



Detailed Comparison of FSC and LCA as Sustainability Assessment Tools for Forest Products

This section provides side-by-side, detailed descriptions of FSC Forest Management certification and LCA covering Use, Definition, Governance, Forest Management, Socio-Economic Impacts and Environmental Impacts. These elements are important to understand if comparing the systems for use in a forest product sustainability assessment.

It should be noted that while FSC Forest Management certification, Chain of Custody certification, and Controlled Wood certification all relate to the origins of forest products, stages of production, and subsequent progress of forest products through the value chain, the FSC Controlled Wood standards for forest management and chain of custody do not carry the same degree of protections that the FSC FM standard requires and FSC 100% label denotes. For the purposes of this table, “FSC” is interpreted as the FSC Forest Management Certification, as this is the intended practice of FSC, and does not examine the limitations of Controlled Wood. Likewise, LCA is being discussed in this section as the standard or typical LCA practice. There are new methodologies that have been developed or are in development to address some of the below-referenced issues, but they are either not widely adopted or the inventory data is not available to fully implement the method.

	FSC	LCA
Who uses it, and why?		
Purpose	Used to guide, verify, reward and communicate responsible forest management practices and associated trade in certified forest products.	Mostly used for decision support to make: 1. Internal process improvements or 2. External marketing claims/comparisons
Audience	FSC claims are used in both B2B and B2C communication.	Results are geared toward a professional/technical audience.
How is it defined and governed?		
Standard	<p>National FM standards are adapted from the global FSC-STD-01-001 V4 and V5 (<i>FSC International Standard, Principles and Criteria for Forest Stewardship V4 and V5- 2</i>) in accordance with Codes of Good Practice for ISO/IEC Guide 59, ISEAL P005 Version 5.01, and WTO Agreement on TBT.</p> <p>FSC delivers guidance for proper implementation of its standard. For P&C V4, national interpretation is particularly relevant where a national FSC office or standard-setting body does not exist, and individual certifying bodies adapt the P&C to performance-based indicators. In these cases, different certifying bodies might interpret application and auditing of the P&C differently.</p> <p>Adoption of P&C v5 is supported by FSC-STD-60-004 V1-0b (<i>International Generic Indicators</i>), which aims to ensure the consistent implementation of the P&C globally and replace the Certification Body's Interim Standards in countries without approved National Forest Stewardship Standards.</p>	<p>ISO 14040/44 are the standards developed to guide LCA studies. They are primarily process and documentation standards under the environmental management series. There is significant room for interpretation of how to implement the standard as long as proper documentation is made of why a study excluded issues or life cycle phases.</p> <p>It is important to note that the ISO standards are written for a study, however many organizations have been adapting LCA methods for quick LCA decision software tools. This cuts out the iterative process built in to LCA between inventory and impact assessment and also removes the more thoughtful interpretation phase of the assessment with a snap decision. A significant amount of the rigor and reflection built in to the standard is lost in these software tools.</p>
Governance	FSC is an independent non-governmental organization and membership association, governed by over 800 members. Members belong to one of three chamber—environmental, social, and economic—which are sub-	ISO – who manages the LCA standards - is an independent, non-governmental organization made up of members from the national standards bodies of 162 countries. A central secretariat coordinates the system

	<p>divided into northern and southern sub-chambers for equal weighting in voting decisions of board members and changes to policies within the FSC system. Members meet at a triennial General Assembly, considered the highest decision-making body. FSC is a member of ISEAL.</p> <p>FSC's central secretariat leads the FSC Global Network of national offices and representatives in 40+ countries.</p>	<p>and is based in Geneva, Switzerland. Members meet as a General Assembly each year to manage organizational priorities.</p> <p>Another influential group in the LCA field is the UNEP-SETAC Life Cycle Initiative. This body advances the practice of LCA in response to the Malmö Declaration (2000) and 10-Year Framework of Programmes to promote sustainable consumption and production patterns established at the WSSD in Johannesburg (2002).</p>
Third Party Review/Audit	<p>Accreditation Services International accredits and audits Certifying Bodies according to FSC-STD-20-001 and ISO requirements.</p> <p>These third-party certification bodies are required to conduct annual surveillance audits of all FSC certificates. For group certificates, surveillance audits visit a sampling of certified units based on the scope of the certified area. While unannounced "spot audits" are possible, they are not required.</p>	<p>An independent review is not required for an internal process improvement LCA study, however it is required for a comparative assertion to be made based on an LCA study. Note that reviewers are often paid by the company conducting the study.</p>
Performance vs Measurement	<p>FSC emphasizes performance and adaptive management based on monitoring. Most indicators of nationally applicable standards, based on globally-consistent criteria, require an absolute level of performance.</p>	<p>LCA estimates differences in systems as a decision-support tool, based on best available data and impact estimation methodologies, however, it does not include a mechanism to ensure that a decision has been carried out or acted upon – there is no necessary link to performance. Product Category Rules are written to set the comparative guidelines for LCAs on products within the same product category – however the results are only relative to one another.</p>

How does it handle key aspects of the life cycle of forest management?

Life Cycle Phases	<p>FSC FM certification is cradle to first gate. It addresses environmental and social impacts and economic benefits from the management of forest resources and the extraction of a forest's raw materials.</p> <p>Commitment to occupational health and safety is included within the scope of the Chain of Custody standard.</p>	<p>A full "cradle-to-grave" LCA should address all life cycle phases from raw material extraction, refinement, production, transport, use to end of life/recovery. Often the use and end-of-life phases will be truncated from the study and this is known as a "cradle-to-gate" study.</p> <p>Many in the conservation community and in early forest industry papers assert that LCA does not adequately represent the providing ecosystem in early stages of forest products, including natural stand establishment and the positive aspects of responsible forest management¹.</p>
Spatially Explicit	<p>The geographic scope of a FSC FM certificate is determined prior to certification, defined by Forest Management Units (FMUs).</p>	<p>This is perhaps one of the most significant limitations of LCA in assessing the sustainability of forest systems. In LCA, the impacts of industrial processes and resource production are modeled independent from the geographic location. This is not appropriate for forest systems as their production depends on climate and soil conditions and are extremely site dependent².</p> <p>The lack of spatialization or regionalization in LCA limits the tool's ability to assess any indicator with site-dependent impacts including: land use, water use, biodiversity, ecosystem services, soil conservation and reduces the accuracy of most eco-toxicity indicators.</p>

¹ As early as 1995, an industry review of LCA in the forest products sector identified concerns about the positive aspects of forestry not being captured through LCA. (Fruhwald 1995)

² Fruhwald 1995

System/Assessment Boundary	<p>In FSC, the Principles & Criteria cover all of a certified organization's management activities that are related to the FMU, whether within the FMU or outside and whether directly undertaken or contracted out. This includes assessment and management responsive to possible landscape-level or downstream impacts of management activities, like disruption of migratory paths or effluence, regardless of geographic boundary of the MU.</p> <p>The FSC system also includes a temporal boundary for land use change after 1994, after which an organization cannot be certified if associated with conversion of natural ecosystems.</p>	<p>A system boundary determines what is inside the scope of the study and what is outside.</p> <p>In LCA, there is a boundary drawn between the industrial processes and the surrounding environmental by design (called nature and the "technosphere"). This limits the ability of LCA to analyze processes that occur directly in the environment like forestry, agriculture, fishing, aquaculture, mining and landfills as that boundary between the two systems is not as clear as in a factory setting.</p> <p>Also, LCA only measures flows through a system and does not account for stocks. This limits its ability to account for overall natural resource use.</p> <p>Another issue that pertains to forests is indirect land use change and how to account for that in forest LCA, but this is a weakness of many approaches not only LCA.</p>
Functional Unit	<p>FSC is a systems-based approach for all forest-derived products, including non-timber forest products, goods, and services, with the Forest Management Unit and related management activities the area of study for certification. Because FSC FM management is qualitative, not numerically quantitative, the Functional Unit as defined by LCA is not a useful tool for the goals and scope of FSC FM management. See Sustainable Yield below for elaboration on Functional Unit as relevant for the FSC system.</p>	<p>The unit of comparison for an LCA study is based on the output or product of the system being assessed.</p> <p>This production focused view tends to reward efficiency in production systems without consequence to the long term viability of the providing ecosystem and many of those impacts unaccounted for.</p>
Allocation	<p>As above – FSC focuses on environmental systems management and is not dependent on a product-specific output. Allocation of impacts, as used by LCA, is not applicable to the FSC FM certification process. As a performance-based standard, FSC does include numerous criteria for monitoring and adaptive management, requiring identification of impacts, root cause, and measures for improvement.</p>	<p>Allocation of impacts is necessary when one or more product (co-products) results from industrial activity. ISO recommends avoiding impact allocation if possible. Allocation can be particularly important in supply chains like forest products where multiple products are coming off of the same land and go in to different end products. Environmental impacts can be missed depending on whether wood chips or forest residues are considered "waste" or "product inputs". There is really no consistent way to make sure that all impacts are captured, it is typically governed through the scientific literature.</p>
Management Intensities/ Plantations	<p>Management intensity is determined by the relative presence or absence of natural stand characteristics. Nationally applicable standards have separate requirements for small and/or medium-sized management units and are formulated to consider scale and intensity of operations. Producers are required to have management plans appropriate to scale and intensity of the operation that demonstrate commitment to long-term social, environmental, and economic viability.</p>	<p>Management intensities are typically described as "high, medium and low" and exist as secondary datasets in existing databases. The available datasets describe forest stand establishment for plantation forestry (including seedling growth, site treatment and planting), but not for natural stand establishment (the amount of time it takes to establish a natural forest).</p>
Management Plans/Practices	<p>FSC requires that all producers have management plans that demonstrate commitment to performance, with scope and objectives of management explicit within the written plan and evident in practice.</p>	<p>The site-specific management practices of some unit processes, like forestry and agriculture, are critical to the environmental impacts generated from that process. The range of practices in these types of systems is broader than a typical manufacturing process due to climatic conditions, native soil, flora & fauna, location of waterways. LCA could capture this through inventory data, but standard practice defaults to industry averages – not site specific.</p>
Recycled and Virgin fibre	<p>The FSC Mix and FSC Recycled labels allow for material from controlled sources, post- and pre-consumer</p>	<p>This is a common comparison that comes up in LCAs. Due to the inability of LCA to assess site-specific impacts (positive or negative) and that most LCAs model</p>

	recycled inputs. FSC standards treat reclaimed material as equal to FSC certified virgin material. Inclusion of pre-consumer material as a controlled input is currently undergoing membership consultation.	biomass-energy as carbon neutral, recycled content will look worse in terms of GHGs because it requires electricity from the grid. These weaknesses in LCA actually strip these types of studies down to a comparison of electricity grids and don't actually look at the material benefits of virgin or recycled. Additionally, the product focus in LCA limits what should be a systems-based question.
RECs/Energy credits	FSC does not address this issue and does not have a position on the carbon impact of bioenergy versus other forms of fuel.	Renewable Energy Credits can be modeled and included in LCA. It is considered best practice to report emissions reductions separately if RECs are purchased to ensure transparency. Often times in LCA when forest products companies use biomass-based energy from residues, they will treat that energy as carbon neutral and also include emissions credits for the fossil based grid electricity that wasn't used to provide that energy.
Pre-harvest Activities	All management activities within a FMU with potential impact on forest functions, including pre-harvest activities, are addressed in the P&C. Management plans include planning and justification for harvest activities.	Stand establishment typically only includes "planted" forests but not from natural/existing forests. While this is considered the most important life cycle phase for forest products, it is poorly represented in LCA due to data and geographic limitations.
Post-harvest Activities	Post-harvest activities relevant to the long-term environmental, social, and economic health of FMU and impacted areas are addressed in the P&C. The remainder of the life-cycle is not addressed beyond added value of traceability and promotional claims.	Production, transport and end-of-life are typically modelled well in LCA. The use phase is often left out of studies due to lack of data and assumed equal impacts if part of a comparative study.
Chain of Custody	the FSC Chain of Custody standard monitors custody and trading, processing or manufacturing of wood-based and non-timber forest products from certified forests, including labeling and promoting of FSC certification. Added value of traceability and B2C communication.	LCA does not address.
Data Sources	FSC certificate holders rely on state, regional, national, and international data where available, and on best available scientific literature and experts to inform environmental assessments and best practices in a FMU's area-specific management. Experts can include local stakeholders, effected community members, and FSC members.	Primary data is typically collected for the process that is being studied. Up stream and downstream processes are modelled using secondary data – often reflective of an "industry average" level of performance and not specific to the supply chain.
Monitoring & Assessment	Certificate holders are required to regularly revise their management plans to reflect the results of monitoring and evaluation of management practices and environmental, economic, and social impacts.	LCA is a snapshot in time and does not include any monitoring of performance on site.

How (well) does it measure socio-economic impacts?³

FSC fully embeds measurement of a broad range of socio-economic impacts.

LCA typically does not address socio-economic impacts. Methods that do exist are not culturally/ geographically specific.

Legality and Tenure	A certified organization is required to comply with all applicable laws, regulations, and nationally-ratified international treaties, conventions and agreements, including customary rights of tenure, access, and use of other parties that apply on the management unit.	LCA does not address.
Dispute Resolution & feedback mechanisms	Certificate holders are required to engage affected stakeholders and document measures taken to resolve disputes related to worker rights, land tenure, access and use, including water use.	LCA does not address.
Indigenous Peoples' Rights	Certificate holders are required to identify and uphold Indigenous Peoples' rights of ownership and	LCA does not address.

³ LCA does have weaknesses relative to forest sustainability issues. Descriptive data are not readily available to quantify forest ecosystems using the approach. Biological diversity, for example, is a fairly qualitative concept and the social and economic factors associated with forest sustainability can be just as hard to quantify. (Straka 2010)

	management of land, territories and resources affected by management activities.	
Community relations	Certificate holders are required to engage in dialogue with neighboring communities and individuals, assess and mitigate any impacts from operations, including maintenance of basic necessities, livelihood opportunities, and respect for sites of cultural significance.	LCA does not address.
Workers rights	Certificate holders are required to ensure healthy, safe, and equitable working conditions for employees, including freedom from abuse, right to collective bargaining and fair wages.	LCA does not address. Some screening methods are being developed in LCA with regards to worker's rights, but they are not site-specific and do not involve speaking with the workers.
Shared benefits	A certified organization is required to implement additional activities that contribute to local communities' social and economic development, such as local development projects and use of local business services where possible.	LCA does not address.
Scenic & recreation values	Certificate holders are required to maintain high scenic landscape values and recreational opportunities.	LCA does not address.
Protection Function	An organization must maintain or enhance critical ecosystem services in critical situations where impacted by management activities, like water catchments and erosion control.	LCA does not address.
Sustainable Forest Product Production	Certificate holders manage the range of multiple products and services of the FMU to maintain or enhance long term economic viability and the range of environmental and social benefits that support continued viability. Producers are also required to take measures to increase resilience and reduce potential negative impacts from natural hazards.	LCA does not address. It does not consider the sustainability of the current yield, how the modeled impacts will affect the forest's ability to produce in the future nor how this will be impacted from future climate changes.

How (well) does it measure environmental impacts?

Climate Change	FSC relies on proxy indicators for protection of climate-regulating function of forests and does not currently require carbon accounting. FSC FM criteria require that there be no unnecessary release of GHG emissions, including limitations to burning. FSC does not address GHG emissions from fuel used for management activities.	LCA excels at measuring emissions from fossil fuels and industrial processes when data are present. Its supply chain perspective is one of the strengths of the tool.
Biogenic Carbon/ Carbon Cycle	Carbon storage is an ecosystem service. P&C requires ecosystem services are maintained, conserved, and restored where needed. As above, FSC relies on proxy indicators for healthy regulation of the carbon cycle and does not require carbon accounting within the FMU. Foresters cannot clear or convert native forest or areas of high above-ground stocks to expand cultivation.	LCAs typically regards any agricultural or forestry product as carbon neutral without accounting for all five biogenic carbon pools (i.e., soil, biomass, litter) that are impacted by disturbance and most studies do not consider the time of harvest, product use/disposal and forest grow-back period. This time element is essential to understand the difference between "Carbon neutrality" and "climate neutrality" as outlined in Cherubini, 2011. As LCA was designed to measure impacts, climate impacts are much more important to measure than carbon neutrality.
Water Quantity	Certificate holders are required to identify water resources, including wetlands, potentially affected by operations in as well as outside the FMU and take measures to minimize and mitigate negative impacts. Producers are not allowed to create or aggravate situations of water scarcity.	Methods to assess water use exist and are often used in LCA, however data on water source, quantity and quality is often missing from inventories. LCIA methods for water consumption have been improving to assess risk, but do not capture regional water issues or the natural water cycle including precipitation, evapotranspiration – providing ecosystem requirements.
Water Quality	Certificate holders are required to avoid run-off and siltation of watercourses, and to protect or restore the quality of surface and ground water. Freshwater	Methods for impacts to water toxicity, acidification and eutrophication are developed and used widely. The lack

	biodiversity within the FMU is identified and negative impacts avoided.	of geographic specificity weakens the output, but the methods are generally accepted as best available.
Energy Use	FSC Chain of Custody does not address energy use. Fluxes of nutrients and energy from nature is considered an ecosystem function and is protected by FM certification through proxy indicators of a functional environment.	LCA excels at measuring energy industrial processes. Its supply chain perspective is one of the strengths of the tool. It does not measure energy coming from nature (e.g., endogenous energy or net primary productivity).
Biodiversity/ Wildlife Habitat	Certificate holders identify biodiversity values potentially affected by operations in as well as outside the FMU, and avoid and mitigate any negative impact. Regular assessment, monitoring, and protection of impacted biodiversity and associated habitat is required. FSC includes criteria for management and control of invasive species as defined by a country's national context, but does not prohibit their introduction..	Current LCA practice does not address in a meaningful way. UNEP/SETAC Life Cycle Initiative has recently recommended a method to measure impacts from land use change on biodiversity that is showing some promise as a screening tool, but the data resolution is at the ecoregional level and not site specific. A significant amount of data development will be required to operationalize this screening method.
Land Use Change	FSC was founded to prevent further deforestation and forest degradation from logging, which can undermine the value of a forest and lead to conversion. FSC certificate holders cannot convert natural forest to plantation or non-forest land use except where extremely limited and where clear, additional, substantial, secure long-term conservation benefit is evident. Certificate holders are required to use management practices in natural/semi-natural forests that reflect natural disturbance regimes. Certificate holders cannot convert or be associated with any conversion of natural forest after 1994.	Current LCA practice does not address in a meaningful way. LCA is limited by lack of geographically specific data in inventory and in impact assessment.
Ecotoxicity	Certificate holders are not allowed to use hazardous chemicals except with site-specific derogation. Negative impacts of agrochemical use on human health and the environment are avoided or minimized.	Methods for impacts to ecotoxicity are developed and used widely. The lack of geographic specificity weakens the output, but the methods are generally accepted as best available.
Resource Depletion/ Material Sink	Certificate holders are required to ensure that products are not harvested at levels above sustainable yields. Regular monitoring, evaluation and measures for improvement of key performance indicators is also required. See Sustainable Forest Products Production, above.	LCA is relatively good at tracking resources consumed by an industrial process, but only as a flow and not relative to the available stock. It generally tracks non-renewable resources better than renewable resources.
Regulating Ecosystem Services (Water, Climate)	The P&C require that regulating ecosystem services of forests are protected. Proxy indicators of overall forest health are used for some functions that are not measured, like air quality.	LCA does not address.
Forest Cover (Evapotranspiration Rate)	Certificate holders are required to ensure that tree cover is regenerated to pre-harvesting or more natural conditions after logging.	LCA does not address.
Soil Conservation	Certificate holders are required to regularly monitor impacts on soil quality and adapt management as needed for improvement. Soil erosion control is an ecosystem service.	LCA does not address.
Air Quality	Air quality is recognized as an ecosystem service within the P&C but not explicitly protected. See above on emissions.	LCA excels at measuring air emissions from industrial processes when data are present. Its supply chain perspective is one of the strengths of the tool.
Oxygen Production	Oxygen production is an ecosystem service and ecological function. P&C requires ecosystem services are maintained, conserved, and restored. Proxy indicators used to ensure protection of this value.	LCA does not address.
Ecological Stability	Ecological stability is embedded within the mission of FSC. All P&C aim to maintain or improve ecological stability of forest ecosystems.	LCA does not address. Forests are an important part of the global ecosystem and their productivity is linked to the environmental impacts they receive, as well as, the management practices used on site. This is not reflected in LCA. (Fruhwald 1995)

Primary Productivity	Primary productivity is an ecosystem service and is protected through monitoring of proxy indicators.	LCA does not address.
High Conservation Value Areas	P&C require protection of High Conservation Values in the FMU through application of the precautionary approach. HCVs include biodiversity, landscape-level values, endangered ecosystems, critical ecosystem services, community needs, and cultural values. Independent expertise in assessing HCVs is not required.	LCA does not address.
