



# The sustainability of a single activity, production process or product



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## ABSTRACT

When is a specific activity, production process or final product sustainable? Life Cycle Assessment and Environmental Footprint Assessment are two different methods to analyse natural resources use and emissions along product supply chains. It is argued that the two methods fundamentally differ in the way they address the question of product sustainability. Whereas the former method takes a comparative approach, comparing potential environmental impacts of alternative products, thus avoiding the question of sustainability at systems level, the latter method takes a holistic systems approach but has difficulty to attribute overall unsustainability to single processes or products. Both methods are useful, for different purposes, and complementary. It remains a challenge to develop a consistent and coherent theoretical framework providing an umbrella for the two different methods.

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## 1. Introduction

There is a strong societal wish to have simple indicators to measure the sustainability of single activities, production processes and final products. One can increasingly find specific localised activities, specific production sites and specific products on the market being advertised or labelled as 'sustainable'. It is impossible, however, to measure sustainability at the level of single production sites, production processes or products, because the sustainability concept is meaningful only at a larger system level. Whether a specific activity or production process is sustainable or not, does not depend merely on the activity itself, but also on the context in which this activity takes place and on how many and what other sort of activities take place as well. It is the aggregated effect of many activities that leads to unsustainability, not the effect of one single activity. If one can thus not speak about the sustainability of a specific activity in isolation, it is also impossible to speak about the sustainability of a specific product, because a product results from just one or a series of activities. What then defines a sustainable product? Seuring and Müller (2008) define 'sustainable products' as 'products that have or aim at an improved environmental and social quality'. With using the word 'improved', this definition enables discussing sustainability in relative terms, but fails to define sustainability in more absolute terms. Understanding

sustainability requires studying the interactions between nature and society, from the local to the global scale (Kates et al., 2001). The concept of sustainability inherently applies to social–ecological systems (Ostrom, 2009), not to single activities, processes or products. Sustainability relates to the scale of the human economy in relation the Earth's limited natural resources availability and carrying capacity (Goodland, 1996). This raises the problem *how can we then meaningfully address the question whether a single activity, process or product is sustainable?* This article discusses and contrasts two different methods that have been developed to work around this problem: Life Cycle Assessment (LCA) and Environmental Footprint Assessment (EFA). Both methods analyse direct and indirect natural resources use and emissions along supply chains, but each method has its specific goal, approach and focus.

## 2. Environmental footprint assessment versus life cycle assessment

The LCA field comprises methods to estimate the different sorts of potential environmental impact attributable to the life cycle of a product, from cradle to grave (Hellweg and Milà i Canals, 2014). The question of sustainability in absolute sense is put aside by focussing on a comparative analysis of potential environmental impacts of alternative processes or products (e.g. the difference in potential impact when using alternative materials or designs) (Rebitzer et al., 2004).

The field of EFA considers the sustainability question from a macro or environmental systems perspective – by analysing total

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environmental footprints of humans in the context of maximum sustainable footprints (Hoekstra and Wiedmann, 2014). EFA comprises methods to quantify and map land, water, material, carbon and other environmental footprints and assess the sustainability of these footprints as well as the efficiency, equitability and security of resource use. Typical questions in EFA studies relate to how different processes and products contribute to the overall footprints at larger scales, how different consumption patterns influence the overall footprint, whether footprints at the larger scales remain within their maximum sustainable levels, how footprints can be reduced by better technology, whether different people have equitable shares in the total footprint of humanity, and what externalisation of footprints may imply for resource security.

Thus, the difference between LCA and EFA is the focus on comparing potential environmental impact at process and product level of the former and the emphasis on sustainability of production and consumption at macro-level of the latter. In LCA studies one purposely speaks about *potential* impacts of specific activities, because actual impacts emerge as the result of the sum of all human activities within the social–ecological system, which is outside the scope of an LCA study. EFA takes a holistic systems approach that enables a meaningful discussion of sustainability of the human economy at macro-level, but has difficulty to attribute overall unsustainability to single activities, processes or products within the economy. The impossibility of determining the sustainability or unsustainability of a single activity, process or product and the different ways LCA and EFA work around this problem can be illustrated with the example of cutting a tree.

### 3. The tree-cutting example

Is it sustainable to cut a tree for the purpose of producing some timber? Although a relevant question, it is impossible to answer this question in isolated form. It is hard to argue that cutting just one tree is unsustainable. After the tree has been cut, a new one will grow, which can be cut again, after which there will be growth again, etc., a process that can continue infinitely. Even without regrowth, one cannot really argue that it is unsustainable to cut a tree, because there are so many trees; we can miss one. When cutting one tree is sustainable, this must also hold for two trees, or ten, or a small piece of forested land. However, if we decide to cut all forests, one cannot maintain that this is sustainable, due to the *scale* of tree cutting. And if we decide to cut just one forest, but every year again, this is impossible due to the *rate* of tree cutting, which is larger than the renewal rate. The reason why answering the simple question about the sustainability of cutting one tree is problematic is that sustainability of a single activity is to be seen in its larger context. The methods of LCA and EFA deal with this problem in fundamentally different ways. The LCA approach is to leave the larger question on sustainability and *compare* the size of potential environmental impact of alternative processes or products, which enables rational choice for those processes and products that have lower impact. While it is impossible to answer the isolated question whether cutting a tree is sustainable or not, it is easy to answer the question whether cutting one tree is better or worse than cutting two trees. In EFA, the approach is to estimate humanity's total natural resource appropriation and emissions and compare that to the Earth's carrying or assimilation capacity (Wackernagel et al., 2002). By looking at all human's tree-cutting activities and the sustainability of that, EFA will thus go beyond the original question of how sustainable it is to cut *one* tree. The isolated question on the sustainability of cutting one specific tree remains unanswered in both LCA and EFA.

### 4. Comparing apples and pears

LCA and EFA similarly struggle with how to compare apples and pears, for example how to compare cutting trees with polluting water. The LCA approach is to *weigh* different types of primary resource use or emissions according to their potential final *impact* on human health and ecosystem quality. The approach in EFA is to compare the different types of resource use and pollution to their respective maximum sustainable levels. LCA thus focuses on weighted indexes of potential environmental *impact* (e.g. ecosystem degradation or biodiversity loss), while EFA focuses on empirical measures of different sorts of environmental *pressure* (size of resource use and emissions).

The similarity between LCA and EFA is that resource use and emissions are analysed per process (activity) and per product (by analysing the processes along supply chains). Both methods equally face the problem that supply chains are extensive and complex – it would be better to speak about supply networks – so that in practical analyses supply chains are truncated at some point. The difference between the methods comes when LCA starts weighing and adding different types of resource use and emissions to enable comparison of products regarding their overall potential environmental impact. In contrast, EFA aggregates the footprints related to different activities to get the overall footprint of a community or within a region, while keeping the accounts for different sorts of resources use and emissions separate. At the macro level, different sorts of environmental footprint (e.g. land, water, material and carbon footprints) are compared to their respective maximum sustainable level. LCA thus maintains a product focus and integrates across different environmental themes, while EFA maintains a thematic focus and integrates over the different activities or consumer goods.

In many applications, the difference between both methods is not so clear. By comparing the footprints of two different processes or products, EFA also allows for comparative analysis. However, the comparative analysis is partial now, because different footprints are not weighted and added to get a measure of 'overall potential environmental impact'. One can also employ an LCA to compare consumption patterns, which is at the larger scale typically for EFA. The fundamental difference between LCA and EFA in the way they address the tree-cutting question, however, remains. The two methods do not solve the impossibility to determine the sustainability or unsustainability of a single activity, process or product, but offer two different ways to work around this problem: the LCA method by taking a comparative approach (what is better, what is worse, leaving the question of sustainability or unsustainability aside) and the EFA method by going beyond the analysis of single processes or products (to the macro level of environmental systems).

### 5. Looking forward

EFA and LCA are young fields under development. We can observe a development in the past few years in which a fruitful exchange between the fields leads to the adoption of approaches from one field into the other (Čuček et al., 2012). EFA studies have adopted life cycle accounting procedures from LCA. In LCA we observe, fed by experiences in EFA, an interest to apply LCA for organisations, for consumer lifestyles and national consumption as a whole (Hellweg and Milà i Canals, 2014). This mutual enrichment and to some extent convergence of approaches does not imply that the two methods will grow into one. Ideally, they develop into a more consistent framework of coherent methods, but the fact that different sorts of questions will remain, implies that different approaches will continue to be necessary.

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