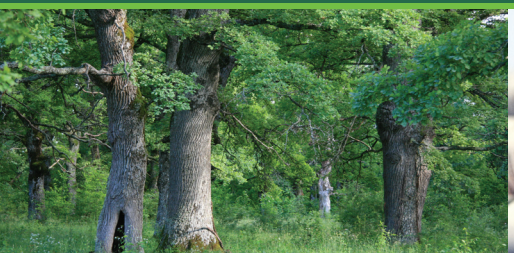
Forest Stewardship Council®
FSC® International



May 2016

PRODUCT SUSTAINABILITY ASSESSMENT: FSC CALLS FOR ADDRESSING THE LIMITATIONS OF LIFE CYCLE ASSESSMENT WITH CERTIFICATION

Executive Summary

• Excessive and unsustainable natural resource use is behind the most important threats to the ecosystems we depend on, and also often comes with negative social impacts.

• The first step for reducing the impacts of our currently unsustainable production and consumption patterns is to systematically assess the impacts of specific resource extraction, production, and consumption processes.

• Life cycle assessment (LCA) is a useful tool for understanding the environmental impacts of production processes, but it has limitations when forestry, fishing, mining or agriculture are at the start of the supply chain, and it does not address social issues.

• LCA is designed to assist in finding the highest product output possible with the least environmental damage. But it is geographically blind and overlooks impacts that happen in the early stages of the product cyle, when natural resources used in production are extracted. This is particularly problematic for forest-based products. In paper production, for example, the majority of long-term environmental impacts happen during the forest management phase of the product cycle.

• LCA is therefore significantly limited in characterizing pressing enviromental and social challenges including biodiversity loss, land use change, threats to ecosystem services, the erosion of Indigenous Peoples rights, and poor working conditions.

• FSC forest certification, when fully implemented, promotes the positive environmental, social, and economic opportunities of forestry at the beginning of a product's life cycle and aims to prevent negative impacts.

• FSC calls upon all those who apply, use or require LCA to recognize its limitations, and to address these with requiring that negative impacts beyond the scope of LCA are prevented or minimized. For paper and other wood-based products, FSC certification is the best way of doing this.

Photos: ©FSC GD / Milan Reska / Arturo Escobar / Jean-Baptiste López

Forest Stewardship Council® (FSC®) · ic.fsc.org · fsc@fsc.org
FSC A.C.· Calle Margarita Maza de Juárez 422 · Colonia Centro · Oaxaca CP 68000 · Mexico
Public Registry of Property and Commerce: Oaxaca · Mexico, Registration No. 38602
FSC® F000100

FSC FORESTS FOR ALL FOREVER™

Product sustainability assessment: FSC calls for addressing the limitations of Life Cycle Assessment with certification

Many of the direct threats to the stability of our planetary systems occur in agriculture, forestry, fishing, and mining[1]. The context of climate change, biodiversity and soil fertility loss, water scarcity, and other environmental problems demands that we systematically minimize the negative impacts of our growing use of natural resources, as well as applying practices that reduce our overall use of virgin resources.

Assessing the environmental sustainability of production is often a first step towards changing production processes to reduce negative environmental impacts. Currently, the most common tool is life cycle assessment (LCA), used by producers to internally monitor and inform their clients about their environmental performance, and by governments and standard-setters to prepare binding or voluntary minimum requirements for products.

While LCA helps to understand some of the environmental impacts of production processes, it is not well equipped to assess impacts on surrounding ecosystems. This is particularly the case when forestry, fishing, mining, or agriculture are at the start of the supply chain. In addition, LCA does not cover social impacts related to the sourcing of virgin materials.

This position paper[2] explains the limitations of LCA methods, describing the uncertainties – and even perverse impacts – that they can create. It discusses why it is necessary to complement the calculated potential impacts LCAs provide with evidence of sustainable resource management. It explains why for wood-based products, Forest Stewardship Council© (FSC©) certification is the best proxy to ensure that the environmental and social impacts of resource mobilization from forest ecosystems are neutral or positive.

FSC applauds those who have taken measures to address the limitations of LCAs for wood-based products. These include several ecolabel standard-setting organizations, including the European Union, Nordic Ecolabelling, and Der Blaue Engel, which require certification of forest resources as a precondition for licensing ecolabel use on relevant products. Several governments and local authorities have also included certification as an element of green or sustainable public procurement policies.

FSC calls upon all those who use or require LCAs to recognize its limitations, and to address these with guarantees that negative impacts beyond the scope of LCA are prevented or minimized. For paper and other wood-based products, FSC certification is the best way of doing this.

What is at stake?

Imagine you're in a poorly managed logging site: nothing but stumps as far as you can see; deep ruts in the soil; sections of hillside fallen away because of soil erosion, and streams overwhelmed by soil runoff; a local community fenced out, with no voice in the future of the forest and no access to the medicinal plants that they have gathered for decades; birds having lost their nests and migratory pathways. LCA captures none of this loss[3].

Now imagine you're in a responsibly managed forest: birds are chirping; evidence of logging is limited to selective skid trails and moderate soil disturbance; biodiversity corridors allow for wildlife movement; only an appropriate amount of logs have been removed from the site; the local community is engaged in the ongoing management of the forest. LCA doesn't capture any of this preservation of forest value, either.[4,5,6,7]

Why does LCA miss so much?

LCA was developed principally by engineers who sought to understand the impacts and risks associated with their industrial production practices and supply chains, and to identify efficiencies in production[8]. It was originally applied to factory-based industrial practices, and based on measurements of inputs (energy use, delivery of raw materials, water use) and emissions (air emissions, water emissions) which were already collected as part of the financial management of companies (e.g. their electricity bills) or their compliance reporting (e.g. SOx emissions).[9,10] Increasingly, LCA is being adopted by companies and governments to conduct sustainability assessments of products, services and even whole sectors,[11,12,13,14] in part because it is seen to provide a 'one-stop shop' that delivers information on many environmental attributes.

The provenance of LCA is important to understand because it has significant influence on the appropriate application, strengths and failings of the method. LCA can provide reasonable estimates of certain types of impacts, where data is available, but it is not a fail-safe method for understanding all significant impacts along the supply chain.[15,16,17] It is an 'efficiency-based model', designed to calculate the highest product output possible with the least environmental damage. It assumes everything in the lithosphere and biosphere is available for human extraction – ignoring the basic needs of the providing ecosystem. And because it views the production chain or technological system as being separated from its surrounding environment by a system boundary, LCA is also geographically blind. **As a result, LCA doesn't adequately represent how the natural resources used in production were extracted, or the impact that extraction has on the local environment, surrounding communities, or on natural resources needed for future human wellbeing.**[21,22]

As currently practiced and applied to forest-based products, LCA does not typically give appropriate value to the existing ecosystem or natural capital prior to resource extraction – the so-called 'cradle' phase of production – partly because there is a significant gap in data quantifying them. LCA does not assess life-cycle phases for which there is no available information; this can lead to a conclusion of 'no impact', when in fact there is simply limited data.[23] LCA claims to evaluate all relevant environmental impacts, but a tool that is geographically blind and does not consider the long-term health of an ecosystem can neither capture the negative nor positive aspects of forest management.

How serious are the limitations?

These limitations are particularly problematic when forestry, fishing, or agriculture –processes that transcend the boundary between industry and nature – form a significant part of the product life cycle.[24] In these cases, ecological histories (natural forest establishment, trophic relationships, soil horizon building) and climatic conditions influence production.[25] And when future production relies on the continued integrity of the ecosystem, we need to pay attention to those factors that threaten ecosystem survival, including deforestation and forest degradation, soil health, species loss, environmental flow requirements, and community and social values.[26] These are broader issues and necessitate approaches that look through the lens of sustainable systems, rather than simply focusing on products.[27] In the field of material flow analysis, this difference is understood as needing to look at both stocks and flows, rather than only at flows or removals, as LCA does[28,29,30].

As early as 1995, a meeting of experts in the forest products industry highlighted the limitations of LCA, reflecting that the majority of the long-term impacts from paper production activities – natural resource depletion, terrestrial ecological impacts, and disturbance – occur in the forest management phase of the life cycle during silviculture and harvesting.[31] The second most impactful phase, according to this panel of experts, is pulp production, which creates air and water pollution. The earlier life-cycle phases, of natural state to extraction to manufacturing, are poorly characterized by life-cycle inventory data.[32] This data gap is important because 'hotspots' [33] identified by LCA will tend to be biased by the availability of data.This data 'blindspot' can mislead users into focusing on manufacturing and distribution, even in cases where the majority of impacts actually occur in the silviculture or harvesting phases.

Using LCA – particularly considering the tool's inherent limitations in characterizing the time and multiple factors that it takes for a forest to form naturally, and any other site-specific criteria – could therefore result in unintended penalties for forest product companies who have invested heavily in responsible forest management.[34,35] Inappropriate use of LCA could also provide a 'windfall' for opportunistic companies, whose business models are dependent on land clearing, intensive land use, and short-term gains that result in rebound effects which occur when technologies that increase the efficiency of resource use in fact result in negative environmental impacts because of systemic responses.[36,37,38] In short, LCA overlooks good forestry practices and may reward bad forestry practices.

While LCA experts have been developing new methods in these areas, there is a significant data lag, and a risk of focusing on hotspots only.

In conclusion, judgments based on LCA as a stand-alone tool are particularly troubling because of its significant limitations in characterizing some of the most pressing environmental and social challenges of our time, including biodiversity loss, land use change, threats to ecosystem services,[39] violation of indigenous rights, poor labour practices, and circularity (the capacity of a product to be repaired, reused, or recycled).[40,41]

From the dead tree back to the forest ecosystem: Combine LCA with forest certification

Given its limitations, LCA needs to be complemented with tools that ensure that a product's impact on natural resources is fully considered and minimized. FSC suggests that whenever forests are part of the resource base for a product system, there should be a requirement to use forest certification to complement LCA. Forest certification is the most reliable instrument to bring evidence for the sustainable management of the wood source into the analysis of product sustainability.

Forest certification is based on expert-informed and well-supported prioritization of the most significant impacts and life-cycle stages of timber products – in the forest.

FSC certification, when fully implemented, promotes the positive aspects of forestry at the beginning of a product's life cycle and alleviates the negative impacts, while promoting improved holistic forest management. This can extend our understanding of a product's life cycle, giving us a systems view beyond just the product. But FSC certification does not measure emissions from the manufacturing phases, so it does not address, for example, impacts from water effluence during the pulp phase.

LCA helps to understand the manufacturing, transport and end-of-life phases to further address any significant impacts in supply chains. Combining LCA with (FSC) certification will address all relevant environmental problems in a practice-, geography- and process-specific manner.

Forest certification and FSC

FSC is an independent non-governmental organization that promotes environmentally sound, socially beneficial, and economically prosperous management of the world's forests. From its creation in 1993, FSC also helped consumers and businesses identify products from well-managed forests.
FSC sets standards for forest management, which include legal, environmental, social and economic, and monitoring requirements. Foresters who comply with these requirements can become certified and use this status in their communications and trade. Granting of certificates and regular verification of performance is carried out by independent certification bodies which are overseen by a specialized organization, Accreditation Services International.

To ensure that wood harvested in FSC-certified forests ends up in FSC-labelled products in a reliable manner, FSC has also developed standards and procedures for companies active in the supply chain. FSC labelling of certified products is allowed only when all the companies in such a chain are FSC-certified.

Currently, more than 187 million hectares of forest are certified to FSC standards (13 per cent of the world's production forests), and 32,000 forest management and chain of custody certificates have been issued, world-wide.

For more information visit **ic.fsc.org**.

The added value of combining LCA with forest certification

1. Geography-specific criteria with on-the-ground impact

Primary environmental and social risks associated with timber, pulp, and paper production include forest degradation and natural forest conversion – which can result in severe biodiversity loss, ecosystem services loss, freshwater impacts, and greenhouse gas emissions – and the displacement or exclusion of local and indigenous communities. These are geographically-specific impacts with long-term and possibly irreversible consequences.

FSC certification occurs at the level of a specific forest management unit and the latitude and longitude coordinates of the unit are associated with the FSC certificate. Its requirements have been adapted to specific contexts in 80 countries, so that the guidance in the standard is aligned with regionally appropriate forest management techniques. It also reflects a high bar for stewardship within a specific site, while considering the direct and indirect impacts on the broader surrounding systems.

Forest management criteria include maintaining the natural functions of a forest concession, protecting high conservation values, and integrating solutions-oriented engagement with affected stakeholders. These location-specific criteria require adaptive management through regular monitoring of an operation's practices and impacts downstream, regardless of whether that impact is within or outside the concession boundary. Such impacts might include a skid road through a stream, compromising downstream water quantity and quality, or disruption of the migratory path of an important species.

The current structure of life-cycle inventory data – the information used in an LCA – does not allow individual flows to be fixed to a specific location; this limits the tool's ability to provide place-based assessments. The impacts of industrial processes and resource extraction are modelled independently from geographic location. Primary data for LCAs is typically collected for the process that is being studied, and upstream and downstream processes are modelled using secondary data. This data often reflects an industry average of performance, and is not specific to the supply chain.

2. Social impacts for long-term sustainability

Governments can face economic instability and companies face reputational risks when they do not consider the social impacts of processes throughout the supply chain. A growing body of evidence[42, 43, 44] connects indicators of social wellbeing – like respected customary rights, secure land tenure, and community health – to sustained ecological and economic stability. Three of the FSC principles focus directly on community and Indigenous Peoples' rights. A 2013 study measured positive social changes in and around FSC-certified concessions in the Congo Basin when compared to non-certified concessions, which included improved living and working conditions, more equitable contribution to local economies, and fewer unexpected social conflicts because of permanent communication channels between forest managers and local populations[45]. FSC certification includes specific criteria for maintaining the scenic, cultural, and recreational values of a forest, protecting critical ecosystem services, and improving the resilience of a forest to future hazards.

LCA does not normally address socio-economic factors in the forest product supply chain. Recently, new methods in 'social LCA' have been developed[46] to address this gap, but they are considered nascent and crude in their ability to address site-specific impacts.[47] These limited approaches to addressing the social impacts of a product are not culturally or geographically specific enough to indicate the sustainability or stability of supply at its origin. For these methods to gain wider credibility and adoption, more engagement with civil society actors working on the social impacts of resource extraction is needed.

3. Transparency and performance

In order to ensure robust sustainability assessment, transparency in both the methodology and the results is paramount. Furthermore, to be robust, sustainability assessments must attain a certain level of performance. So, while a company can report calculations of their impact in a transparent way, that does not indicate that they have addressed the issues identified, or achieved a high level of sustainability performance. So leadership in sustainability assessment includes both transparency and high performance. The methods and criteria of both FSC certification and LCA are published in publicly available standards, and both can promote transparency in reporting environmental information. But only forest certification ensures that a certain level of performance has been achieved, whereas LCA does not.

FSC forest certification includes third-party, on-site auditing by independent forestry and social experts; the findings of these audits are made publicly available for review. The FSC audit reports include site-specific information about the forest and requirements for improved management to be compliant with the FSC standard. This transparency allows for greater stakeholder engagement in management of specific FSC-certified forests, and has influenced the stakeholder consultations that shape FSC standards.

LCA is applied as a transparency tool, usually through Environmental Product Declarations,[48] LCA-informed documents that reflect the enviornmental impact results of a specific product in a format that is comparable with other products in the same category. This allows a user to see the difference in performance between two products, but does not require a standard be met as part of the comparative process.

4. Legality throughout the supply chain

Illegal logging causes loss of revenues for producing countries, depresses market prices, contributes to organized criminal activity, disrupts the potential for local forest-based livelihoods, and disadvantages companies that produce and sell legally sourced forest products.[49] The gravity of illegal logging is global in scale, and cannot be effectively reduced so long as market signals tolerate and even encourage non-compliance with local or national laws. Forest certification reduces many of the risks of illegality[50] in sourcing forest products. This is not an issue that LCA is designed to address.

Adherence to all legal requirements does not necessarily mean that forest management is sustainable in social, economic, or environmental terms, and certification cannot serve as an entirely foolproof method for verifying that wood comes from legally managed operations. But the FSC system's core structure involves annual monitoring of criteria that includes an operation's legal compliance, with timebound requirements for remediation, reducing the risk of illegality. FSC certificate holders also demonstrate respect for customary land tenure and access rights, and work to resolve related conflict as it arises. LCA does not address legality and includes no mechanism for enforcement of preferred practices.[51]

5. 'Deforestation-free' commitments

In an effort to exhibit responsible sourcing and to slow down climate change, a significant number of companies and governments are making 'deforestation-free' commitments for their supply chains.[52]

For the timber, pulp and paper supply chains, FSC provides requirements on allowable land use change, limiting change from natural forest to plantations unless there are either clear conservation benefits[53] or evidence that the change will not damage or threaten high conservation values.[54] Organizations that have contributed to deforestation are prevented from joining the system, or certifying previously converted land. Additionally, impact evaluation research has shown that FSC certification is extremely effective in preventing deforestation when compared with other forest management systems.[55, 56, 57]

LCA does not address 'deforestation-free' commitments, and given the lack of geographically specific data that is specific to a particular supply chain, it is hindered in its use as a tool toward this end.

Some examples of combining LCA with forest certification

• **The European ecolabel:** The European Commission sets criteria for European ecolabels in cooperation with national competent bodies. The basis for discussion is research done by its Joint Research Centre, which applies LCA, but also investigates the markets; stakeholders are also consulted. For all forest-based products, the limitations of LCA are systematically compensated for by having a specific, non-conditional requirement for sourcing from sustainably managed forests. And forest certification (FSC, Programme for Endorsement of Forest Certification (PEFC), or "equivalent") is required as evidence.[58]

• **The Nordic Swan:** Set up by the authorities of Denmark, Sweden, Finland, Norway and Iceland, sustainable forest management has long been one of this ecolabel's core requirements. In 2015, it revised its rules and now usually requires 70% certified wood, with the rest coming from controlled sources according to FSC or PEFC. In addition, it has produced a list of species that are not allowed at all.[59]

• **Der Blaue Engel/The Blue Angel:** Set up by the German Federal authorities, this ecolabel requires forest resources that come from sustainably managed forests. The evidence of this that producers have to provide varies from one product group to another.[60]

• **Public procurement policies:** In many countries, governments at national, regional or local levels include environmental and sometimes social criteria in their tenders for goods and services. Increasingly, these criteria go beyond the performance of the good or service itself, but refer back to the production process. For forest-based products, public authorities often require certification before they set more comprehensive, LCA-based requirements. This because of civil society pressure in particular to avoid co-responsibility for illegal logging and the destruction of tropical forests.

• **Leadership in Energy and Environmental Design (LEED) certification system:**The US Green Building Council's LEED certification system for green buildings promotes the use of wood as a building material because of its inherent environmental advantages compared to other construction materials. It then recognizes FSC certification as evidence of the sustainable sourcing of (virgin) wood materials.

Conclusion

Current sustainability assessment or rating systems that are based solely or principally on LCA, or that weigh LCA evidence over all other scientific information (i.e. EU Product Environmental Footprint, or the methods used by the Sustainability Consortium), run the risk of under-estimating impacts on the providing ecosystem or the natural resource base.[61] As outlined above, critical, geographically specific impact areas like land use change, biodiversity and ecosystem services loss, freshwater, and social dimensions are not captured by current LCA-based systems of sustainabilty assessment. These impact areas are vital to maintaining a sustainable natural resource base, particularly in the face of an uncertain future because of climate change.

While the life-cycle perspective is important to consider in product-level assessments, it should be complemented with other tools in order to fully cover the impacts mentioned above. Certification systems that promote responsible management of our resource base provide a credible complement to an LCA assessment, and provide benefits that include geographically specific impact areas, social impacts, a high standard of sustainability performance, and provisions that combat illegality in supply chains.

FSC RECOMMENDATIONS

Be clear on your question, and use the right tools to ask it. As discussed above, forest management standards like FSC and production-based sustainability assessments like LCA were developed for different purposes and by different communities of practice. It is important to understand these differences in development and intent, and apply the tools to the appropriate context in environmental management. If you are concerned with managing your resource base and reducing supply risks and social risks, forest certification is a better tool. Additionally, FSC can help to reduce the risk of illegality and deforestation in the sourcing of your forest products. If you are seeking to analyze relative risks across the life cycle of your product, LCA is a helpful tool when sufficient and representative data is available.

Play to the strengths of different tools. FSC certification and LCA can be complementary tools. FSC certification indicates whether criteria for responsible forest management have been achieved at the beginning of the product's life cycle, and manages the forest with a systems view that looks beyond the product. While initial forest area and silvicultural practice assessments are an essential part of the certification process, FSC certification goes beyond this assessment to guide management that both mitigates negative impact and adds value to the surrounding ecological and social systems. LCA helps to understand the manufacturing, transport, and end-of-life phases to further address any significant sustainability impacts in supply chains. Combining LCA with (FSC) certification will address all relevant environmental problems in a practice-, geography- and process-specific manner.

Source forest products from credibly verified, responsibly managed forests.
While FSC recognizes that it does not cover the environmental impacts of the supply chain beyond the forest gate, the importance of ensuring sustainable sourcing of raw materials has become more and more essential. As described above, this dimension of sustainability is not sufficiently included in the LCA method. When assessing forest-dependent product supply chains, LCA users must therefore utilize the appropriate methods and tools available to ensure sourcing for well-managed forests. Today, forest certification is the most reliable way to assess and manage for long-term forest health, provided the certification system is reliable and effective.

Enrich LCA with the benefits of FSC forest management practices. Evidence from several studies reflects the positive benefits of FSC forest management on biodiversity retention, reduced land use change/deforestation and social goods.[62, 63, 64] These benefits, achieved through better forest management, should be reflected in the life-cycle inventories of products coming from FSC-certified forests and included in LCA studies and comparisons with other products that do not originate from FSC-certified forests. Sustainability assessment systems should reward companies who can show that they are investing in the sustainability of their natural resource base, and are providing additional ecosystem services as a result.

Test the effectiveness of these tools. FSC has been challenged to prove that its certification system results in the positive environmental benefits that it was conceived to deliver through better forest management. In response to this challenge, a number of studies and impact evaluations[65] have been conducted to test various social and environmental outcomes and impacts of FSC certification.[66, 67] Some of the studies have found that there is a high correlation between FSC-certified sites and maintained biodiversity, reduced deforestation, reduced illegality risk, and an increase in livelihoods and health for communities.[68] LCA should be challenged and evaluated in a similar way, to be certain that the time and money invested in the methodology and the environmental management changes that result from LCAs are resulting in positive physical change for the environment and social systems.

For further information, please contact:

John Hontelez, Chief Advocacy Officer

j.hontelez@fsc.org

REFERENCES

[1] *See for example: Rockström, J. et al.(2009) Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2):32.*

[2] *In writing this paper, we appreciate the assistance of two experts in this field, Martha Stevenson and Annika Terrana from WWF USA. They also produced a detailed comparison of FSC and LCA as sustainability assessment tools for forest products, which can be found on the WWF USA website: https://www.worldwildlife.org/publications/detailed-comparison-of-fsc-and-lca-as-sustainability-assessment-tools-for-forest-products.*

[3] *This paper is considers the current and most common practices in LCA.*

[4] *Johnston, R. (1997) A critique of life cycle analysis: paper products. In Richards, D.J. (ed.) The Industrial Green Game: Implic ations for Environmental Design and Management, pp. 225–233. National Academy Press, Washington DC.*

[5] *Alvarenga, R.F., Erb, K-H., Haberl, H., Soares, S., van Zelm, R., and Dewulf, J. (2015) Global land use impacts on biomass production – a spatial-differentiated resource-related life cycle impact assessment method. The International Journal of Life Cycle Assessment 20(4):440–450.*

[6] *Fruhwald, A., and Solberg, B. (eds) (1995) Life Cycle Analysis: A Challenge for Forestry and Forest Industry. Proceedings of an international workshop organized by the European Forest Institute and the Federal Research Centre for Forestry and Forest Products, 3–5 May 1995, Hamburg, Germany.*

[7] *Klinglmair, M., Sala, S., and Brandão, M. (2014): Assessing resource depletion in LCA: a review of methods and methodological issues. The International Journal of Life Cycle Assessment. 19(3):580–592.*

[8] *Baumann, H. and Tillman, A-M. (2004) The Hitch Hiker's Guide to LCA. Studentlitteratur, Lund, Sweden.*

[9] *Finnveden, 2000.*

[10] *Baumann and Tillman (2004) Op. cit.*

[11] *Erlandsson, J., and Tillman, A-M. (2009) Analyzing influencing factors of corporate environmental information collection, management and communication. Journal of Cleaner Production 17:800e810.*

[12] *Fava, J., Baer, S., and Cooper, J., (2011) Green(er) product standard trends in North America. Journal of Industrial Ecology 15:9e12.*

[13] *The Sustainability Consortium. https://www.sustainabilityconsortium.org/adopting-lca/ (accessed 3 March 2016).*

[14] *European Commission, Environment. http://ec.europa.eu/environment/eussd/smgp/policy_footprint.htm (accessed: 3 March 2016).*

[15] *Jolliet, O., Müller-Wenk, R., Bare, J., Brent, A., Goedkoop, M., Heijungs, R., Itsubo, N., Peña, C., Pennington, D., Potting, J., Rebitzer, G., Stewart, M., de Haes, H., and Weidema, B. (2004) The LCIA midpoint-damage framework of the UNEP/SETAC life cycle initiative. The International Journal of Life Cycle Assessment 9(6):394–404.*

[16] *Finnveden, G. (2000) On the limitations of life cycle assessment and environmental systems analysis tools in general. International Journal of Life Cycle Assessment 5(4):229–238.*

[17] *Freidberg, S. (2013) Calculating sustainability in supply chain capitalism. Economy and Society 42:571–96.*

[18] *Milà i Canals, L., Orr, S., and King, H. (2009) Water footprinting and life cycle assessment – a discussion note. Unpublished paper.*

[19] *Alvarenga et al (2015) Op. cit.*

[20] *Freidberg (2013) Op. cit.*

[21] *Alvarenga et al (2015) Op. cit.*

[22] *Klinglmair et al (2014) Op. cit.*

[23] *Chaudhary, A. (2014) Life cycle assessment of wood products: filling data gaps and developing new impact assessment methods. Paper presented at Swiss National Science Foundation NRP66 Progress Report Meeting, Morten, Switzerland, 9–11 April.*

[24] *Ibid.*

[25] *Fruhwald and Solberg (eds) (1995) Op. cit.*

[26] *Hassan, R., Scholes, R. and Ash, N. (2005) Millennium Ecosystem Assessment 2005: Ecosystems and Human Well-being: Findings of the Conditions and Trends Working Group Volume 1. Island Press, Washington, DC.*

[27] *Freidberg (2013) Op. cit.; Finnveden, G., Hauschild, M.Z., Ekvall, T., Guinée, J., Hiejungs, R., Hellweg, S., Koehler, S., Pennington, D., and Suh, S. (2009) Recent developments in life cycle assessment. Journal of Environmental Management 91(1):1–21.*

[28] *Klinglmair et al (2014) Op. cit.*

[29] *Fruhwald and Solberg (eds) (1995) Op. cit.*

[30] *Finnveden (2000) Op. cit.*

[31] *Fruhwald and Solberg (eds) (1995) Op. cit.*

[32] *Johnston (1997) Op. cit.*

[33] *The term "hotspots" is used in LCAs to describe the stages in the life cycle of a good orservice that make the largest contributions to the total environmental impact.*

[34] *Freidberg (2013) Op. cit.*

[35] *Fruhwald and Solberg (eds) (1995) Op. cit.*

[36] *Finnveden et al. (2009) Op. cit.*

[37] *Environmental Resources Management's 2008 study of Asia Pulp and Paper's carbon footprint study was questioned and criticized by environmental NGOs for ignoring land use change and peat draining (see, for example https://environment-analyst.com/3213, accessed 3 March 2016). All references to the original report have been removed from APP website.*

[38] *Alvarenga et al (2015) Op. cit.*

[39] *Wegener Sleeswijk, A., Kleijn, R., Meeusen-van Onna, M.J., Leneman, H., Sengers, H.H., van Zeijts, H., Reus, J.A., (1996) Application of LCA to Agricultural Products; 1. Core Methodological Issues; 2. Supplement to the LCA Guide; 3. Methodological Background. Institute of Environmental Sciences, Leiden University. Available at https://openaccess.leidenuniv.nl/handle/1887/11471 (accessed 3 March 2016).*

[40] *Finnveden et al. (2009) Op. cit.*

[41] *Freidberg (2013) Op. cit.*

[42] *CIHR (2014) Human Rights in Conservation: Progress Since Durban. Conservation Initiative on Human Rights, Gland.*

[43] *CBD (2010) Linking Biodiversity Conservation and Poverty Alleviation: A State of Knowledge Review. Convention on Biological Diversity, Montreal.*

[44] *Chivian, E. and Bernstein, A. (eds) (2008) Sustaining Life: How Human Health Depends on Biodiversity. Oxford University Press, New York.*

[45] *Cerutti, P.O., Tacconi, L., Nasi, R., and Lescuyer, G. (2011) Legal vs. certified timber: preliminary impacts of forest certification in Cameroon. Forest Policy and Economics 13(3):184–190.*

[46] *Benoit, C. (2009) Guidelines for Social Life Cycle Assessment of Products. United Nations Environment Programme and Society of Environmental Toxicology and Chemistry Life Cycle Initiative. UNEP, Nairobi.*

[47] *Finnveden et al. (2009) Op. cit.*

[48] *Ingwersen, W.W. and Stevenson, M.J. (2012) Can we compare the environmental performance of this product to that one? An update on the development of product category rules and future challenges toward alignment. Journal of Cleaner Production 24:102–108.*

[49] *Hoare, A. (2011) Tackling Illegal Logging and the Related Trade: What Progress and Where Next? Chatham House Report. Royal Institute of International Affairs, London.*

[50] *Cerutti et al (2011) Op. cit.*

[51] *ISO (2006) International Standard in Environmental Management – Life Cycle Assessment – Requirements and Guidelines. International Organization for Standardization, Geneva.*

[52] *UN Climate Summit (2014) New York Declaration on Forests. United Nations, New York. Available at http://www.un.org/climatechange/summit/wp-content/uploads/sites/2/2014/07/New-York-Declaration-on-Forest-%E2%80%93-Action-Statement-and-Action-Plan.pdf (accessed 3 March 2016).*

[53] *FSC STD-01-001 V5, criterion 6.9. Available at FSC-STD-01-001 V5-2 EN.pdf (accessed 3 March 2016).*

[54] *The six categories of high conservation values are: concentrations of biodiversity; intact and landscape-level ecosystems; rare, threatened, or endangered species; critical ecosystem services; basic community needs; and culturally or historically significant sites and values. See https://www.hcvnetwork.org/about-hcvf/the-six-high-conservation-values (accessed 3 March 2016).*

[55] *Price, F. (2010) The Nature Conservancy and tropical forest certification. In Sheil, D., Putz, F.E., and Zagt, R.J. (eds). Biodiversity Conservation in Certified Forests, pp. 105–111. Tropenbos International, Wageningen, the Netherlands.*

[56] *Hughell, D., and Butterfield, R. (2008) Impact of FSC Certification on Deforestation and the Incidence of Wildfires in the Maya Biosphere Reserve. Rainforest Alliance, New York.*

[57] *Miteva, D.A., Loucks, C.J. and Pattanayak, S.K. (2015) Social and environmental impacts of forest management certification in Indonesia. PLoS ONE 10(7): e0129675. doi:10.1371/journal.pone.0129675.*

[58] *http://ec.europa.eu/environment/ecolabel/products-groups-and-criteria.html*

[59] *http://www.nordic-ecolabel.org/portals/paper/paper-and-pulp/forestry/*

[60] *https://www.blauer-engel.de/en/companies/basic-award-criteria*

[61] *Freidberg (2013) Op. cit.; LaChappelle, J. (2014). 'The buzz about LCA: How do sustainability standards compare? An interview with Martha Stevenson' ISEAL blog, 14 June. See http://www.isealalliance.org/online-community/blogs/the-buzz-about-lca-how-do-sustainability-standards-compare (accessed 15 March 2016).*

[62] *Karmann, M. and Smith, A. (2009) FSC reflected in scientific and professional literature: Literature study on the outcomes and impacts of FSC certification. FSC Policy Series P001. Forest Stewardship Council, Bonn*

[63] *Sheil, D., Putz, F.E. and Zagt, R.J. (eds) (2010) Biodiversity Conservation in Certified Forests.Tropenbos International, Wageningen*

[64] *Cubbage, F. Diaz, D., Yapura P., and Dube F. (2010) Impacts of forest management certification in Argentina and Chile. In: Forest Policy and Economics 12(7): 497–504.*

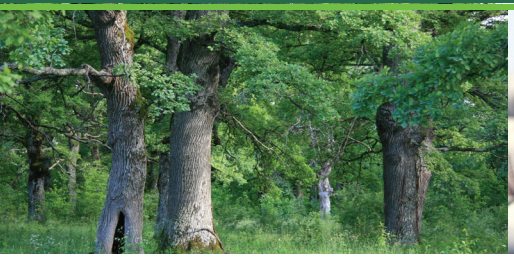
[65] *A rigorous scientific method involving quasi-experimental, matched site studies.*

[66] *de Lima, A.C.B., Novaes Keppe, A.L., Corrêa Alves, M., Maule, R.F and Sparovek, G. (2008) Impact of FSC forest certification on agroextractive communities of the state of Acre, Brazil. Instituto de Manejo e CertificaçãoFlorestal e Agrícola, Piracicaba*

[67] *Auld, G., Gulbrandsen, L.H. and McDermott, C.L. (2008) Certification schemes and the impacts on forests and forestry. Annual Review of Environment and Resources 33: 187–211.*

[68] *Hughell and Butterfield (2008) Op. cit.; Miteva et al (2015) Op. cit.*

Forest Stewardship Council®
FSC® International



FSC FORESTS™ FOR ALL FOREVER

ic.fsc.org

Forest Stewardship Council® (FSC®) · ic.fsc.org · fsc@fsc.org
FSC A.C.· Calle Margarita Maza de Juárez 422 · Colonia Centro · Oaxaca CP 68000 · Mexico
Public Registry of Property and Commerce: Oaxaca · Mexico, Registration No. 38602
FSC® F000100