NCASI Fact Sheet

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Challenges in Characterizing the Effects of Forest Management on Biodiversity in LCA

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Overview

Land uses, including forest management, have long been accompanied by dialogue about sustainability. Life cycle assessment (LCA) has emerged as a tool for assessing the environmental sustainability of producing goods and services, including forest products, by organizing and considering relevant scientific information associated with their production. To date, however, few LCAs have addressed environmental aspects of land use, including potential effects on biodiversity, and there is ongoing debate about approaches for doing so. As a result, a need for new methods has emerged that would allow consideration of land use effects, specifically effects of forest management on biodiversity into LCAs. The current LCA methodological framework poses unique difficulties for incorporating biodiversity considerations, especially for forest management, which may hamper the ability for land use and biodiversity to be objectively and comprehensively incorporated into LCAs.

Time- and Site-Dependency

A Life Cycle Assessment covers the entire life cycle of a product or service, but information on where and when the land use associated with the production of this product or service occurred is often partially or completely missing. Forest management effects on biodiversity are time-dependent and site-specific; therefore, the integration of these effects in LCAs can be very challenging. Indeed, these effects can vary considerably by plant and wildlife species based on their specific ecology, migration patterns, landscape productivity, land ownership patterns, and many other factors. While forest management may have short-term negative effects on some species, it has positive effects on others. This “bi-directional” biodiversity response is relatively unique to forest management and is the source of much of the nuance in optimizing active management of forests on the landscape, and in quantifying these effects. As a result, generalized forest land use effects on biodiversity are extraordinarily difficult to incorporate into LCA studies.

Baseline Definition

Assessing effects of land use in LCAs requires definition of a reference state (or baseline). For this purpose, the LCA standard practice is to use some sort of ideal “natural conditions”, for instance the perceived forest condition prior to any human intervention or the forest regeneration potential if human interventions were to stop. Applying these baselines to forest management is challenging. First, natural disturbances are important processes in ecosystems and usually lead to the creation of a dynamic mosaic of forest landscapes. Each patch in a mosaic can be characterized as a unique assemblage of fauna and flora, making it difficult to determine what constitutes “natural conditions”. In addition, using “natural conditions” as the reference state for quantifying biodiversity effects in LCAs may provide little incentive for making changes in management practices

to improve the state of biodiversity because, in the LCA framework, the effect of a change in human activity may be perceived as very small compared to the difference between the state of biodiversity on a landscape under theoretical "natural conditions" and the state of biodiversity of a managed landscape. Using the regeneration potential as the baseline poses additional challenges. First, it raises the question of allocation of effects between successive land uses. Second, predicting how today's ecosystem would evolve in the absence of human intervention is almost impossible, given the series of factors that can influence this.

Biodiversity Indicators

There are significant shortcomings in indicators that are currently available to assess biodiversity in LCAs. First, there is a disproportionate focus on indicators that reflect changes in compositional aspects of biodiversity (e.g., species richness), where the functional and structural attributes of biodiversity are largely neglected. In fact, not all species have the same ecological importance in a community. Therefore, it is helpful to understand how biodiversity affects specific ecosystem functions (functional diversity). Some LCA indicators have been proposed in this context but are rarely implemented in practice. Second, indicators often focus on vascular plants, although more recent proposals include other taxonomic groups. Plants are an important component of terrestrial ecosystems, but they only make up a fraction of estimated species on a given landscape and their reaction to land use is not necessarily representative of potential effects on other species groups. In addition, many biodiversity assessment methodologies used in LCAs have a unidirectional focus on loss, damage or extinction. It is very often assumed that using less land results in fewer negative effects. In contrast to a simple unidirectional metric of biodiversity loss, however, the relationship between forest management and biodiversity is highly complex, is dependent on spatial scale and, in many cases, can include positive effects on biodiversity. Finally, available biodiversity indicators can typically be applied only to a few categories of forest management practices (e.g., "intensive" and "extensive"). These limited categories are far from being sufficient to appropriately describe the range of forest management practices and hence, results generated from applying these indicators are of limited practical utility.

Conclusion

Many proposed approaches for integrating biodiversity considerations in LCAs rely on a single indicator of biodiversity even though biodiversity is a multidimensional concept that can never be fully represented by a single measure. However, using multiple LCA indicators for biodiversity would create a disproportionate focus on biodiversity compared to other environmental aspects for which LCA uses only one indicator.

Biodiversity is a key component that should be considered when undertaking an LCA. However, at this time, given the considerations discussed above, using LCA approaches for biodiversity should be limited to identifying the primary risks associated with biodiversity in complex supply chains. These approaches are not suitable for product comparisons (e.g., wood vs. steel or concrete; bioenergy vs. fossil fuels; virgin vs. recycled paper) and will likely lead to inappropriate conclusions about effects of local forest management practices. Therefore, successful consideration of biodiversity responses to forest management in the context of LCAs requires integration of other approaches such as site-specific and/or territorial studies or analyses, which should be considered as an essential complementary tool to LCA.

References

Material in this Fact Sheet was derived from the following references.

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