Energy, Greenhouse Gases and Way of Living

Lebensstile, Konsummuster und Ökologische Folgen

Objectives | Scientific Results | Achievements | Ph. D. Thesis | Publications | Research Staff & Institutions

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Objectives

Our research work started with the aim to investigate and analyze the environmental impacts linked with household consumption patterns in the necessity field nourishing. The research plan consisted of the following goals:

1. The direct and indirect energy use of Swiss households will be investigated. A comparison with results from foreign countries should show the influence of different natural and social restrictions (e.g. climate, culture, and political situation). Further environmental indicators will be included as far as possible and necessary for the assessment.
2. The total energy use of Swiss households is investigated and analyzed in dependence on consumption habits, income, social position, number of household members, environmental awareness and other influence factors. Possibilities will be elaborated how a change in consumption patterns could lead to energy savings. These guidelines will consider the existing restrictions given by the life-style (e.g. income, dwelling situation). The possible contribution of the proposed steps for a more ecological development will be quantified.
3. An in depth analysis will investigate the contribution of the nourishing sector to the total environmental impacts caused by the households. Different case studies will investigate the environmental impacts of the nourishing sector including production, transportation, trading and consumption of food items. The results shall be used to develop advises for the different actors within this field, leading to an ecological development.
4. Energy use and greenhouse gas emissions are used as the main indicators for an ecological development. This assumption will be checked using the LCA's executed during the project. Further indicators will be elaborated and integrated in the analysis if necessary.
5. Different projects in the IP Society and in the SPPU cooperate for single issues. As a part of this cooperation the discussion panels "Life-Cycle Assessments" (Diskussionsforum "Ökobilanzen") is organized.

back to top

Scientific Results

A lot of advice is given to consumers about how to buy environmentally sound products. They should buy fresh, organic products from the region, which are available with nearly no packaging. But, in everyday life there exist many difficult situations where a consumer has to decide what is more environmentally sound: A product from a greenhouse in the region or a product cultivated in open air but imported from overseas.

Different levels of decision-making for the consumer were distinguished while judging the environmental impacts of consumption patterns. The consumers can recognize the environmental burden by considering certain product characteristics, which correspond to the determinants of environmental impacts. Various combinations of the product characteristics are possible when a consumer looks for food in a shop. A diary survey, conducted in collaboration with a group of psychologists, asked for these characteristics.

The aim of this research work was to support consumer decisions and to highlight the characteristics of a product that are most important with respect to the environmental impacts. The following questions should be answered:

- How can impacts of food purchases be assessed in a scientific way?
- What are the possibilities for an ecological behaviour from the consumers' point of view?
- How far do different consumers realize an environmentally sound behaviour?
- Which restrictions for an ecological behaviour do different consumers face?

Meat and vegetables where chosen as examples in the necessity field of nourishing. These two product groups together account for about 40% of the total energy use due to food consumption. The environmental assessment for food purchases has been simplified by using a modular life cycle assessment (LCA). In this approach the inventory is split into five modules according to the important product characteristics. At the end, the results of the five separate modules can be aggregated, to assess the total environmental burden of a purchased product.

The Eco-indicator 95 and the Swiss method "Ecological Scarcity" have been used as methods for valuation. Both impact assessment methods do not vary much as to the general messages. The overall impact of meat products is dominated by the agricultural production. Differences from the consumers' point of view arise mainly from differences among meat from organic and from integrated production. The import of fresh products from overseas by air adds significant environmental impacts. Other product characteristics, such as packaging, conservation method and consumption, are of minor importance.

The impacts of animal production vary for the different types of meat. Poultry and pork show the lowest impacts while grazing animals show the highest. This point would merit further investigation (by means of a more detailed, e. g. marginal LCA) because from a top-down perspective it does not seem to make sense to produce more pork instead of meat from grazing animals in Switzerland.

In case of vegetable purchases, all characteristics might have a relevant contribution to the environmental impacts. Production in the greenhouse has much higher impacts than open-air production. The consumption stage adds significant impacts to the inventory. The region of production, and corresponding transports, are important especially if vegetables are flown in

from overseas. Packaging, which has gained a lot of public awareness in the past, does not add much to the total environmental scores and thus is not relevant to be considered in consumers' decisions (for this example of vegetables and meat). High differences exist between the products with the lowest and the highest impacts. Purchases of a certain amount of food may differ by a factor of seven or nine in the environmental impacts caused for meat and vegetables respectively. The comparison shows lower scores for organic products, compared to products from integrated production, but this result is unsure and thus needs further research work by LCA.

People do not only differ in their behaviour, but also in their constraints and resources. Acknowledgement of these preconditions has important implications for intervention strategies aimed at fostering environmental behaviour. Therefore, subgroup differences in consumption patterns were investigated. A sample of 134 consumers reported the characteristics of their meat and vegetable purchases in a diary over a period of four weeks. It could be shown that different subgroups exist which differ in their environmental impacts.

The ecological relevance of meat and vegetables for the whole purchases was assessed with energy use as an indicator. The expenses for different product groups, reported in the diary study, were used to calculate this energy use. This broad estimation shows some variances between different consumer subgroups. It also highlights the importance of meat consumption. Reducing the amount of meat consumed, might be an option for minimising the environmental impacts due to nutrification that should be investigated in more detail in forthcoming studies.

Consumers will normally not buy only the less polluting product. However, they can adopt their behaviour to buy more environmentally friendly. Starting from the average purchases investigated in the diary study, different options for these changes were compared. The highest change for a meat or vegetable purchase is caused by a renunciation of fresh products flown in from oversees. A second important option, is a preference for organic products.

The modular LCA, which has been developed in the Ph.d. thesis of Jungbluth (2000), points-up the importance of different product characteristics. The method makes it possible to assess "environmental behaviour" of persons based on information about their consumption patterns. Moreover, the method simplifies the LCA approach if a range of similar products is investigated and if knowledge of LCA studies can be used to identify hot spots and main inputs to the life cycle.

back to top

Achievements 1996-2000

Information about existing LCA approaches in the field of agriculture and food were collected. For different themes (e.g. agricultural practice, transports or labeling) a compilation was made with the results from different studies.

A student thesis has investigated a full meal in an LCA and analyzed the contribution of different life-cycle stages and ingredients (Hess 1997). The environmental impacts of cooking had been investigated in an LCA (Jungbluth 1997b, Jungbluth 1997a). The environmental impacts of different food packaging had been investigated in an LCA (Bättig & Beeler 1998).

The indirect energy use embodied in a range of consumer products has been investigated during a practical training (Roth 1998). A student thesis has investigated the differences of bread produced in a regional cooperation in comparison to a product made for a big distributor (Probst 1998). This thesis was supervised in co-operation with TP5.

The working group "Restrictions & Option" within the Integrated Project Society developed a transdisciplinary heuristic to investigate, analyze and optimize processes of sustainable development in the necessity field nutrition (Arbeitsgruppe Restriktionen & Optionen 1998).

Environmental impacts of food consumption depend on different product characteristics and on consumers behaviour. Two internet applications have been developed to demonstrated these impacts to consumers. The internet game ULME assists consumers in assessing the environmental impacts of their food consumption behavior. At the end information for ecological sound consumption of vegetables and meat are given (Epp&Reichenbach 1999). The internet simulation game SIMULME shows scenarios of ecological and economical change that develop as a consequence of the players` food consumption behaviour (Hansmann, Monsen & Tietje, 2000).

Eleven discussion forums on life cycle assessment were organized from 1996 until the end of 1999 (Buxmann et al. 1998, Friedrich et al. 1998, Hirsch et al. 1997, Hofstetter 1996, Hofstetter & Tietje 1998, Jungbluth 1998c, Lalive d'Epinay 1999, Pohl et al. 1997a, Pohl et al. 1997b, Scheringer et al. 1999, Schmidt et al. 1997, Weidenhaupt 1996).

Environmental impacts of food consumption depend on different product characteristics and on consumers behaviour. The main results of the project are summarised in the Ph. D. thesis of Jungbluth (2000). They were presented at different opportunities.

Thus goal 3 to 5 could be achieved within the research project.

back to top

Research Staff & Institutions

The project *Energy, Greenhouse Gases and Way of Living* is part of the research work for the integrated project *Social Transformation Processes for a Sustainable Switzerland* (IP Society). The IP Society investigates the nourishing sector as an integrated coupled social-natural system. Researchers from different disciplines within different projects of the IP Society, have investigated the structure of the necessity field, the link between the socio-economic and the ecological system and the possibilities for a sustainable development within this sector.

The research staff consists of the following persons: Prof. Roland Scholz (Principal Investigator), Dr. Olaf Tietje (Project Leader) , Dr. Niels Jungbluth, Dr. Ralf Hansmann and Dr. Patrick Hofstetter. Different other projects at the Natural and Social Science Interface are dealing with the development of the Life-Cycle-Assessment method as also other methods for environmental evaluation (MEEM) and modelling.

The project is financed by the Swiss National Science Foundation as a part of the Swiss Priority Programme Environment (SPPU). This programme aims to bring together scientific

knowledge from different disciplines to find new ways and strategies for sustainable development. The research projects of the second phase started in 1996 and ran until 2000.

back to top

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back to top

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back to to

Abstracts

Ökologische Beurteilung des Bedürfnisfeldes Ernährung. Arbeitsgruppen - Methoden - Stand der Forschung - Folgerungen. ***(Case Studies. Research***

Groups and Results of LCA's for Food Products)

This Working Paper provides an overview of research groups and their work that is related to environmental assessments for the activity nourishing and the household consumption. The overview for working groups is split in a Swiss and an international section. For Switzerland, LCA-groups whose work is related to the activity nourishing, are listed. Groups working especially on parts of the activity nourishing were asked for further information on their work and publications. This information is quoted in the survey. International groups are listed as far as their work is closely related to the activity nourishing.

The second part of the study analyses about 150 publications dealing with environmental aspects of the activity nourishing. The publications are classified with regard to the methodological approach used and the special product investigated. The main target was to analyze how far the results of these publications can be used to assess the environmental impacts of the activity nourishing in Switzerland. Results of studies investigating special themes like ecological impacts of transportation, use of LCA for ecolabeling, type of production, vegetable, and meat production are summarized. All publications are summarized in a very short matter for this report. The listing covers not just life-cycle-assessment but also other approaches like material flow accounting, energy analysis, eco-audit or ecological footprint.

Finally it is investigated what could be could indicators to describe the environmental impacts of nourishing habits. It could be shown that energy use or greenhouse gas emissions do not indicate satisfying the environmental impacts of food production. The important findings of the different studies for an ecological development of the necessity field nourishing are: preference for seasonable products, avoidance of long transports, preference for fresh products, light packaging materials and an environmental friendly consumer behavior. The summary shows that different influence factors must be balanced out in an ecological assessment for different food products. (In German)

Update of the full dokument in Acrobat Format (1 MB)

Life-Cycle-Assessment for Stoves and Ovens

This report analyzes and compares cooking alternatives by means of a Life-Cycle-Assessment (LCA) for the situation in Switzerland. For this purpose, data are collected to assess the use of electricity, natural gas, liquefied petroleum gas, wood ,and kerosene. Information about the cooking possibilities is partly adopted from a prior investigation of cooking alternatives in India (Jungbluth 1995). Data for the necessary upstream processes are taken from the inventory of Frischknecht et al. (1996). The database ECOINVENT is used for the inventory computation. The assessment pursues two goals:

* Elaborating an inventory for cooking that can be used in coming LCA studies
* Comparison of various cooking options.

Useful heat delivered by the cooking alternatives is chosen as the functional unit for the comparison. Besides, LCA data are given for a certain energy input to the distinguished stoves and ovens. As a consequence it is possible to calculate the environmental impacts of cooking related to the amount of energy used. A first evaluation using the method of Eco-indicator 95+, supplemented by an additional investigation of some environmental impact categories (radioactive releases, space use, waste heat and ecotoxicity), shows a small

environmental advantage for cooking with natural gas in Switzerland in comparison to an electric stove (Swiss electricity mix). But, due to data and methodological uncertainties the environmental performance of the two possibilities is assessed here to be the same. Wood is an interesting ecological alternative, especially if the stove is combined with room heating. If natural gas is not available, the use of liquefied gas is not preferable to electricity regarding the environmental impacts. A comparison of gas use in Switzerland with electric cooking in Germany shows, that the latter option has considerably higher impacts because the electricity production is mainly based on fossil fuels. Cooking with kerosene or wood on a simple open fire exhibits relatively high environmental impacts. It has also be shown, that the environmental impacts depend considerably on the efficiency of the stove used and on the energy consumed due to the users' behavior. The inventory data shown in annex 6.5 may be used in further LCAs, e.g., when comparing the preparation of meals. (In English) **(download)**

back to top