# SCIENCE, LCM AND COMMUNICATION TOOLS FOR HARMONISED ENVIRONMENTAL AND SOCIAL SUSTAINABILITY IN THE EUROPEAN FOOD AND DRINK CHAIN – THE SENSE PROJECT

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*Keywords: Sustainability, Food & drink chain, LCA, LCIA*

## ABSTRACT

This paper presents the first outcome of the SENSE project (HarmoniSed ENvironmental Sustainability in the European food and drink chain). In Work Package 1 the main environmental challenges in three European food supply chains (beaf/dairy products, orange juice and farmed fish) have been reviewed. Based on LCA studies, key environmental impact categories (climate change, eutrophication, acidification, human toxicity, ecotoxicity, land use, abiotic resource depletion and water depletion) have been identified as the most relevant for the food supply chains. Life cycle impact assessment (LCIA) methodologies to be used in the project have been chosen for the selected categories. The feasibility to regionalize the characterization factors and the relevance of Key Environmental Performance Indicators (KEPIs) are also being investigated.

## INTRODUCTION

The food and drink industry in Europe is highly fragmented, and food chains are very complex. The environmental impacts are normally largest in the first part of the value chain, the agriculture and fishery. They are mainly caused by biological processes, hence difficult to quantify, and show large temporal and spatial variations. To assess and communicate the sustainability impact of a food product there is a need for applying integrated, harmonised and scientifically robust methodologies, together with appropriate communication tools and strategies for making sustainability understandable to consumers. The SENSE project (http://www.senseproject.eu/) will deliver a harmonised system for sustainability impact assessment of food and drink products as a basis for communication. The three year project started in February 2012. The SENSE consortium is formed by a multidisciplinary team involving 23 partners from 13 countries: research organisations, food and drink SMEs, environmental and LCA experts, and European Food Associations. SENSE is coordinated by AZTI Tecnalia, Spain.

The main results of SENSE will be:

- Harmonised methodology for environmental and social impact assessment, regionalised when appropriate
- Key environmental and social performance indicators for beef and dairy products, orange juice and farmed fish
- SENSE tool for simplified data collection throughout the supply chain
- Results presented in an Environmental Identification Document (EID) and a Communication Platform
- Certification Scheme Concept based on EID
- Road map for policy and governance implementation

## METHODS

The three food supply chains beef/dairy, orange juice and salmon aquaculture have been selected as case studies. In Work Package 1 (WP 1) the environmental challenges for the food supply chains have been identified and key environmental impacts have been defined based on literature reviews of LCA studies. Furthermore, a set of environmental life cycle assessment methods has been established and regionalisation has been considered.

## RESULTS

*Key environmental challenges and impacts categories*

The production at the farm stage has generally the greatest environmental impact, while the production of packaging, transports and the final disposal (recycling) have less important impacts. The total environmental impact of the life cycle is therefore to a large extent dependent on the variability at the farm stage due to variations in the technical production system e.g. for the beef and dairy chain, extensive grassland versus intensive with high volumes of imported feed. Similarly, for the aquaculture chain the production systems vary and the feed has the main environmental impact caused by the use of forage fish and plant based feed components.  For orange juice also fuel consumption is of great importance.

Based on the literature review of LCA studies the key environmental impact categories listed in Table 1 have been identified as the most important for food products. Biodiversity was also defined as a key environmental impact from the study of the three supply chains. However, because of uncertainty and availability of data the project team has decided to handle biodiversity in the SENSE project as part of the environmental impacts due to land use.

*Life cycle impact assessment methodologies*

Existing LCIA methodologies has been reviewed as well as current developments. The ILCD handbook was a starting point for the review. The LCIA methodologies chosen for each impact category are listed in Table 1 and they are to be used in the LCA’s of the three food supply chains in WP 2 of SENSE.

Table 1. Life cycle impact assessment methodologies to be used in SENSE.

| Impact category | Selected LCIA method |
|---|---|
| Climate change | Bern Model – IPCC (Solomon, 2007) |
| Eutrophication | Terrestrial: Accumulated Exceedance (Seppälä et al., 2006, Posch et al., 2008)<br>Aquatic: EUTREND Model (Goedkoop et al., 2009) |
| Acidification | Accumulated Exceedance (Seppälä et al., 2006, Posch et al., 2008) |
| Human toxicity | USEtox Model (Rosenbaum et al., 2008) |
| Ecotoxicity | USEtox Model (Rosenbaum et al., 2008) |
| Land use | Soil organic matter model (Milà i Canals 2007) |
| Abiotic resource depletion | CML 2002 (Guinée et al., 200A2) |
| Water depletion | Ecological scarcity model (Frischknecht et al., 2009) |

*Regionalization*
It has been found that the LCIA methodologies for water depletion, acidification and terrestrial eutrophication are feasible to be implemented on a country scale. For other impact categories, e.g. land use and ecotoxicity, there are yet no scientifically verified and robust methodologies available

*Key Environmental Performance Indicators*
In the SENSE tool Key Environmental Performance Indicators (KEPIs) will be used to communicate environmental impact through the supply chain and to the consumers. Those KEPIs must be simple and linked to key environmental challenges, build on accessible production data in the supply chain production steps and should also be easy to understand. Examples of the key environmental challenges that can be communicated as KEPI´s are: use of fossil fuels, use of fertilisers and manure, pesticides, irrigation, land and water use and waste. A key environmental challenge was defined as the activity that can be altered to reduce the specific environmental impact from the production step.

## DISCUSSION

The main environmental impact from the food and drink supply chain are normally from the cultivation of biomass and animal rearing, but the feed and food industry as well as transport must also be taken into account to present the total impacts. Furthermore, it is not possible to focus on a few environmental impact categories only, as the emissions and use of natural resources in the food and drink chain contributes to the impact from many environmental categories.

The complexity of both the supply chains and their environmental impact calls for simplification both for measuring and improving but also for communication. The approach suggested in SENSE, that is to use KEPI's with sufficient accuracy while at the same time being based on easily accessible production data, is a critical factor. Therefore, comprehensive LCA-studies covering the range of different production systems need to be performed to verify the applicability of KEPI's which fulfil these requirements. Moreover continuous updating will be needed as production systems are developing.

## CONCLUSIONS

Based on the research in the study the following environmental impact categories has been identified as the most important for the food supply chain: climate change, eutrophication, acidification, human toxicity, ecotoxicity, land use, abiotic resource depletion and water depletion. For each impact category a LCIA method, regionalized when appropriate, has been selected to be used in the further work in the SENSE project. The development and use of KEPI's are a promising approach to facilitate the application of LCA in complex supply chains with many small actors.

## REFERENCES

Frischknecht R., Steiner R., and Jungbluth N. 2009. The Ecological Scarcity Method -Eco-Factors 2006: A method for impact assessment in LCA. *Federal Office for the Environment FOEN, Zürich und Bern*

Goedkoop, M., Heijungs, R., Huijbregts, M.A.J., De Schryver, A., Struijs J., and van Zelm, R. 2009. ReCiPe 2008 - A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level. *First edition. Report I: Characterisation. The Netherlands.* http://lcia-recipe.net/

Guinée, J.B.; Gorrée, M.; Heijungs, R.; Huppes, G.; Kleijn, R.; Koning, A. de; Oers, L. van; Wegener Sleeswijk, A.; Suh, S.; Udo de Haes, H.A.; Bruijn, H. de; Duin, R. van; Huijbregts, M.A.J. 2002. *Handbook on life cycle assessment. Operational guide to the ISO standards. I: LCA in perspective. IIa: Guide. IIb: Operational annex. III: Scientific background. Kluwer Academic Publishers, ISBN 1-4020-0228-9, Dordrecht, 2002, 692 pp.*

Milà i Canals, L., Romanyà, J., Cowell, SJ. 2007. Method for assessing impacts on life support functions (LSF) related to the use of "fertile land" in Life Cycle Assessment (LCA). *Journal of Cleaner Production 15, pp. 1426-1440*

Posch, M., Seppälä, J., Hettelingh, J.P., Johansson, M., Margni Mand Jolliet, O., 2008. The role of atmospheric dispersion models and ecosystem sensitivity in the determination of characterisation factors for acidifying and eutrophying emissions in LCIA. *International Journal of Life Cycle Assessment. 13: 477-486*

Rosenbaum, R.K., Bachmann, T.M., Hauschild, M.Z., Huijbregts, M.A.J., Jolliet, O., Juraske, R., Köhler, A., Larsen, H.F., MacLeod, M., Margni, M., McKone, T.E., Payet, J., Schuhmacher, M., and Van de Meent, D. 2008. USEtox - The UNEP-SETAC toxicity model: recommended characterisation factors for human toxicity and freshwater ecotoxicity in Life Cycle Impact Assessment. *International Journal of Life Cycle Assessment, 13 (7), 532-546*

Seppälä, J., Posch, M., Johansson, M., Hettelingh, J.P. 2006. Country-dependent Characterisation Factors for Acidification and Terrestrial Eutrophication Based on Accumulated Exceedance as an Impact Category Indicator. *International Journal of Life Cycle Assessment 11:403-416*

Solomon, S., Qin, D., Manning, M., Alley, R.B., Berntsen, T., Bindoff, N.L., Chen, Z., Chidthaisong, A., Gregory, J.M., Hegerl, G.C., Heimann, M., Hewitson, B., Hoskins,B.J., Joos, F., Jouzel, J., Kattsov, V., Lohmann, U., Matsuno, T., Molina, M., Nicholls, N., Overpeck, J., Raga, G., Ramaswamy, V., Ren, J., Rusticucci, M., Somerville, R., Stocker, T.F., Whetton, P., Wood, R.A. and Wratt, D., 2007. Technical Summary. *In: Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. *Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA*