susTAinable LandscapE manageмeNT

Fine-tuning sustainable practices through LCA

Today, life cycle assessment (LCA) is the most standardized, internationally recognized methodology for estimating the environmental impact of human activities along a supply chain.

LCA is based on t o fundamental principles. First, environmental impacts are quantified throughout the supply chain or 'life cycle', from ra material extraction ('cradle') to end-of-life of the product or service ('grave'). Then, the impacts are quantified ith respect to a functional unit, either a product quantity (one kilo, one car, etc.) or a service (hours, tonne.km, etc.). In that ay, the environmental impacts of systems producing a similar function can be compared. Thus, LCA has become the orld ide standard for implementing environmental product declarations (e.g. European Product Environmental Footprint, Thailand Carbon Footprint International).

From a global perspective, it is paramount to account for the entire life cycle, so that local environmental improvements at one production stage or in one place are not merely the result of problem shifting to another stage or place. Similarly, comparison based on a common functional unit is crucial, in order to avoid problem shifting from one chain to another in order to compensate for any functional shortcoming. Finally, LCA assesses environmental performance across multiple impacts, such as climate change, acidification, ozone layer destruction, terrestrial ecotoxicity, marine or fresh ater eutrophication, etc. *A priori*, such a multicriteria approach does not emphasize any one impact but it pinpoints the greatest impacts and their origins at certain production stages. The necessary tradeoffs and arbitrations can thus be documented.

Cropping system contribute to global warming

Since the 2000s, many studies have been published on agricultural LCA. In a revie focusing on perennial crops, e analysed 70 LCA studies for ra or processed agricultural products, particularly in the case of bioenergy supply chains. In most chains, the cropping system as the main contributor to global arming, eutrophication and toxicity impacts. The major sources of emissions contributing thereto ere the production and application of nitrogen fertilisers, in particular in the case of global arming and eutrophication, and pesticide and fertiliser use, as regards toxicity. Those emission sources ere critical not only for the analysis of cropping systems (even for the less mechanized ones) but also in the case of cropping systems delivering ra material for a processed product (bioenergy, ground and packaged coffee, palm oil derivatives...).

Scientists can only deliver incomplete answers

LCA implementation poses specific problems for agricultural products because of insufficient data or scientific kno ledge, hich gives rise to a number of uncertainties. The main scientific challenges are, first, to define the representative system for the function under study, and second, to account for the variability of practices and of climatic and soil conditions. This is particularly true for perennial cropping systems or plantations. As highlighted by research on perennial crop LCA, agricultural practices, yields and impacts ere found to change over the years, especially during immature stage and until the full production stage is reached.

Besides, the analysis of the many and highly diverse agroforestry systems planted under the tropics is a particularly complex task. Indeed, such systems are able to provide a series of different products and services, so the ay emissions are allocated bet een products must be carefully defined. Moreover, researchers are orking to improve the modelling of impact chains, by including ne design parameters such as the consideration of soil carbon and albedo in climate change impact assessments, the impact of practices on functional soil biodiversity, etc.

At its current stage of development, LCA is able to identify the main sources of impact, then to target, test and prioritize improved practices. The LCA approach also highlights risks that can never be offset, such as irreversible peat oxidation or pollution transfers bet een impact categories. Scientists can only deliver incomplete ans er to the questions raised by the improvement of the method; nevertheless, LCA remains one of the most comprehensive and consistent method for estimating the impacts of human activities on the environment, including climate change.

More on Life Cycle Assessment

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