

Laminated Strand Lumber

Laminated strand lumber manufacturing is a variation of the OSB process. The strands are longer than those found in OSB, and all of the strands are arranged parallel to each other to simulate solid-sawn lumber. The adhesive blending and mat forming are similar to OSB processes. LSL is produced in billets 5–12 cm thick, 2.4 m wide, and 15 m long. Due to its thickness, conventional heating in the press is not practical. An LSL press employs steam injection through the press platens into the mat of strands. The steam greatly accelerates the rate of heat transfer to the core of the mat, thus reducing the time in the press. The steam injection also serves to reduce the gradient in density through the thickness of LVL. Polymeric MDI adhesive is used for the manufacture of LSL due to the steam injection process. This waterproof, thermosetting adhesive requires water to polymerize, while steam interferes with the bond strength development of phenol-formaldehyde adhesives.

Further Reading

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Streamflow see **Hydrology**: Hydrological Cycle; Impacts of Forest Conversion on Streamflow; Impacts of Forest Management on Streamflow; Impacts of Forest Management on Water Quality; Impacts of Forest Plantations on Streamflow.

SUSTAINABLE FOREST MANAGEMENT

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Overview

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Introduction

Sustainable forest management (SFM) has become one of the core ideal concepts in the use and conservation of forest resources worldwide. Despite its uncontested appeal, a bewildering variety of interpretations of its meanings does exist, which makes discussions and implementation difficult. Underlying the concept is the ethical principle about how the relation between forests and people should be designed. Dependent on the interpretations, the aspect of continuation in the concept of SFM can include a wide range of different dimensions, including, for example, the maintenance of forest ecological characteristics, the maintenance of yields of forest products and services, as well as the sustenance of human institutions that are forest-dependent. Conflict among these is inherent and reflects other contested values in society. Consequently there cannot be an objective, universally agreed definition of SFM. The various understandings of SFM are outcomes of social or political processes, and are thus context-dependent as well as subject to continuous change. The international forest policy dialogue as well as market-driven certification approaches have provided major stimuli for such processes on national, regional, and local levels. There is widespread agreement that achievement of SFM requires adequate institutionalization as well as a widely shared understanding of the concept.

Bewildering Variety of Meanings

SFM is more and more frequently viewed as an ideal in managing forests worldwide. Numerous declarations have recently been published at national and international levels in which SFM is claimed to be the main objective of all future efforts in forestry. However, despite the long tradition of the term, there exists a virtual wilderness of meanings. The question already rises whether SFM is a mere constraint on forest management or whether it is a goal in itself. Depending on the answer to this question, the terms ‘sustainable forest management,’ ‘forest sustainability,’ ‘sustainable forests’ or ‘sustainable development of forests’ are interpreted as distinct, different concepts, or as at least partially overlapping synonyms. The discussion of what SFM means precisely has kept the forestry profession busy, probably since the term ‘sustainable’ was first mentioned explicitly with regard to forest management in 1713 by von Carlowitz in Central Europe. However, despite general agreement on the need to implement SFM, the term means different things to

different people. Nevertheless, there is consensus that SFM describes forest conservation practices, including their tools and techniques, that take into account the social, economic, and ecological dimensions of forests in the context of the needs of the present generation and future generations. In this respect SFM forms a strong unifying concept, with no one being conceptually against it.

Why Should Something Be Sustained?

The very core of discussions about the meanings of SFM are formed by the question of why something should be sustained with regard to forests or the relation between forests and people. SFM is thus not a natural characteristic of a forest or a technical issue in forest management planning. Rather, it is an ethical principle about how the relation between forests and people should be designed. History clearly shows that discussions about SFM always peaked in times of perceived or real crisis, such as timber shortages after war in the first half of the twentieth century or massive tropical forest destruction for whatever reason in the late twentieth century (overexploitation, forest fires, conflicting land uses, such as mining, etc.). In that respect also very early efforts such as religious obligations to replant for every tree that fell for whatever reason or to set aside certain forest patches as sacred groves, even though not termed ‘sustainable forest management,’ must be interpreted similarly. It is thus not a concept with origins limited to European forestry, as is often stated, even though it might have been there that the ethical core was explicitly designed over more than one generation and made an explicit technical science out of it.

What Should Be Sustained?

The second core question in discussions about the meaning of SFM is about the question of what should be sustained. This is well reflected by the etymology of the term ‘sustainable,’ which is described in dictionaries with synonyms such as continuous, perpetuated, constant, or durable. At first glance SFM therefore seems to show great affinity with concepts such as bag limits in wildlife management, carrying capacity in wilderness and recreation management, and recharge rates in aquifer management. Not surprisingly, discussions on SFM at the beginning of regular forest management often focused on aspects of sustained yield. Sustained yield in this respect was interpreted as constraining the periodic consumption of a renewable forest resource (timber

and nontimber) not to exceed its periodic growth. However, the technical constraints for safeguarding continuous supply do not in themselves provide an answer to the question of what should be sustained on the demand side. Despite the voices of a few leaders in the forestry profession at the turn of the twentieth century, it is only more recently that the focus of discussion on SFM has broadened to include values on an ecological, social, and economical dimension similarly. The aspect of continuity in SFM can consequently refer to some quite different things, such as:

- maintenance of forest ecological characteristics, including the production capacity of forest soils, the vegetative renewal capacity, certain forest species and components, as well as biodiversity and natural forest ecological processes
- maintenance of yields of forest products and services
- sustenance of human institutions that are forest-dependent, including community stability, cultural integrity, and labor and income generation.

Reflection of Social Values

Accordingly, more than 14 different categories of definitions of SFM have been identified in literature depending on how the different dimensions are weighted. Even within one single dimension, be it the ecological, economical, or social one, weighting of values can differ greatly, leading to completely different interpretations of SFM. In the ecological dimension, for example, the question of whether ecological processes themselves (implying change and uncertainty) or the existence of individual species at a given time should be sustained has resulted in endless discussions. However, even if agreement about the relative weights of values can be achieved, their operational definition still remains vague and contested, because spatial and time scales often remain unidentified. On a spatial scale, different understandings of SFM are contested, depending on whether the achievement of norms and values is realized on forest stand levels, on district levels, or on regional levels. At a temporal scale a crucial point for discussion and different interpretations for SFM are formed by the way in which social and ecological changes are incorporated in different norms and values. For example, how do we deal with natural fluctuations (e.g., dry years) and disturbances (e.g., storms, forest fires)? The concept of SFM not only comprises three substantive dimensions – ecological, economical, and social – but also temporal and spatial dimensions.

Concept of Conflict

SFM is controversial for good reason: any one definition represents particular values on these five dimensions at others' expense. Inherent in the concept is conflict among the value systems that underlie these differences. SFM is thus a concept reflecting conflict rather than harmony, as it is often misinterpreted. SFM serves as the vehicle by which the underlying norms and values of these standards can be expressed. By supporting a certain understanding of SFM, participants' preferences and values are expressed, but nothing has been harmonized, no value conflicts have been resolved. The only thing that happens is that certain values are discussed so that social bargaining processes, e.g., concerning certification of SFM, may begin.

Thus, the achievement of SFM ultimately depends on the reconciliation of different social perspectives with respect to forest resources in social or political processes. The reasons behind differences in participants' values may be different interests, expertise, or knowledge levels but also different views of how the world works. Reconciliation processes are therefore not easy, and can become very easily corrupt or biased, where there is no right or wrong answer, only more or less appropriate ones.

Whereas in earlier times forest management planning was generally considered a technical issue and responsibility was exclusively dedicated to forest owners or forest professionals, it is increasingly recognized that SFM must integrate narrow private and broader public interests in forest resource utilization through adequate institutional designs of social or political processes. The challenge of SFM is to recognize, accommodate, and respond effectively to diverse and dynamic value perspectives about forest management in society. Achieving SMF is consequently in the first instance a social exercise and only secondarily a technical issue.

Context Dependency

There is widespread agreement between authors that the meaning of SFM is dependent on time and place and that there cannot be an objective, universal definition. What will be sustained, and for whom, is determined through social processes. Still, there are always predominant understandings in certain times and places, reflecting the prevailing social, economic, and political conditions. The understanding of SFM is thus not only context-dependent but also subject to continuous change. The question of which definition will predominate in a certain region and during a certain time period

may also be one of political power, and not necessarily only of objective necessities, as is well reflected by the history of the 'sustained yield' principle in Europe and its adaptation when introduced in the USA.

With the age of enlightenment in the eighteenth century, central Europe was ripe for the development of scientific models for the use and conservation of forests, replacing practical and unsystematic approaches which had been predominating in European forestry until then. Based on the idea of continuous production, the aim of achieving, at the earliest practical time, an appropriate balance between growth and harvest was translated into mathematical formulae, which culminated in the ideal model of the 'normal forest.' Whereas initially sustained timber production with special attention to sustaining growing stock was central, the focus switched to sustaining net revenues and aspects of the ground rent when the predominant economic system of mercantilism was replaced by the free-market philosophy. In general, forest management for sustained yield in central Europe in the middle of the nineteenth century had as its objectives the production of annual timber crops of approximately equal size, maintenance of stable industrial communities, furnishing permanent income for forest owners, and purchasing power, and full use of the productive capacity of the forest lands. With the arrival of the first ideas on environmental conservation and the renaissance of a holistic perspective on nature at the turn of the twentieth century, sustained-yield forestry was brought into line with the productive power of the soil and the functioning of the forest as an organic community. With the increasing wealth of society in the twentieth century, when spare time and recreation became more important, the traditional sustained-yield concept gradually shifted to that of SFM for multiple benefits.

When the ideal of the normal forest and sustained-yield regulation necessary to maintain it were introduced from Europe to the USA at the turn of the twentieth century, the ignorance of the context dependencies of the concept gave rise to heavy criticism. The criticisms seemed to have two common elements: (1) perpetual output was perceived as inconsistent with the 'frontier' mentality of a young and still developing American society; and (2) the physical models bore little relation to the economic realities of the predominating liberal capitalism. Consequently, the idea of sustained yield as a production technique designed to ensure a sustained commodity flow over time was broadened to an understanding of SFM, encompassing the continuity of multiple benefit flows and ecological stability

while maintaining the potential to respond to evolving demands.

The context dependency of the understanding of SFM is also well illustrated by the rejection of the concept of SFM as being 'reactionary and capitalistic' under communistic sovereignty, as for example in the time of the Soviet Union. Forest resources there were instead interpreted as an important component in the development of a socialistic society, giving space to an alternative interpretation of the concept of extended reproduction.

Formal and Informal Processes

In the beginning of regular forest management, the idea of sustained yield was usually interpreted by the forestry profession and advocated by government and industry. Local communities themselves have not usually promoted sustained yield in such a scientific sense. However, in several cases they have undertaken measures to limit exploitation and protect forests. As the concept has been broadened from sustained yield to SFM, this has changed. The reconciliation of different social values in the respective understanding of SFM now takes place in the form of social processes which encompass socioeconomic impacts and the stakeholder participation. These processes usually began at national or regional level but more frequently became institutionalized at a local level. The character of these processes can be both formal and informal.

The United Nations Conference on Environment and Development (UNCED) in 1992 in Rio de Janeiro provided an important stimulus for discussion about SFM in all types of forest at a global level. Even though the conference did not result in a legally binding instrument on the conservation of forests, its follow-up processes resulted in a clear recognition of the importance of SFM. The issue of SFM was furthermore taken up by several regional political processes, in the follow-up, or parallel, to the United Nations' process, such as the so-called Montreal Process or the Ministerial Conference on the Protection of Forests in Europe – all provided important contributions to the discussions or even binding definitions of SFM for their member parties. These understandings have long departed from the classical understanding of SFM as sustained-yield regulation. The Ministerial Conference on the Protection of Forests in Europe, for example, defines SFM in their Helsinki resolution as 'the stewardship and use of forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill now and in the future, relevant ecological, economic and social

functions, at local, national, and global levels, and that does not cause damage to other ecosystems.'

SFM has also emerged as a consideration in the international trade of forest products. Many consumers, individually and collectively, prefer to buy products obtained from sustainably managed forests and manufactured by environmentally acceptable processes. In response to this demand, several timber certification systems have been established at international as well as regional level, which concur with each other. At a global level, the Forest Stewardship Council (FSC) was founded by environmental non-government organizations in cooperation with the timber industry to promote the sustainable management of forests worldwide. By formulating principles, criteria, and indicators for SFM that are differentiated according to different regions of the world, the FSC acts as an accreditation body for certifying organizations, thereby guaranteeing certain minimum standards for SFM. However, given the impossibility of an objective, universally agreed definition of SFM, all certification schemes have also been the subject of conflict.

Another example of how the consumers' call is influencing discussions about SFM is reflected by the ambitious year-2000 objective of the International Tropical Timber Trade Organization (ITTO) which stated that 'ITTO members will progress towards achieving sustainable management of tropical forests and trade in tropical timber from sustainably managed resources by the year 2000.' Even though ITTO's own evaluation showed that only a few countries 'appear to be managing some of their forests sustainably,' it is nevertheless a good example for the many social and political processes which have been started all over the world in search of criteria and indicators for SFM. At the same time, the ITTO example clearly indicates that understanding of SFM needs to be adequately institutionalized, in order to become implemented.

Institutionalization

Experience from all over the world seems to indicate that one of the most important institutional prerequisites for SFM is legislation that establishes appropriate and reliable forms of forest tenure, including various forms of forest ownership and usage rights. There are furthermore clear indications that the political, economic, and ethical setting in which SFM is pursued will determine success or otherwise. As history and practical evidence show, SFM seems not to be feasible unless it benefits from a sound and stable context of consistent developments and converging strategies occurring in related

sectors. Implementing SFM thus involves policy action in forestry as well as in other policy fields, with cross-sectoral policy coordination being another crucial institutional device. In many countries the policies of several government ministries have an impact on forest lands.

Significant influential factors for the successful implementation of SFM include financial incentives, a clear sharing of costs and investments, as well as an active, informed civil society.

Symbolic Function

Yet, even if no consensus on criteria and indicators can be achieved, and implementation cannot be adequately institutionalized, the concept of SFM is not without importance for forestry. Critics of SFM have underestimated its emotional and symbolic significance. The bewildering variety of understandings and its multifaceted character is a weakness and a strength at the same time. The concept of SFM can also serve as a platform on which disparate actors can stand together – its ambiguity allows participants with seemingly irreconcilable positions to search for common solutions without appearing to compromise their principles. Furthermore, the informal, personal, and implicit properties of the concept should not be forgotten – its ability to provide a guideline for coping with uncertainty and ignorance in forest management decisions and to serve as an *esprit de corps* for the forestry profession.

See also: **Mensuration:** Yield Tables, Forecasting, Modeling and Simulation. **Plantation Silviculture:** Multiple-use Silviculture in Temperate Plantation Forestry; Sustainability of Forest Plantations. **Sustainable Forest Management:** Certification.

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or service conforms to specified standards, on the basis of an audit conducted to agreed procedures. Certification may be linked with product labeling for market communication purposes. It comprises a variety of mechanical tasks that aim to produce highly objective assessments. However, it tends to have market and political implications, because it results in a judgement of whether a product, process or service is acceptable or not. The International Organization for Standardization (ISO) has set precedents in the various tasks of certification, standardization, and accreditation that are outlined below, and most certification schemes in any sector have chosen to adhere to them. This is partly because ISO standards tend to be recognized by the World Trade Organization (WTO) as not creating unnecessary barriers to trade. Certification of social and environmental performance is already changing the rules of the game for many industries. It has occupied a key role in the 'organic' and 'fair trade' niches of food production for some time; it is emerging in fisheries and tourism; and it is being explored for mining. Certification has had a particularly rapid evolution in the forest sector, where it is becoming routine practice.

Certification

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Introduction

Certification provides a means by which the quality of forest management may be independently assessed to agreed standards. It offers credible evidence that enables the forest manager to obtain benefits, notably access to markets that demand sustainably-produced forest products. Several certification schemes have experienced rapid development and certification is now routine practice. This article reviews the process in general, the key players, and the early achievements of certification in light of its implicit assumptions.

Definitions and Description of Forest Certification Processes

Certification

Certification is the procedure by which a third party provides written assurance that a product, process

Forest Management Certification

Forest management certification is the process by which the performance of on-the-ground forestry operations is assessed against a predetermined set of standards. This is voluntary, at the request of the forest owner or manager. If the forestry operations are found to be in conformance with these standards, a certificate is issued, offering the owner/manager the potential to bring products from the certified forest to the market as certified products. This market potential is realized by a supplementary certification, which assesses the chain of custody of wood (see below). In this sense, forest certification is market driven – aiming to improve forest management through market-based incentives, and to improve market access and share for the products of such management. It addresses the quality of forest management, as opposed to the quality of forest products. In addition, systems for the certification of wood quality exist (see below).

Standards

Standards used in forest certification schemes are of two general types:

- performance standards
- management system standards.