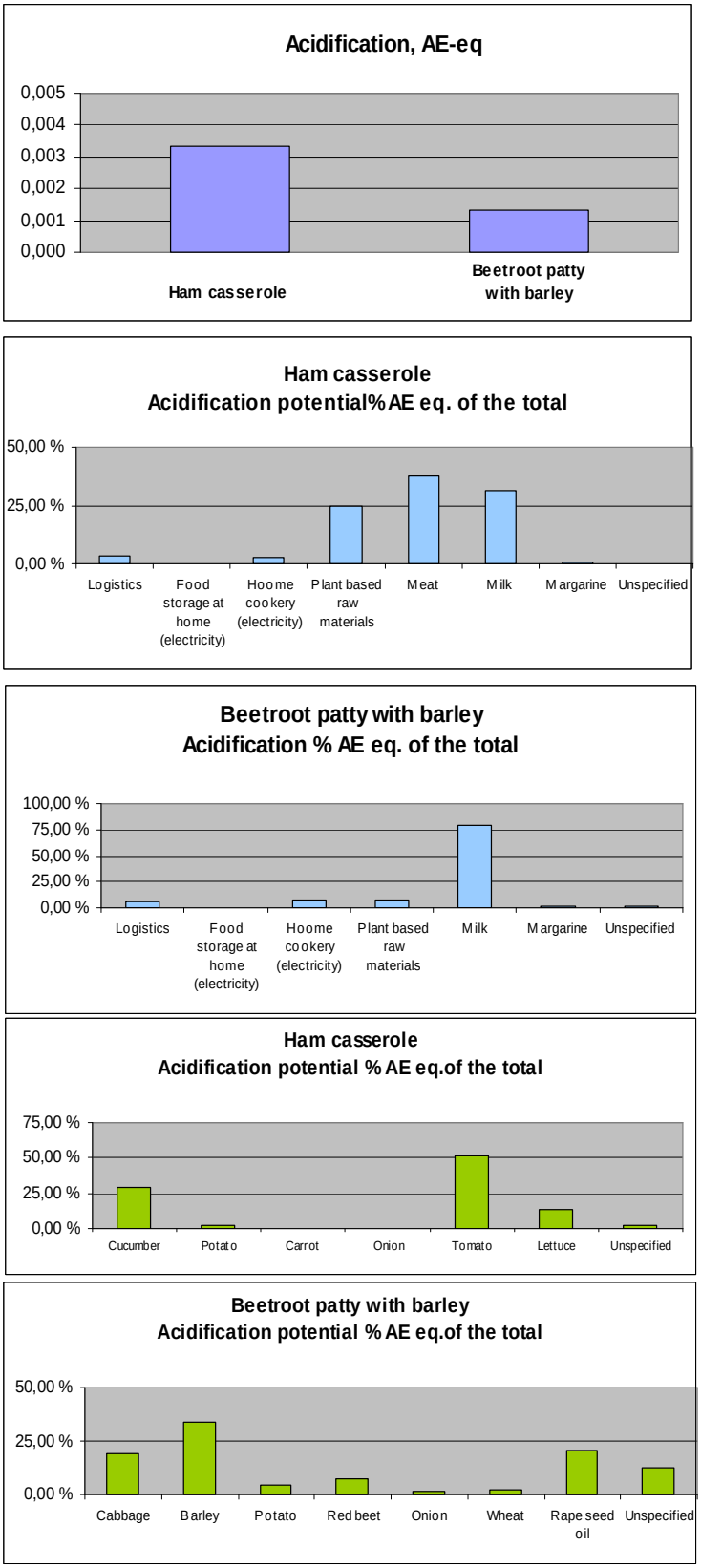

Figure 3. *Acidification potential: from above a) the two lunch portions in relation to the mean, b) proportionate profile of impacts for the ham casserole portion, c) proportionate profile of impacts for the beetroot patty portion, d) proportionate impacts for the plant raw materials in the ham casserole, e) proportionate impacts for the plant raw materials in the beetroot patty.*

For the acidification impact, the animal-based portion was almost three times higher than that for the animal-based beetroot patty. In absolute values: ham casserole 3.33E^{-03}kg AE-eq, beetroot patty 1.31E^{-03} AE-eq.

The acidification impact of meat is highest, followed by milk and the plant-based raw materials in total. In a beetroot patty, the production chain for milk only has a major impact on acidification.

When looking at the plant-based components of the portions separately, the fresh greenhouse vegetables, especially tomato, play a major role.

DISCUSSION AND CONCLUSIONS

The basic issue rising in the interpretation of environmental impacts of food, is the fact that lunch is a nutritional whole, in which changeability of components is restricted as a compensating the energy and protein content with another product. In terms of balanced nutrition, it is not feasible to cut a beef to a half without major change in other components of the portion. We actually play with functional whole of human food systems and measure combination of single LCA impacts.

For consumers, environmental contrasts should be described generic enough to concretize key environmental impacts of consumption. This should not be disturbed by variability of data or even missing of data concerning available alternatives. We already know that for a comprehensive view the input-output approach[19] would be helpful as a support to the LCA approach. While waiting for the hybrids of input-output and LCA approaches, variable failures and successes in the interpretation of the LCA impacts in the context of overall food systems will be a reality.

On the other hand, one can claim that only process based (i.e. trade mark based) LCA data is exact and applicable to use in purchasing alternative trademarks of a certain product. This is important for markets of ecodesign, but results presented in this study do not provide proper information for that purpose. Most possible we need a two step approach; first to learn the principal order and logics of various food impacts and then to focus on specificities of competing products with the same function in our food system.

Many seasonal products in our climate have been introduced to greenhouses and made season free. But at a same time a production system has been created, that is causing high emissions to our environment, some greenhouse vegetables being a regrettable example.

We did not have examples of cultivated versus wild raw materials. For wild raw material, harvesting and transferring the products are critical. However if we compensate greenhouse products with wild berries, for instance, we can be reasonably sure to be in safe side in terms of changing environmental impacts.

How we fit this to school context? Choices for food are personal, thus one option to introduce this information to practice is to build up self-efficacy of the children to make the decision, and gradually embed the LCA in their personal strategy of nutrition and welfare[20]. The collaboration of all stakeholders in school context and innovative approach to school curriculum are needed for that.

To conclude the results from the view of consumers, it become clear that consumers really have an impact, and the impact is complex to manage on a knowledge level, but perhaps easier when linked in context of culture and understanding of a living environment. For global warming, animal based products are critical. Thus consuming of animal based raw material should be restricted to a modest level. But, it is most misleading to think that in animal based food component of a portion is the only source of pollution, if we add greenhouse vegetables into an additional salad. For fresh products, following a natural seasonality would be advantageous in terns of an environmental welfare.

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