

with their cultural, social and economic dimensions, for complete analysis. Their channels of exploitation, rights and concessions for their collection, legal provisions, marketing rights, problems in marketing income and employment generation, trade flows at national and international levels have also been taken care of to understand the effectiveness of LCA and its scope in forestry management. The LCA of timber and seed/fruit based NTFPs, like *Embllica officinalis* (Aonla) have been considered in this study and it is accomplished through covering stages of trees as applicable to various products. For *Embllica officinalis*, for example, stages considered are (1) Seed (2) Germination of seed (3) Seedling (4) Transfer to site (5) Plant (6) Tree and of fruit, i.e., (1) Appearance of fruit (2) Extraction of fruit (3) Packaging (4) Transporting (5) Storage (6) Processing (7) Waste.

Results and Conclusions. NTFPs are available in large quantities in the state and they are subject to large number of uses, although no efforts have been made to develop the databases relating to their inventory, use patterns, procurement, processing, consumption and disposal. LCA for Aonla has proved to be an effective tool and this could be extended to other NTFPs. Current study findings over the exploitation of Aonla and further concerning its processing has been done in a most environmentally unfriendly manner. This study also gives recommendations to sustainable harvesting and processing of this important medicinal NTFP. It further throws light on how the economic value of various products and by-products can be increased by performing the LCA of such products.

Recommendation and Outlook. The challenge before the forestry sector for its sustainable management is not of sustained productivity, but also co-existence of ecological balance with the industrial development and growth. This study of LCA of timber and an important NTFP, Aonla, clearly points out the major role that LCA can play in the forestry sector. A product like Aonla and many other medicinal plants which have been an integral part of our lives are leading for extinction today just because of certain unscientific practices and apathy of stakeholders. Application of environmental management techniques like LCA can prevent this depletion and lead the way towards long-term benefits and sustainable management of forests in a true sense.

Keywords: Aonla; life cycle assessment; medicinal plants; sustainable forest management; timber

Environmental Impacts of Food Purchases Investigated in a Modular LCA

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Goal and Scope. The environmental impacts caused by different types of consumers while purchasing food products were investigated in a diary study and assessed with a modular LCA approach. This research aimed to show, in collaboration with a group of psychologists, the ecological, economic, and cognitive restrictions and options for an ecological orientation of food purchases.

Methods. The extent of environmental impacts of food purchases depends on various factors, for example, agricultural technique, transport distance, packaging or the consumption phase. It is not easy for consumers or even for experts to account for these impacts. In order to simplify the analysis a modular LCA approach has been developed. Single life cycle inventories for the different peculiarities of the five characteristics can be combined in order to assess the total burden of a purchased product. The analysis made it possible to show the influence of different product characteristics

within the total environmental impact of meat and vegetable purchases. The life-cycle-inventory considers all environmental impacts related to a particular consumer decision.

Results and Conclusions. The environmental impacts are evaluated with the Eco-indicator 99 impact assessment method. The simplified modular LCA method allows investigating the trade-offs among different decision characteristics. It can be shown that most of the decision parameters, such as origin, production method, type of conservation, might have an influence on the overall impacts of a vegetable product. The predicted more ecological types of consumers caused lower environmental impacts than the so-called 'anti-ecologists'. Greenhouse production and products transported by air cause the highest surplus environmental impact if marginal changes of consumption patterns are evaluated. The agricultural production determines the overall environmental impacts for meat products.

Recommendations and Outlook. The method allows to investigate a range of similar products in a simplified approach. It might also be used for other examples of environmental decision making where a range of product choices has to be modelled. The method helps to identify options of environmental sound behaviour for consumers.

Keywords: Environmental behaviour; food consumption; meat; simplified LCA; vegetables

Environmental Assessment of Seafood with a Life-Cycle Perspective A Case Study of a Frozen Cod Product

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Goal and Scope. The aim of the study was to perform environmental Life Cycle Assessment (LCA) for a seafood product, including fishery-specific types of environmental impact like seafloor impact, discarding, emissions from anti-fouling paints and impact on the stocks of target and by-catch species. The product chosen to be studied is one of the most common seafood products consumed in Swedish homes; consumer-packed frozen cod fillets. The fishery takes place in the Baltic Sea, east of Sweden, and is mainly performed with trawls and gillnets. The study comprises all steps from the production of gear, fuel, packaging material and anti-fouling paints to fishery, processing, storage, wholesalers, retailers, the household phase and ends after the sewage treatment plant. Wastewater treatment within the processing industry and waste treatment of the package as well as transportation between the different steps is included in the study.

Methods. Logbook data for fishery and research data for discards has been provided by the Swedish National Board of Fisheries (NBF). One of the major cod processing industries has provided data for the industrial phase and the producer of the packaging material for resource and emission data for the primary packaging. Some database data was also used for transports and secondary package. The seafloor impact was calculated by overlaying trawl effort data from the NBF in a GIS with a depth isocline below which oxygen-deficiency is common due to natural conditions in the semi-enclosed Baltic Sea. The impact of a passing trawl can be assumed to differ considerably between an oxygen-depleted sediment and an oxygenated sediment where higher life forms can exist. Fuel consumption data and emissions from fuel combustion have

been studied previously in this fishery and the data were used in this study. Data was summarised in an LCA software where three scenarios were built; gillnet fishery, trawl fishery and a realistic mixture of the two reflecting the true fishery in the Baltic today.

Results and Conclusions. Preliminary results include that fishery is by far the most energy-consuming step of the life cycle of the studied product, which corresponds to previous findings for other seafood products. The difference between the two fishing methods regarding energy consumption was considerable, gillnet fishing was in the studied case less energy-consuming than trawl fishery. However, the resulting quality and product exchange of the catch could not be quantified and if those factors differ between the two fishing methods, the results could change. By-catch and discards are relatively low in the Baltic Sea due to its' naturally low bio-diversity. Nevertheless discarding, especially of undersized specimens of the target species cod, is a waste of a limited resource. The total area impacted was around 1700 m²/kg cod landed and most of it occurred in sediments above 80m.

Recommendations and Outlook. The results of a seafood LCA can be useful for companies who want to develop their products in an environmental way. It can also be helpful for policy-makers setting the strategies for the future fishery sector. Information coming out of these studies could also constitute a basis for eco-labelling of seafood products to give information to environmentally conscious consumers.

Keywords: Environmental assessment; fishery; GIS; LCI; seafood

LCA of Beech Manufactured Products

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Goal and Scope. In the wood sector, the international trade between developing countries – where forests are localised – and industrialised countries – where the manufacturing of wood which is directed to the production of chairs, tables and different furniture occurs – is more and more evident. In the productive flowcharts of the wood products one can identify two main phases: the forest one, which is carried out in the developing countries, and the industrial one carried out in the different wood districts of the industrial countries.

Even if the quality of the Albanian beech forest is not that high, the commercial flows between Italy and Albania in this sector are relevant. This paper aims to identify the environmental burdens of the beech products over their whole life cycle which occur in Albania and Italy due to the respective phases of biologic growth/primary transformation and final transformation in finished product, in order to suggest options for the improvement of the environmental performance of the silviculture and wood manufacturing activities.

Methods. In order to evaluate the environmental burdens, a life cycle approach has been adopted: all the energy and materials consumptions together with the emissions and releases to atmosphere, water and soil have been accounted for during the phases of production, use and disposal of beech products. The methodology used is the Life Cycle Assessment as stated by the ISO 14040 rules.

Results and Conclusions. Due to irrational forest uses and inefficient processes of utilisation of the wood which is available in Al-

bania, the process of utilisation of this resource leads to relevant environmental burdens which are typical of a 'non-sustainable' development. The analysis will permit to identify the hot spots of the forestry and industrial phases at the levels of the energy consumptions, pollutants emitted in atmosphere or released in water and solid waste to disposal and/or recycle.

Recommendations and Outlook. The first results of this work in progress allow to forecast that a better environmental performance is possible to gain if the system is analysed in its whole with an integrated approach, in order to avoid that such environmental benefits which are gained in some phases of the flowchart could be transformed into damages in other industrial phases and geographical sites. An improvement of the technology efficiency is required together with the most 'energy savings' techniques.

In order to reach this aim the transfer of some saw operations to Albania is desirable to obtain semi-manufactured which are more similar to those required for the final assembly of the products.

Such transfer of technologies in Albania could involve both the reduction of the environmental burdens and the increase of the national economical activities.

Keywords: Beech; forestry; LCA; life cycle assessment; wood

Life Cycle Assessment of Milk Production in India

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Goal and Scope. Milk production in India is characterized by a large number of milch animals, a large number of milk producers, mixed farming and low productivity of milk per animal. Most of the total milk production in the country comes from indigenous cows (27%), crossbred cows (15%) and buffaloes (54%). Goats and other animals contribute only a minor share (4%) to the total milk production. The population of crossbred cows and buffaloes is kept largely for milk production while the population of indigenous cows is maintained for producing both milk and drought animals. About 58 per cent of the total population of cattle and buffaloes in India is with marginal and small farmers (below 2 ha of land holding).

This study uses the LCA approach to estimate the environmental impact of milk production in terms of methane emissions. The study focuses only on bovine milk production as it accounts for about 96 per cent of the total milk production in India. The methane emissions in the study are estimated at the level of indigenous cows, crossbred cows and buffaloes instead of the usual two categories of cows and buffaloes. The analysis of methane emissions in terms of per kg of milk production has been extended to methane emissions per rupee worth of milk production, as the prices of cow and buffalo milk are very different due to the different fat content.

Methods. The environmental impact has been assessed in two steps: (1) inventory analysis and (2) impact assessment. Under the first step, an inventory has been taken of raw materials and associated emissions. The impact of these raw materials and emissions has been assessed under the second step. The raw materials used by cattle and buffaloes are divided into two categories, namely (1) concentrates and (2) roughages. The roughages are sub-divided further into green fodder and dry fodder. The emissions of methane associated with bovine milk production take place mainly at three stages, namely (1) enteric fermentation, (2) manure management, and (3) use of dung as domestic fuel. The study has used IPCC guidelines and is based largely on the secondary data available from various sources.