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METSÄTEHO

Sustainable Development in Forest Management in Finland

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PREFACE

The concept of sustainable development, in such form as accepted worldwide in principle, has in Finland so far shaped forestry possibly more than any other industry. Forestry is an extensive and visible activity that has itself also initiated such changes. People responsible for environmental issues in forest companies and Metsähallitus (formerly known as the Finnish Forest and Park Service) have familiarised themselves with the evasive concept of sustainable development as part of their work. This paper describes the concept and contents of sustainable development as seen from their points of view. The aim of this report is to make these viewpoints better known, in order to promote mutual understanding between forestry actors, stakeholder groups and researchers whenever environmental issues are discussed in a forestry context.

1 SUSTAINABLE DEVELOPMENT AND SUSTAINABLE FORESTRY

Behind the idea of sustainable development lies concern about the global conflict between general economic development and the need to conserve environmental resources. Since the UN Conference on Environment and Development in Rio de Janeiro in 1992, the aim of sustainable development has unanimously been understood as to adjust economic and social development to the framework of natural resources so that natural resources and the conditions for human development can be sustained into the future. *Ecological*, *economic*, and *social aspects* are seen as the three main components of sustainable development. The defining documents resulting from the conference are the *Rio declaration*, the *Agenda 21 programme*, the *Framework Convention on Climate Change*, the *Convention on Biological Diversity* and the *Forest Principles*. [1] The programme and the related agreements are the basis for international development processes and national environment policies. [2]

The exploitative use of forests and widespread deforestation are serious global problems. In order to limit these trends, special *criteria* have been defined for *sustainable forestry* based on the Forest Principles drawn up in Rio. The achievement of these criteria can be monitored using specially devised *indicators*. [3]

These indicators have been chosen to cover certain features of forests and forestry to ensure that taken together they should tenably measure how each criterion has been fulfilled. The indicators should also be simple to measure and reliably verified. These criteria and indicators are used to monitor forestry developments and to guide forest policies. They are also the basis for forest certification criteria.

However, the external features of sustainable forestry are not yet enough to allow practical solutions for forest use to be specified. How then can forestry be practised so that sustainability is achieved in its widest sense with all the aspects of sustainable development are taken into account in an appropriate way? Is it necessary to somehow ensure that forestry is simultaneously ecologically, economically and socially sustainable?

[1] Earth Summit. UN Conference on Environment and Development (1992).
[2] Information box 1: The notion of sustainable development.
[3] Information box 2: Sustainable forestry criteria.

2 BALANCING DIFFERENT ASPECTS OF SUSTAINABLE DEVELOPMENT

2.1 The problem of weighting

Theoretically, forest use solutions would require weighting of ecological, economic and social aspects in decision-making. In practice, this weighting is not an easy task, as it involves complex issues.

The concept of sustainable development tends to shrink away from any exact definition. It can be said to have a pragmatic definition without any semantic or operational definition. This means that although the concept has a clear purpose, there are no detailed rules to describe its contents, or how the relevant data can be obtained. In the Convention on Biological Diversity, sustainability appears simultaneously as an aim to be pursued through the protection *and* sustainable use of biological diversity. It is not presented as an unambiguously definable target, which could be permanently and verifiably achieved.

Sustainable development is widely discussed in many sectors of society, but depending on the viewer's standpoint, the concept can be interpreted in different ways. Economic actors and different social groups routinely try, consciously or unconsciously, to guide and control the discussion according to their own interests. [4]

2.2 Weak interpretations

Interpretations that particularly emphasise the economic dimension of sustainable development and pay little attention to ecological and social questions - and thus ignore the original objective - have been referred to as *weak interpretations* of sustainable development. Critics of such economically centred interpretations point out that the idea of sustainable development has widely been harnessed to support the competitiveness of companies and their current practices. Weak interpretations with an economic bias may also focus excessively on such factors as the national economy and employment.

The approaches often adopted by environmental non-governmental organisations and their associates can be seen as representing another kind of 'weak interpretation' of sustainable development, over-emphasising the ecological aspects of sustainability, and neglecting the social and economic dimensions. This angle is often used to promote the general environmental movement or as a tool in forest disputes. Certain economic and social factors including traditional livelihoods and nature tourism are also often used to support such views.

From the sustainable development point of view, any approach that overemphasises one aspect has to be considered as problematic, if it neglects the other dimensions or makes generalisations about them on the basis of selec-

[4] Markkanen, P. 2003: Kestävän kehityksen diskurssi – ihanteita, realismia ja näköalattomuutta.

tive information, and implies the conclusion to be a universally applicable solution. These approaches are problematic because they mean in practice that parties to the related discussions will be talking at cross purposes. This makes it hard to promote mutual understanding with regard to the different aspects of sustainability, and can reduce the credibility of the principles of sustainable development as a tool. Weak interpretations may also lead to a polarisation of attitudes and deadlocked opinions, reducing the prospects for constructive problem-solving.

2.3 Pragmatic interpretations

Weak interpretations are often derived from a desire to prioritise aspects of sustainable development according to some hierarchical structure. The ecological dimension can be considered primary to the economic dimension, for instance, with economic aspects themselves outweighing social considerations, since social structures are themselves limited by economic feasibility, while economic considerations are constrained by ecosystem functionality. [5] On this basis, it could be held that in the first instance ecological sustainability has to be ensured as a condition for forest use. Although this rhetoric does somehow follow the idea of sustainable development, its implementation in practical land use solutions would be questionable. The Convention on Biological Diversity does not define any such unconditional hierarchy for aspects of sustainability in the conservation and use of biodiversity. Conversely to this line of thought, it can also be argued that economic aspects are generally primary to other aspects since the economic value of forests is a safeguard against deforestation, and the ensuing advanced forestry can be understood as a prerequisite to their protection.

Looking at these issues more closely, it is specifically ecological sustainability that perhaps cannot in all respects be verified objectively for any particular kind of land use.

Where ecological sustainability means the sustainable use of natural resources, verification is clear if the necessary information on utilisation rates and resource renewal rates are available, and renewal processes are well understood. This interpretation of sustainability has already been traditionally included in forestry, where controls such as forest inventories have been widely applied.

When species, habitats and genetic diversity are included in the concept, however, the objective verification of ecological sustainability becomes questionable. Such verifications are complex because of the abstract nature of biodiversity and problems in measuring natural phenomenon. Verification would require arbitrary agreement on the consequent conclusions. [6]

Economic sustainability can be fairly straightforwardly condensed into long-term continuity and profitability, which clearly require that natural resources are used sustainably. Social sustainability, on the other hand, seems

[5] Burger, J. A. 1997: Conceptual framework for monitoring the impacts of intensive forest management on sustainable forestry.
[6] Information box 3: Biodiversity and the verification of ecological sustainability.

to be a very vague entity, where the central challenges include many different values within society and their consideration in decision-making. [7]

All in all, it is questionable whether striving to achieve sustainability by fulfilling each of its main aspects is a realistic basis for evaluating practical choices for forest use.

Where practical solutions are concerned, however, it is not necessary to weight the ecological, economic and social components specifically in themselves. This is because instead of evaluating these more abstract aspects, the concrete **consequences** of forest management options can be evaluated, assessed as 'product mixes' from optional forest uses. Such assessments should cover all the essential *products* (e.g. wood, other natural products), *services* (e.g. recreation) and *resource states* (e.g. biodiversity) resulting from each option over a long time span. This will ensure that all the benefits produced by the forest ecosystem are included together with all the environmental impacts of the resource use. [8] The task of setting relative values and choosing between the options eventually becomes a question of negotiations between the interests involved.

3 SUSTAINABLE DEVELOPMENT AS A PROCESS

3.1 Participants

Since the UN World Commission on Environment and Development in 1987 (the Brundtland Commission report), [9] sustainable development has often been expressed as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. When considering practical land use solutions, future generations are not actually present, and issues have to be resolved here and now. This makes sustainable development, as defined in the form of ecosystem benefits and impacts, **a socio-economic process**.

The parties to such processes are *economic actors* and their stakeholder groups, i.e. people or groups who depend on the economic actors to achieve their aims. Economic actors are to varying extents dependent on their stakeholder groups. [10] *Direct stakeholder groups* are considered to be those whose income is connected to the economic actor's operations, while *indirect stakeholder groups* representing social interests such as the authorities and civil organisations.

When the economic actor is a company, its stakeholder groups and relations are defined in its environmental management systems, as is the case for the forestry companies and Metsähallitus (formerly known as the Finnish Forest and Park Service). These systems are typically presented in corporate social

[7] Juurola, M. & H. Karppinen. 2003: Sosiaalinen kestävyys ja metsien käyttö.
[8] Bormann, B. T., M. H. Brookes, E. D. Ford, A. R. Kiester, C. D. Oliver, & J. F. Weigand. 1994: Volume V: A framework for sustainable-ecosystem management.
[9] Bruntland, G. (ed.). 1987: Our common future.
[10] Näsi, J. 1995: A Scandinavian Approach to Stakeholder Thinking: An Analysis of its theoretical and practical uses 1964 – 1980.

responsibility reports. Corporate Social Responsibility (CSR) is widely understood as a combination of economical, ecological and social responsibility. From an economic actor's point of view, CSR can embody the principles of sustainable development. In recent years, corporate social responsibility has been widely emphasised along with globalisation and communications technology developments, and company stakeholder groups have become active in bringing forward their own opinions on these issues. [11]

The socio-economic process of sustainable development thus proceeds as interaction between the economic actor and their stakeholder groups. The parties' varying values and interpretations of reality are the rival driving forces behind the process. The tools of the economic actors include the *planning systems* used to evaluate options, *quality and environmental management systems*, *participatory planning procedures* and other *stakeholder co-operation*. Stakeholder groups use direct feedback and the news media as their tools. Economic actors' interactions with direct stakeholder groups are generally easier than relations with environmental organisations, for example, who often have an intrinsically negative attitude towards the economic use of forests. Some stakeholder groups aim to influence the economic actors' customers and bring their demands to the fore outside the stakeholder group process via requirements expressed by the customers.

3.2 Types of solutions

Alongside their economic objectives, forestry actors also set environmental goals, e.g. to protect and enhance biodiversity. [12] Economic actors thus aim to find forest use solutions that produce the highest possible net benefit value. This includes safeguarding the use of forests in the long term. It is important that stakeholder groups generally approve the main features of these practices.

The forest use solutions achieved through such processes are necessarily compromises between the economic actor's objectives and the expectations of different stakeholder groups. These processes produce different solutions in different countries as a result of variations in natural conditions and socio-economic differences. By their very nature, these solutions are not permanent. Technical and economic developments change the conditions for future optional solutions, while stakeholder groups and their values also change. The varying perceptions of reality held by the economic actors and stakeholder groups can also change. These perceptions are greatly influenced by the results of research, which can produce completely new information or reshape existing knowledge.

[11] Information box 4: The concept of corporate social responsibility.

[12] Information box 5: Environmental commitments concerning wood raw material in the Finnish forest industry

4 RESEARCH AS A TOOL FOR THE SUSTAINABLE DEVELOPMENT PROCESS

4.1 The previous role of forest research

In Finland, information and expertise gained from research have widely been used to direct forest policies, through legislation, management guidelines and efforts to promote forestry. Researchers have also actively participated in the preparation of forest policy programmes. This extensive utilisation of research-based know-how is based on the intensive research carried out in the forest sector. [13]

For the economic actors, forest research has produced plenty of basic knowledge concerning how forest trees grow. Research has also been used for developing new methods in forestry operations. Such research has typically been designed to help find out what kinds of forest management produce the best possible economic result. Optimisation is possible at least in principle, when the limitations have been defined and all the relevant information is available. Problems related to the process of sustainable development, however, cannot be controlled using conventional research procedures. Forest use options are negotiable items in this process, and the relevant available knowledge is neither conceptually uniform nor acceptable to all parties, and may not be easily subjected to any kind of systematic analysis.

4.2 The new role of natural resources utilisation research

The incommensurable character of sustainable development aspects and the importance of values in any conflict make it impossible in practice to define any single 'correct' forest use solution. Such problems cannot ultimately be resolved by conducting scientific research. Instead, more wide-ranging research can improve the organisation of the existing information basis in the process of sustainable development by **producing information that is as applicable as possible covering all the main aspects of sustainable development.** Research can help to increase the understanding of a single aspect, or, according the problem phrasing, help in assessing the benefits and impacts of forest management options. The task of research is not to determine the mutually acceptable weightings to be given to different values, as these must be defined through the sustainable development process itself.

As described above, information on such factors as biodiversity can considerably influence forestry practices. An understanding on biodiversity impacts has been seen to affect forestry operations as follows:

- *by basically guiding actors* towards better solutions that support biodiversity (assuming there is no fundamental conflict between the actual objectives and the goal of safeguarding biodiversity)
- *by defining operational limitations* to prevent harmful impacts on biodiversity (assuming that some conflict may exist, but that actors will comply with the agreed solution)

[13] Reunala, A. 2004: Metsäntutkimuksen rooli metsäpolitiikassa.

- *by substantially changing operations* by influencing legislation and incentive systems (assuming that any conflicts have been recognised and will be dealt with in the social value discussion)
- *by introducing new operations* to promote biodiversity (assuming there are no acute conflicts and the question is merely of funding)
- *by producing a basis to influence and operate* internationally to promote biodiversity [14]

So far, changes in forest practices which have to some extent been made on the basis of the results of biodiversity research have mainly been linked to the first two points listed above. Such changes have included site-oriented forest regeneration, growing broadleaved mixtures in stands, protecting deadwood, leaving retention trees, setting aside valuable natural habitats and buffer zones along brooks and lakesides, and reintroducing prescribed burning in site preparation. This 'green change'[15, 16] in forestry in Finland was adopted fairly quickly at the beginning of the 1990s as part of the forest industry's guidelines and the State forest management guidelines, and then taken up a little later by the forest authorities and in legislation. These changes were made on the basis of general knowledge, and it was expected that research results on the effectiveness of these changes would subsequently become available.

Extensive research on biodiversity in Finland has been conducted, especially in the *FIBRE (Finnish Biodiversity Research) programme* (1997 - 2002), which was prompted by the Convention on Biological Diversity, and in a subsequent biodiversity research programme. Some of the related research projects resulted in demands for major additional changes to forestry practices, [17] although there was little analysis of the likely impacts of these changes on other aspects of sustainable development.

The economic impacts of the changes in forestry practices in the 1990s have remained at a moderate level. The more recently proposed major changes, especially those concerning forest regeneration regimes, would presumably in the long run affect wood production rates and to some extent also harvesting costs, since current practices have been purposefully shaped over the years to improve economic efficiency. [18] Any large-scale changes in practices whose present socio-economic basis is fairly stable should involve an assessment of all ecosystem benefits and impacts, and a very thorough strategic discussion of the possible social impacts.

[14] Hildén, M., A-P. Auvinen & E. Primmer (Eds.). 2005: Suomen biodiversiteettiohjelman arviointi.
[15] Hänninen, E., K-M. Korhonen, R. Koskinen & J. Kostamo. 1992: Managing.the forest environment in Finland.
[16] Kalland, F. & A. Pätilä. 1993: Green change.
[17] Kuuluvainen, T., J-P. Jäppinen, P. Keto-Tokoi, J. Kuuluvainen, M. Kuusinen, J. Niemelä & M. Ollikainen. 2004: Suomen metsien monimuotoisuuden turvaaminen.
[18] Information box 6: Economic aspects in different forest regeneration options.

4.3 Research needs from the economic actor's point of view

In recent years, a lot of resources have been used in biodiversity research. [19] The resultant overall picture of the situation regarding forest species is non-uniform, and largely interpretative, but it has nevertheless been concluded that there are not sufficient habitats for all species. There is concrete evidence about species becoming more threatened, but also that the recent changes in forestry guidelines have improved the suitability of forest habitats for some endangered species. It has thus also been concluded that species loss will continue over the coming years, because the situation that has been created in Finland's forests over a long time period cannot be changed quickly, even where new guidelines have been issued. [20, 21]

Research into species, their habitats and their ecosystem behaviour provides a picture about forest biodiversity and the dynamics that shape it. This constitutes important background information that can be considered when forestry practices are developed. Species research and theoretical ecological research cannot be directly applied in forest use guidelines, however, in the same way that economic theory cannot be directly applied when it comes to such factors as rotation times in forestry.

In addition to the ecological dimension, research would be needed particularly on the social aspects of sustainable development. The social dimension is the least structured of the three main dimensions of sustainable development. The relationships between convergent factors like social impacts and employment impacts are vague, and differences and similarities with regard to the economic dimension require clearer analysis. Social scientists have so far seldom participated in research into the use and management of forests.

From the economic actor's point of view, a multidisciplinary approach, which can be used to compare the core benefits and impacts of forest management options in an overall analysis, would clearly be the most applicable. This kind of a trade-off analysis examining all of the various aspects of sustainable development can widen the spectra of economically, ecologically, and socially functional solutions, and improve the prospects for a more constructive socio-economic dialogue. [22] This type of research, carried out in cooperation with economic actors, supports the development of forest use and provides a Nordic equivalent to the models used in countries where extensive forestry is practised to connect different levels of research and experiments to practical forest management. [23]

It must always be remembered, however, that when assessing forest use solutions research in itself cannot remove any problems that are fundamentally caused by value conflicts.

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[19] Information box 7: Approaches to forest biodiversity research.

[20] Ahlroth, P. 2003: Metsälajiston nykytila ja tulevaisuudennäkymät eri skenaarioiden ja tutkimustiedon valossa.

[21] Otsamo, A. (ed.). 2004: MOSSE puolimatkassa – monimuotoisuuden tutkimusohjelman (2003–2006) välitulokset.

[22] Information box 8: The role of research in developing forestry practices.

[23] Sit, V. & B. Taylor (eds.). 1998: Statistical Methods for Adaptive Management Studies.

5 CONCLUSIONS

Sustainable development as described above is a directional process, rather than a state of affairs that can be reached. From the economic actor's point of view, the issue is to develop forest management, with stakeholder groups as partners, and research results as tools.

Protecting biodiversity has been an essential issue in the development of forestry practices over the last ten to fifteen years. The overall effects of today's environmental management work in the forests will only become visible in the long run, however. Developments in the forests are determined by the history of forest use, as well as today's practices. So far we have little knowledge of the effects of forestry practices on biodiversity, based on experimental research. It has been suggested that the loss of forest species as indicated by research would not be halted in the next few years, even if forests were not used at all. This would mean that the objective stated in the European Union's sixth environment programme "to protect and restore the functioning of natural systems and halt the loss of biodiversity in the European Union and globally", [24] could not possibly be reached during the programme period. However, changes in forestry practices should serve to promote biodiversity at least in the long run.

There is a lack of mutual understanding between all parties with regard to the socio-economic process of sustainable development. This means that all forest use solutions are necessarily compromises. Their future direction depends greatly on the interests, conflicts and social influence of the parties involved, and also on which parties are invited to participate in the process – or consent to such an invitation, when it comes to environmental organisations, for instance. At times, some environmental organisations seem to prefer to act outside the participatory process by seeking to influence forest products customers' choices.

There is no generally accepted method for recording, managing and reconciling stakeholder group interests. Quality and environmental management systems require the consideration of significant social and environmental impacts, in goal setting, monitoring and updating. [25] Forestry operators have different methods for consulting their stakeholder groups, and working models have been developed for considering social aspects as part of the land-use planning process. [26] In Finland, this has been structured perhaps best in Metsähallitus's *Natural Resources Planning Process*. [27] Developing such methods and applying them more widely could help to promote mutual understanding.

Stakeholder groups' views are not only closely connected to their values, but also to the knowledge basis available. But research is not the main driver of the sustainable development process. Guidelines, laws and other

[24] Environment 2010: Our future, Our choice.
[25] Environmental management systems. Specification with guidance for use.
[26] Wallenius, P. 2001: Osallistava strateginen suunnittelu julkisten luonnonvarojen hoidossa.
[27] Asunta, A., V. Hiltunen & M. Väisänen. 2004: Metsähallituksen luonnonvarasuunnittelu.

regulations that affect forestry practices are based on the objectives of Finnish and international environmental and forest policies, and not on scientifically researched information covering all the details of environmental mechanisms. In practice, the innovation chain in the development of forestry practices works so that first the economic actors modify their methods on their own premises, having considered socio-economic developments and the requirements of their stakeholder groups. Only a little research is carried out into the related natural processes beforehand in such cases, and research only really starts to be conducted when the changes have already been introduced on the practical level.

The starting point and objectives of the economic actors are clear. The effectiveness of the changes is important for directing development work, and from the perspective of staff motivation. On the other hand, it is natural for stakeholder groups to promote their own interests and demand suitable additional changes to practices. In the end, solutions have to be both economically viable and socially desirable, with this social desirability also including the ecological dimension. In the overall process of sustainable development there is no third party who can give judgement on sustainability for the economic actor and all their stakeholder groups. Research and science can only serve as tools in this process.

Is forest use and management in Finland sustainable? It seems highly questionable that ecological sustainability in its broadest sense could be completely verified for *any* land use. In addition, there is still no recognised way to analyse social sustainability. It could instead be asked whether forest use and management in Finland today fits in with the widely held notion of sustainable development. General global concerns about development and the environment seem to be focused on other issues than forest management in Finland or the other Nordic countries. The documents drawn up in Rio and at the follow-up conference in Johannesburg in 2002 only briefly discuss forestry. Giving fair and balanced consideration to the different aspects of sustainable development may be easier in developed countries where society is open. Indeed whenever the state of environmental stewardship is compared between different countries, the Nordic countries and Finland rank highly. [28]

Forestry as a form of land use will always cause environmental impacts. The consequent impacts on natural resources and the economy can be examined from a global perspective, as well as nationally. From this global perspective it could reasonably be asked where in the world the required wood raw material could be produced and processed with the most favourable environmental and social impacts. [29]

[28] Information box 9: ESI 2005 - Benchmarking environmental stewardship.

[29] Mayer, A. L., P.E. Kauppi, P.K. Angelstam, Y. Zhang, & P.M. Tikka. 2005: Enhanced: Importing Timber, Exporting Ecological Impact.

Information box 1:

THE NOTION OF SUSTAINABLE DEVELOPMENT

The concept of sustainable development aims to address concerns about the global conflict between current economic development and the need to conserve environmental resources. The concept as it is presently understood took shape at the UN Conference on Environment and Development in Rio de Janeiro in 1992 (UNCED). 179 countries participated in this conference and their representatives approved the following documents:

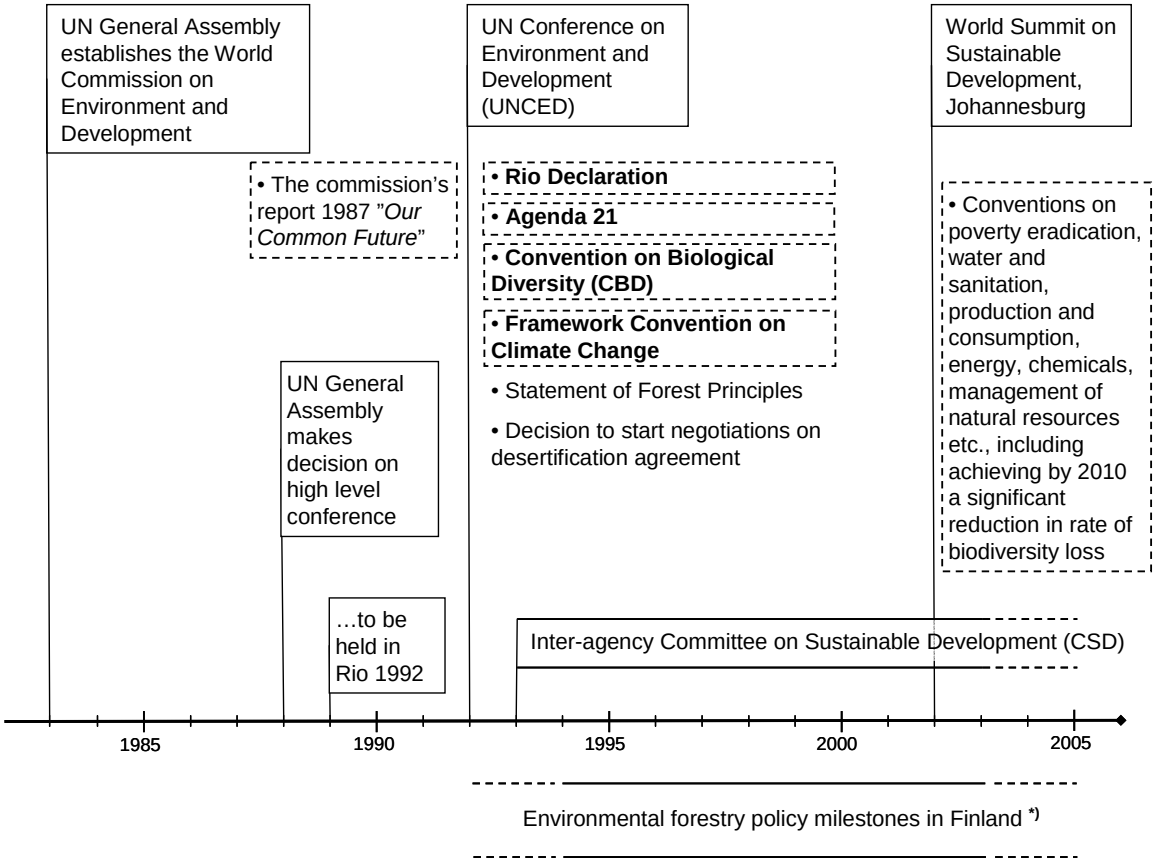
- A declaration on environment and development (Rio declaration)
- A global sustainable development agenda for the 21st century (Agenda 21)
- A set of forest principles

In addition, a general agreement on the protection of biodiversity (the Convention on Biological Diversity, UNCBD) and a framework agreement concerning climate change (climate agreement, UNFCCC) were also drawn up for subsequent ratification. Decisions were also made to start negotiations on a desertification agreement (UNCCD). [30]

The concept of sustainable development was further elaborated at the UN Summit on Sustainable Development held in Johannesburg in 2002. [31] This summit emphasised the connections between poverty, the environment and the use of natural resources.

Figure 1 shows the path that led to the outcomes of the Rio conference, and also illustrates the timing of Finnish forestry's "green change" in relation to worldwide developments.

[30] Earth Summit. UN Conference on Environment and Development (1992).
[31] Johannesburg summit 2002. Keyoutcomes of the summit.



*) Kuuluvainen, T., J-P. Jäppinen, T. Kivimaa, P. Rassi, P. Salpakivi-Salomaa & J. Siitonen. 2004: Ihmisen vaikutus Suomen metsiin.

Figure 1. Events that shaped the principles of sustainable development.

The Rio conference was the starting point for several international processes, some of which quickly had an impact on the general principles of forestry at global level. At the EU level, no common forest policy has been established, but forest matters have been quite extensively covered in meetings between forestry ministers. [32]

The EU Biodiversity Strategy came into force in 1998. Its starting points are the main points of the 1992 Convention on Biological Diversity. In order to meet the targets of its environment strategy, the EU Commission published action plans in 2001 for integrating biodiversity protection into agriculture, fishing and development policies (Fig. 2). [33]

[32] Ministerial conference on the protection of forests in Europe.
[33] Environment 2010: Our future, Our choice.

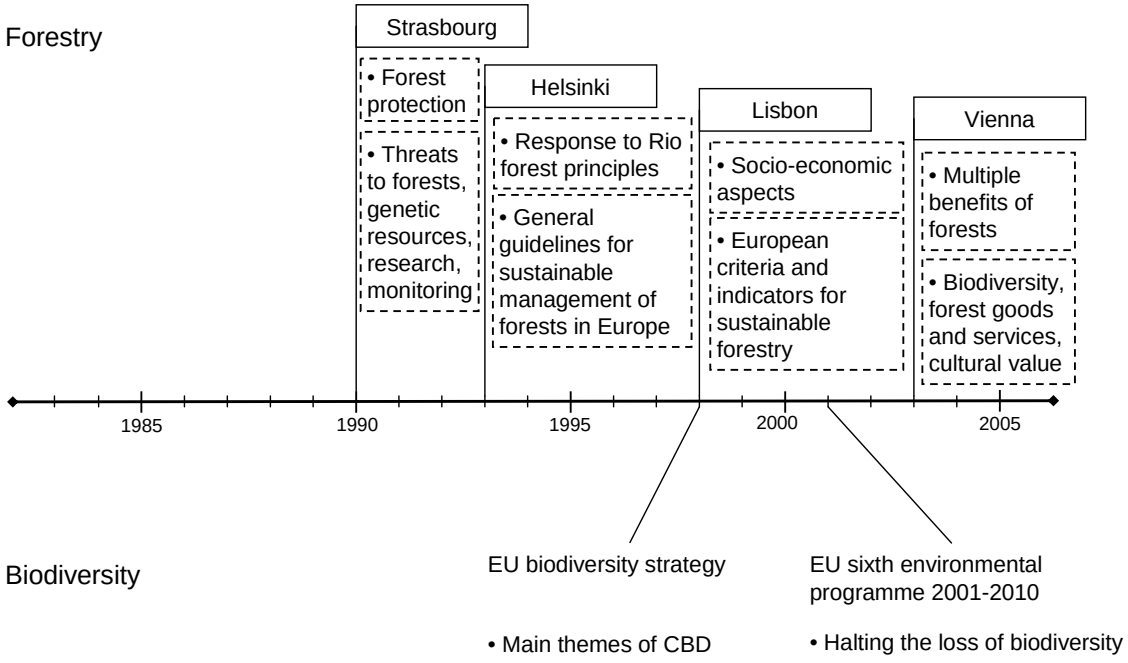


Figure 2. Forests and biodiversity in the EU.

The core documents relating to the incorporation of sustainable development principles into forestry could be considered to be the results of the Rio conference, and in particular the Convention on Biological Diversity and its implementation processes. On the international level, the forest principles defined in Rio have led to definitions of sustainable forestry and the still ongoing preparation of UN forest agreement. These processes, which directly relate to forestry, have been broadly in line with trends in forestry in Finland, and have not so far led to any new developments in themselves.

It is noteworthy that the Rio and Johannesburg documents do not frequently refer to forest matters. The one concrete product of the enforcement of the Convention on Biological Diversity with regard to forests so far has been the recommendation for applying the so-called ecosystem approach (see Table 1) – a concept which has been introduced in forest literature. [34] A later Finnish publication dealing with this subject refers to multiple use forestry planning as an example for other sectors aiming to apply this approach. [35]

[34] Schlaepfer, R. 1997: Ecosystem-Based Management of Natural Resources: a Step Towards Sustainable Development.

[35] Jäppinen, J.-P., J. Seppälä & J. Salo. 2004: Ekosysteemilähestymistapa biodiversiteetin suojelussa, hoidossa ja kestävässä käytössä.

TABLE 1. The core results of the UN Conference on Environment and Development.

Commitment	Contents
Rio Declaration	This political document defines 27 principles designed to make world development sustainable. The introduction to the declaration states the goal of establishing a new and equitable global partnership through the creation of new levels of cooperation among States, key sectors of societies and people; and by working towards international agreements which respect everyone's interests and protect the integrity of the global environmental and developmental system. The first principle crystallizes the message and goal of the whole declaration in brief: *Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature*.
Agenda 21	This programme defines how the Rio principles are to be implemented in practice at national and international level. It includes 40 sub-programmes (chapters). The protection of biological diversity is dealt with in Chapter 15, and the control of forest decline in Chapter 11.
Convention on Biological Diversity	The aims of the convention are the protection of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. The enforcement of the agreement is regularly monitored at the Conference of the Parties (COP), aided by the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA). In connection with the implementation of the agreement during the period 1995 - 2004, principles and guidelines were developed for the *ecosystem approach*, which aims to promote the protection of biological diversity, its management and overall sustainable use.

Information box 2:

SUSTAINABLE FORESTRY CRITERIA

Finland's national sustainable forestry criteria and indicators were created in 1995 by adopting Pan-European criteria with a few minor changes (see Figure 1).

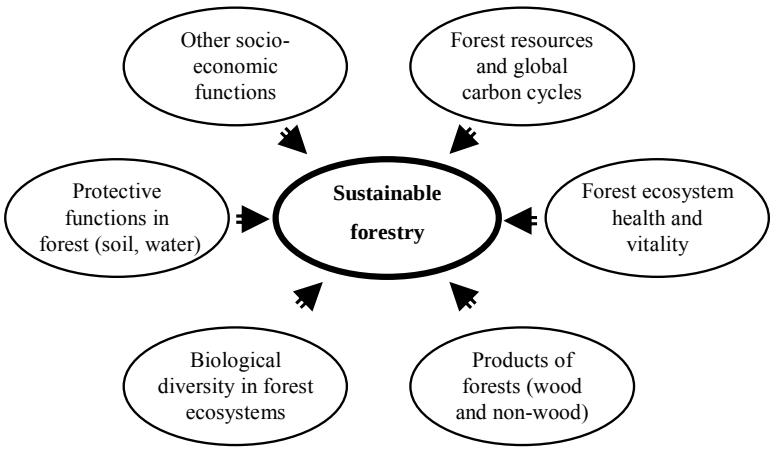


Figure 1. Pan-European sustainable forestry criteria produced through the 'Helsinki process'. [36]

The criteria and indicators have been selected to help evaluate forestry practices and developments, and also for monitoring the impacts of forest policies. They can also be directly applied in forest certification systems. Certification systems differ chiefly in respect to performance requirement levels and the verification procedures for the criteria.

Finland's national criteria and indicators were revised by an extensive working group in 2000, especially with a view to the monitoring of the national and regional forest programmes. [37] They are due to be revised again during 2005. [38]

The Montreal Process initiated by Canada is independent from the European process, but covers a similar climatic area. The criteria in the Montreal process are practically the same as for Europe, but they are presented in a different order. [39, 40] A total of 182 member countries are involved in the nine international sustainability processes based on the Rio forest principles (see Table 1).

[36] Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles.

[37] Mikkelä, H., S. Sampo & J. Kaipainen (ed.). 2000: Suomen metsätalouden tila 2000. Kestävän metsätalouden kriteerit ja indikaattorit.

[38] - " -

[39] Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests - The Montreal Process.

[40] - " -

TABLE 1. Processes involving criteria for sustainable forestry. [41]

Initiative	First version	Concerns	Participating countries
International Tropical Timber Organization (ITTO)	1992	Natural tropical forests	31
Pan-European Forest Process	1994	Northern Europe and the temperate zone	41
Montreal Process	1995	America, Asia, North Pacific region and the temperate zone	12
Tarapoto Proposal	1995	South America, Amazon area	8
Dry-Zone Africa Process	2000	Sub-Saharan Africa	30
African Timber Organization	2001	African tropical zone	14
Near East Process	2000	Near-east region	30
Lepaterique Process		Central America	7
Dry Forests in Asia	2001	Central and southern Asian countries	9

[41] Gaynutdinova, T, & F. Koza. 2003: Summary of the International Conference on the Contribution of Criteria and Indicators for Sustainable Forest Management: the Way Forward.

Information box 3:

BIODIVERSITY AND THE VERIFICATION OF ECOLOGICAL SUSTAINABILITY

The 1992 Convention on Biological Diversity defines biodiversity as follows: Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. [42]

According to this definition, biodiversity must be studied on multiple temporal and spatial scales at the same time. The main regional variables are site conditions and climatic factors, which are vital for species. Interaction between species, disturbance factors and the geographic dynamics of species distributions produce ecosystem successions, which together with the time variable lead to biodiversity. Regional variations and time scales are also interlinked in that the impacts of frequent events are normally small-scale, while conversely more infrequent but major disturbances interact with the long-term changes to lead to larger-scale impacts – for example the succession cycle of forests and regeneration cutting.

Biodiversity is hard to quantify or grasp in a concrete sense. It is not possible to unambiguously measure biodiversity as a specific state that predominates within a defined area at a certain point of time. In field research, single species and groups of species have not worked as indicators as had been hoped. It has been suggested that the subject of biodiversity should better be approached through indicator shopping baskets, which would cover species, forests and the landscape structures. With the help of specific measurements these indicator shopping baskets could determine biodiversity in all its spatial and temporal dimensions. [43]

Measurements aiming to determine ecological sustainability for a certain land use comprehensively and clearly can face normative and verification problems, especially where biodiversity is concerned:

(1) What species occurrence should be held as the requirement for ecological sustainability and at what spatial and temporal scales?

(2) Should we require the restoration of species that originally occurred before the land was ever used, or during some earlier land use; or should we merely strive to maintain the present species? What tasks should be set for each land use to maintain regional biodiversity? What should forestry's role be, for example, in maintaining grass-herb forest type species which have declined as a consequence of earlier land use changes, i.e. population growth and the spread of agriculture?

[42] Convention on Biological Diversity. Convention Text.
[43] Niemelä, J. 2001: To what extent biodiversity of forests can really be measured?

(3) Can any kinds of land use be unequivocally verified as being ecologically sustainable? Resources are regularly moved from ecosystems to technosystems, which can lead to the loss of species, or at least a narrowing of their genomes. Previous historical examples worthy of mention include the loss of forests in Central Europe due to the spread of farming, and the impacts of early forest use on the phenotypes of tree species around the Mediterranean.

Information box 4:

THE CONCEPT OF CORPORATE SOCIAL RESPONSIBILITY

This concept approaches sustainability from a corporate viewpoint, where the various dimensions of sustainable development have been analysed beyond the original basic idea (see Fig. 1).

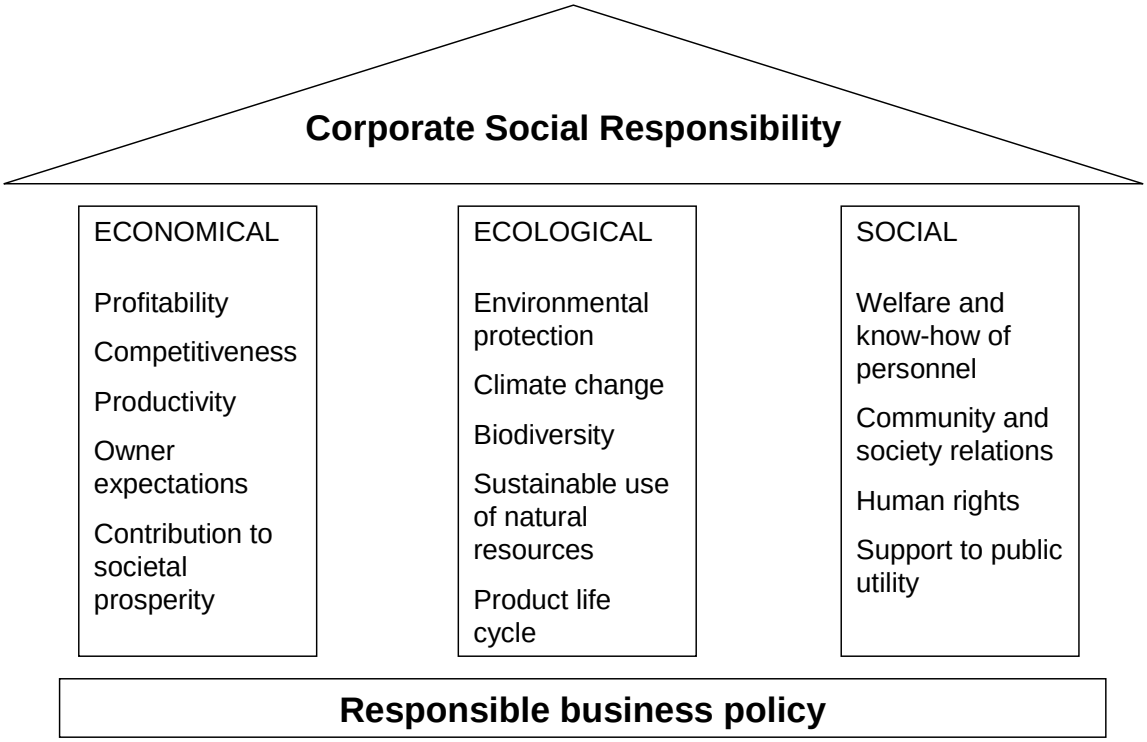


Figure 1. The main components of Corporate Social Responsibility. [44]

[44] Niskala, M. & K. Tarna. 2003: Yhteiskuntavastuun raportointi.

Information box 5:

ENVIRONMENTAL COMMITMENTS CONCERNING WOOD RAW MATERIAL IN THE FINNISH FOREST INDUSTRY

The Finnish forest industry has announced the following commitments: [45]

To promote economically, ecologically, socially and culturally sustainable forestry:

- protecting nature's biodiversity, soil and water; safeguarding forest ecosystems' health and ecological functions; maintaining and promoting forest resources and wood production; safeguarding traditional livelihoods and diversity
- supporting internationally accepted forest certification standards which are suited to local conditions.

To promote and implement responsible wood procurement policies:

- adhering to national laws, regulations, and also guidelines and instructions from the relevant authorities
- procuring no wood from protected areas, or other areas where the authorities have banned felling
- protecting valuable ecosystems and threatened species in natural forest habitats.

To support the implementation of the national action plans for biodiversity in Finland.

To work in cooperation with interest groups.

To communicate actively with other actors both in Finland and abroad.

To communicate internally and provide staff with training related to the forest environment.

To use environment and quality management systems and origin of wood systems to guarantee the high level of environment management.

To support research related to forests and biodiversity.

To avoid the use of genetically modified organisms for forest regeneration in Finland.

To be aware of its responsibilities for biodiversity also outside Finland.

[45] Raivio, S. 2005: Metsäteollisuuden metsäympäristöpolitiikka.

Information box 6:

ECONOMIC ASPECTS IN DIFFERENT FOREST REGENERATION OPTIONS

A joint research project, *Forest Regeneration Options in the Light of Biodiversity and Economics*, which started in 1994, compared the impacts of different final felling practices in mature spruce stands. The results from the technical-economic section of the project showed in a concrete way that wood harvesting technologies and costs do not limit felling options in practice, but rather that the critical question is their functionality as part of the regeneration system. [46]

The following conclusions were drawn in the project's technical-economic section:

- Harvesting based on *selection system felling* is likely to cost more than other methods
- The differences in costs including wood transportation were estimated to range within 0.5 - 4%
- The differences between harvesting methods in site preparation and planting costs, when these were applied, were considered to be negligible
- The effects on stand establishment success were considered to be decisive with regard to:
  - restocking results (stand density, height growth, spacing, quality)
  - decay risks
  - windfall risks
- The prospects for *selective systems* and *gap felling* have been anticipated (the sample plots are still under measurement) as follows:
  - these methods are feasible when tree cover retention is important to biodiversity or the landscape
  - the final restocking quality is uncertain
  - by applying these methods extensively, larger areas would be required under operations because of slower restocking than with current methods [47]

[46] Kaila, S. 2003: Monimuotoisuus kuusikon uudistamisessa.
[47] Monta-esite. Monta-tulosseminaari 17 May 2002.

Information box 7:
APPROACHES TO FOREST BIODIVERSITY RESEARCH

Different approaches

Three different approaches have been used to evaluate the state of forest biodiversity and the related trends:
(1) species distribution and threatened status
(2) threshold values and extinction debt based on population dynamics
(3) forest structures based on natural disturbance dynamics [48]

The first approach looks at changes in the occurrence of forest species; the second approach aims to predict species loss through changes in the spatial occurrence of their habitats; and the third approach compares commercial forest structures and management systems with forests in a natural state and the natural disturbances they experience. Issues related to biodiversity are also covered in applied research dealing with forest policies and environment policies, including assessments of alternative biodiversity protection methods and their implementation in forest planning and private forestry. [49]

Studying species distribution and threatened status

Species diversity is widely seen as an important guarantee of ecosystem functionality and continuity. This makes it an obvious way to evaluate the condition of biodiversity by examining the number of species living in an area. Assessment how the populations of endangered species are developing is particularly central, as such trends are thought to significantly reflect any quantitative or qualitative changes in ecosystems caused by land use. [50] The threatened status of species is monitored in Finland through periodic national assessments. The third of these national "red lists" was completed in 2000. Species monitoring is a central element of the biodiversity monitoring carried out by the authorities, and is based on the obligations of the Finnish Nature Conservation Act and EU Habitats and Birds Directive. [51] Species that are considered to be declining significantly are specially protected through regulations defined under the Nature Conservation Act. These species are usually classified as critically endangered (CR), endangered (EN) or in some cases vulnerable (VU), and the authorities are obliged to organise monitoring and, if needed, special protective measures for these species. [52] At present birds and game mammals are the most extensively monitored species groups.

[48] Ahlroth, P. 2003: Metsälajiston nykytila ja tulevaisuudennäkymät eri skenaarioiden ja tutkimustiedon valossa.
[49] Otsamo, A. (ed.). 2004: MOSSE puolimatkassa – monimuotoisuuden tutkimusohjelman (2003–2006) välitulokset.
[50] Hildén, M., A-P. Auvinen & E. Primmer (Eds.). 2005: Suomen biodiversiteettiohjelman arviointi.
[51] Toivonen, H. & U-M. Liukko (Eds.). 2005: Ehdotus biodiversiteetin tilan valtakunnallisen seurannan järjestämisestä.
[52] Kuusinen, M. & R. Virkkala. 2004: Luonnonsuojelulakiin perustuva metsien suojelu.

In the red list report that assessed the status of threatened species in Finland in 2000, approximately 1,500 adequately known species were classified as threatened to varying degrees. Some 600 of these are forest species. According to the assessment, the declining trend among forest species has generally slowed down in recent decades, but is still continuing for old-growth forest species in Southern Finland. [53] The forecast for 2010 included in the evaluation report of the *Finnish Biodiversity Programme* anticipates that forest species will continue to become more threatened in all species groups except mammals, and that in well known groups the number of threatened species may increase by as much as 10%. The most critically affected forest species groups are considered to be species that rely on deadwood, and species associated with grass-herb forest types and dry lichen heaths. [54]

Studying threshold values and extinction debt based on population dynamics

The significant decline in natural forest ecosystems and their structural features has led to corresponding declines in the species associated with such features. Trends in the populations of many species only exhibit a delayed reaction to such changes, however. Isolated local populations can survive for long periods in small ecosystem patches, depending on their size and ecology, even for hundreds of years in some cases. This delayed but predictable species loss is described as ecosystem change *extinction debt*. Correspondingly, the effect of an increase in the distribution of suitable ecosystems due to protection and habitat restoration has been referred to as *species credit*. [55]

Changes in the forest landscape and its structural features tend to be slow. Harvesting is typically carried out in just 1–2% of the total area of forested land each year, and the subsequent ecological succession is slow. The structures of commercially managed forests are chiefly the consequence of successions that are determined by forest management practices. Today's forests do not yet reflect current practices and forest use much, rather they reflect the forestry practices of the last few decades. Over such a long period there have been many changes in forestry practices (see Figure 1). [56]

[53] Rassi, P., A. Alanen, T. Kanerva & I. Mannerkoski (Eds.). 2001: Suomen lajien uhanalaisuus.
[54] Hildén, M., A-P. Auvinen & E. Primmer (ed.). 2005: Suomen biodiversiteettiohjelman arviointi.
[55] Siitonen, J. & I. Hanski. 2004: Metsälajiston ekologia ja monimuotoisuus.
[56] *Based in:* Wessman, H., P. Salpakivi-Salomaa & S. Kaila. 2002: Problems and procedures of integrating forestry into LCA.

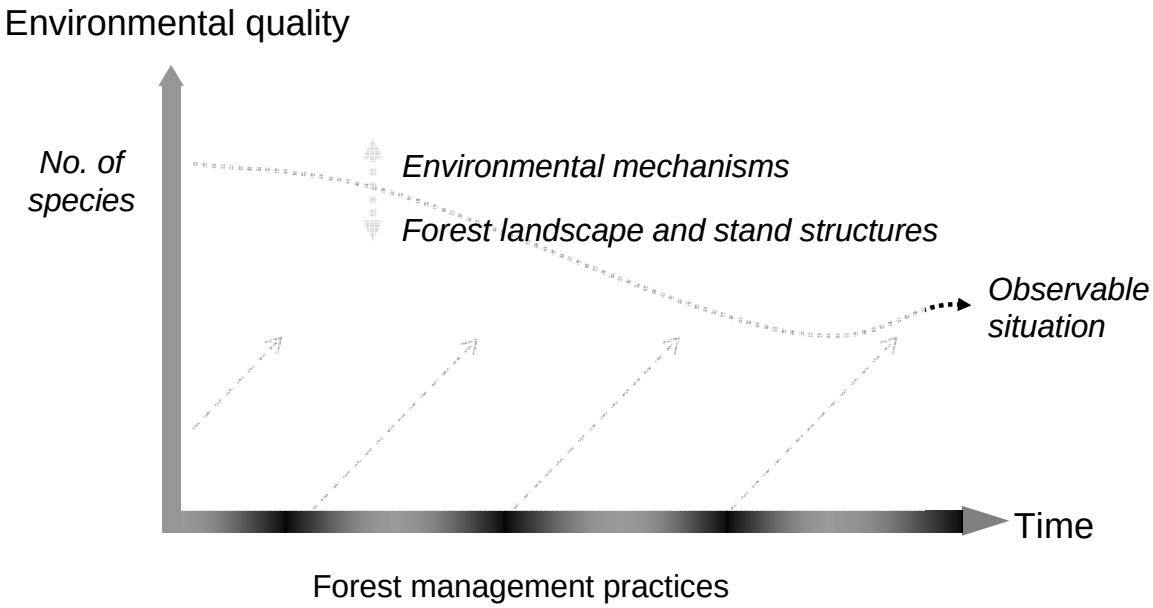


Figure 1. Forest management and land use practices affect the quality of the forest environment, and also forest biodiversity, but this process occurs indirectly through the structures of forest landscape, which result from previous practices rather than current practices.

Significant changes in Finnish forestry during recent decades have included:

- **Rationalisation** during the 1960s and 1970s, aiming to reduce costs through mechanisation, intensive stand establishment methods and larger unit sizes for management areas
- **Site-oriented forest regeneration** in the 1980s, aiming to use the productive capacity of the land more effectively, through the diversified use of site preparation and planting stock, intensive tending of young stands and reduced management areas
- **Emphasising environmental values** in the 1990s, aiming to give more attention to the ecological and social impacts of forest management, through "the green change" in Finnish forestry, with a new emphasis on visual features such as retention tree groups and key biotopes for biodiversity [57, 58]

Studying forest structures based on natural disturbance dynamics

Forest biodiversity is the result of the forest landscape and the forest's previous management history and natural dynamics. The base point in comparisons between commercially managed forests and natural forests is that in order to safeguard species against the threat of extinction, the managed forest landscape should still contain plenty of the characteristic features of natural forests. In aiming to protect biodiversity, the forest landscape as a whole should resemble as much as possible the setting in natural forests,

[57] Hänninen, E., K-M. Korhonen, R. Koskinen & J. Kostamo. 1992: Managing the forest environment in Finland.
[58] Kalland, F. & A. Pätilä. 1993: Green change.

where natural disturbances and the subsequent ecological succession create the necessary variety and spatial heterogeneity. This is considered to mean that forest management practices should purposefully create structures and disturbances that resemble those in natural forests. [59]

Research has shown that natural forests differ from commercially managed forests in many ways, which over recent decades have been most significantly shaped by the widespread practice of clear felling. It has been proposed that forest management practices need to be revised according to the following principles:

- The structural diversity of forests should be retained.
- The heterogeneity and interconnectedness of forest landscapes should be maintained.
- Small-scale watercourses and their associated ecosystems should be protected.
- Risks should be decentralised.

This would mean that forests would be managed using a combination of the existing clear felling and thinning methods, together with selective felling and gap felling. Selective felling and gap felling would aim to maintain a varied forest stand mosaic with continuous but varied crown cover, and also preserve a variable age and tree size structure within stands. At the regional level, forest fragmentation could be reduced by concentrating fellings so that better integrated structural connections could be formed between similar forest compartments. Fairly wide buffer strips should additionally be left around small-scale watercourses, and the sizes of felling areas should be varied in order to reduce the uniformity of the resultant patterns in the forest landscape.

As a possible criticism of this approach, it could be asked whether features that are important for biodiversity, such as deadwood and landscape variability, could be more cost-efficiently increased through current forest practices.

[59] Kuuluvainen, T., M. Mönkkönen, P. Keto-Tokoi, M. Kuusinen, K. Aapala & H. Tukia. 2004: Metsien monimuotoisuuden turvaamisen perusteet.

Information box 8:

THE ROLE OF RESEARCH IN DEVELOPING FORESTRY PRACTICES

The knowledge basis concerning sustainable development is on one hand fairly fragmented and insufficient, and on the other hand conceptually incommensurable. What kind of research would be most helpful with regard to the need to make forest management comply with the concept of sustainable development?

Forest management options can be compared by carrying out inventories in sites managed in different ways and drawing conclusions on the basis of their condition. However, the results from such inventories are likely to be affected due to the specific circumstances of each site, which inherently are not similar in different management options, meaning that the results may not be directly comparable. It is not either easy to make reliable predictions and generalisations about the reactions of ecosystems and their elements to disturbances. Therefore experimental research is also needed, even though organising sample plots can be laborious and the final results will not be available for long periods, since the effects on species and forest growth only become evident after several years.

In the sustainable development process, the knowledge basis is not an unchangeable entity, but rather a complex agglomeration which can serve as a framework for new research, and which is constantly liable to new interpretations. The kind of comparative experimental research that examines alternative modifications of forest management methods, and measures their impacts on species, wood production and wood procurement, while also assessing their wider socio-economic impacts, can nevertheless improve our understanding of the merits of alternative forest use solutions (Fig.1).

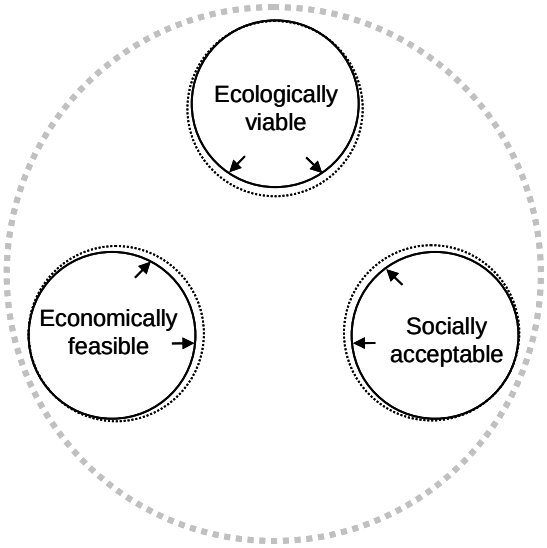


Figure 1. Research traditionally analyzes the world from a single viewpoint, but where sustainable development is concerned it is important to link the same research to different viewpoints. [60]

[60] *Based in*: Bormann, B. T., M.H. Brookes, E.D. Ford, A.R. Kiester, C.D. Oliver & J.F. Weigand. 1994: Volume V: A framework for sustainable-ecosystem management.

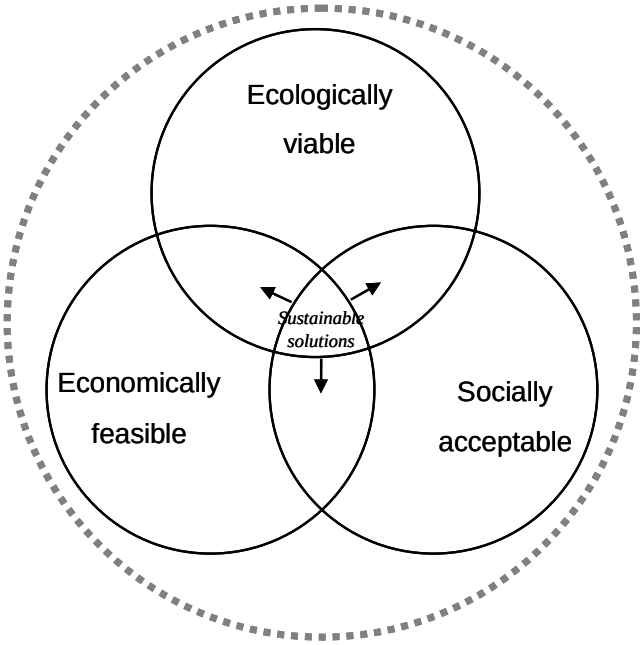


Figure 2. Multidisciplinary research can cover different viewpoints to assess the possible ecological, economic and social trade-offs involved in optional solutions, in order to enhance the sustainability of forest management. Our notions of economical feasibility, ecological viability and social acceptability are widened, and so are the prospects of sustainable solutions.

In practice, this type of multidisciplinary research can widen our understanding of the functionality of different forest management options with regard to the different aspects of sustainable development, by examining their consequent economic, ecological and social advantages and disadvantages. As a result of such analysis, the room for universally acceptable solutions may ultimately prove to be wider than was previously thought. In such cases the prospects for constructive compromises are improved (see Figure 2). [61]

[61] Kaila, S. & P. Salpakivi-Salomaa. 2004: Monimuotoisuuden turvaamisen ohjaus talousmetsissä.

Information box 9:

ESI 2005 –
BENCHMARKING ENVIRONMENTAL STEWARDSHIP [62]

The Environmental Sustainability Index (ESI) was developed to benchmark the ability of nations to protect the environment. The index works by integrating 76 data sets into 21 indicators of environmental sustainability. The indicators are grouped into five categories:

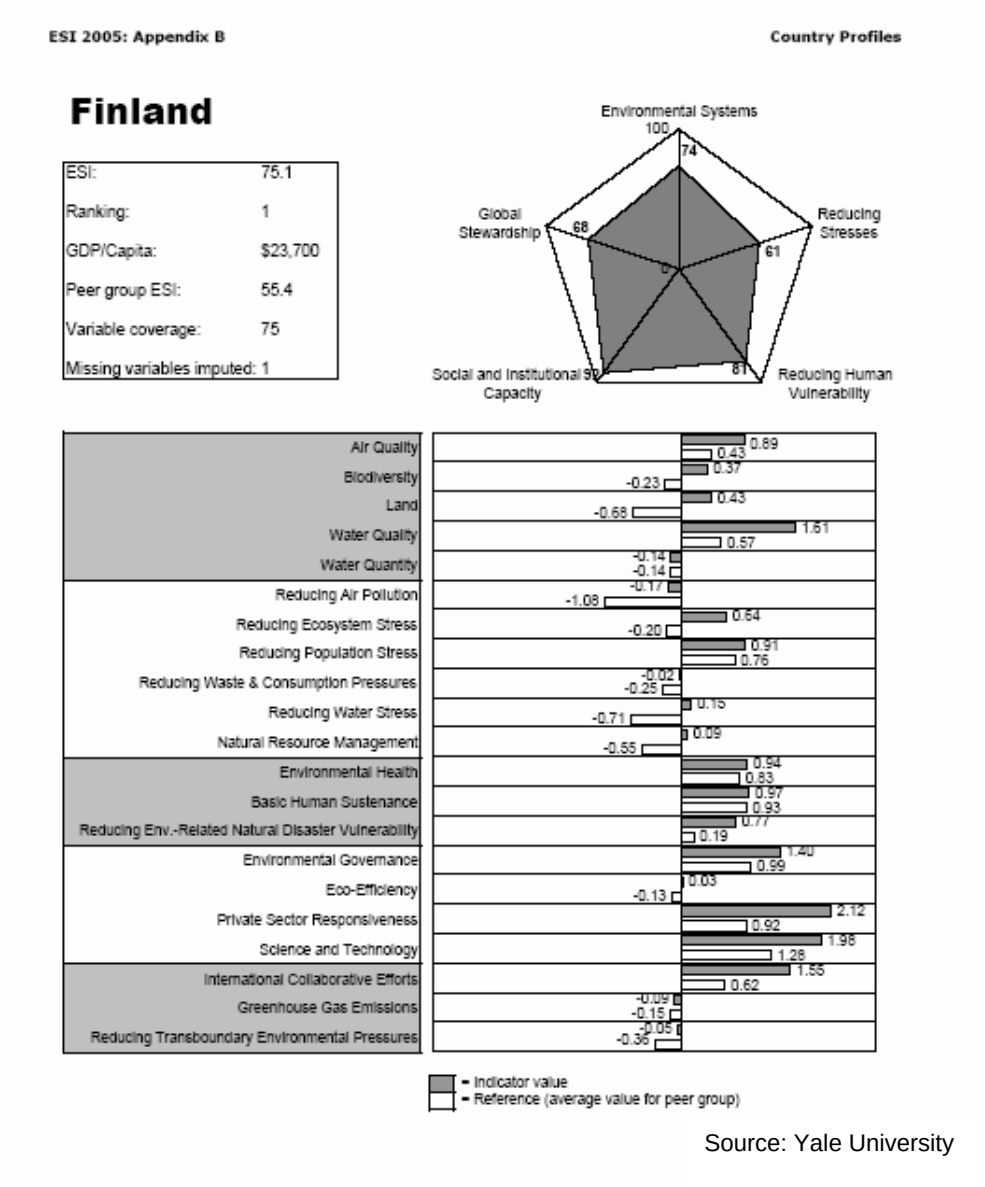
- Environmental Systems
- Reducing Environmental Stresses
- Reducing Human Vulnerability to Environmental Stresses
- Societal and Institutional Capacity to Respond to Environmental Challenges
- Global Stewardship

Five of the 76 data sets cover biodiversity, and two more the state of forests and forestry.

The ESI has been designed as a tool to gauge national environmental stewardship. It is seen as a summary measure of environmental performance, human development and economic well-being. Like any measure of sustainability, the index has its shortcomings, related to gaps in the data sets, divergent views about sustainability, and the way uncertainties are addressed.

The 2005 ESI benchmarking covered 146 countries. Figure 1 shows Finland's ESI score, ranking and country profile. On all the indicator values Finland outranked peer group countries with similar conditions, and on three indicator values Finland came out narrowly ahead of all the other countries assessed.

[62] Esty, D. C., M. Levy, T. Srebotnjak & A. de Shrebinin. 2005: Benchmarking National Environmental Stewardship.



Source: Yale University

Figure 1. Finland's country profile in ESI 2005. [63]

[63] Esty, D. C., M. Levy, T. Srebotnjak & A. de Shrebinin. 2005: Benchmarking National Environmental Stewardship.

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