Future Forest Research Strategy for a Knowledge Based Forest Cluster: An Asset for a Sustainable Europe

A Vision Paper of European National Forest Research Institutes

François Houllier, Julius Novotny, Risto Päivinen, Kaj Rosén, Giuseppe Scarascia-Mugnozza and Konstantin von Teuffel

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FOREWORD

On the 5th and 6th of July 2004, the Heads of National Forest Research Institutes (NFRIs) of MCPFE-countries convened in Vienna for their first meeting[1]. One of the decisions taken at that meeting was that the NFRIs together, with the European Forest Institute as co-ordinator, will undertake steps aiming at a better integration of forest research in the upcoming EU's 7th Framework Programme for R&D, inviting also other institutions and organisations to participate in this effort.

A small Task Force was established for this task, consisting of François Houllier, INRA, France, Julius Novotny, FRI, Slovakia, Risto Päivinen, EFI (chair), Kaj Rosén, Skogforsk, Sweden, Giuseppe Scarascia-Mugnozza, CNR, Italy, and Konstantin von Teuffel, FVA, Germany.

On 12 November 2004, the Task Force organised in Brussels a meeting '*European forest research – outlook for the future*', aimed at the representatives of the Commission and the Heads of National Forest Research Institutes[2]. Two papers were drafted for the meeting, one characterising NFRIs as a potential to contribute to EU policy objectives, and a vision paper on the future forest research in Europe. This Discussion Paper is largely based on those two documents. The Paper thus visions the future forest research needs in tomorrow's Europe, and describes the potential role of the – so far rather fragmented – NFRIs in answering, for their part, to those challenges and needs through better co-operation, integration and use of available instruments.

National Forest Research Institutes cover a substantial share of the forest research capacity in Europe, but there are also other equally important players: forest faculties and privately funded research organisations form a substantial research resource. It was agreed at the first NFRI meeting in Vienna that these other research bodies should also be brought into discussion on how forest researchers can be proactive in contributing to the European research agenda.

One of the forums for discussing future directions of EU research is the Commission initiative on Technology Platforms, which will be a major tool in the 7th Framework Programme. The key aims of Technology Platforms are to bring together whole sectors in order to develop strategic research agendas. The vision of the Technology Platform for the European forest-based sector has recently been elaborated. The strategic research agenda is currently being drafted and should be finished in the year 2005. We hope that the current Discussion Paper provides a useful contribution to the research agenda of the Forest-based Sector Technology Platform.

1 http://bfw.ac.at/iyfw/imh_intro.html
2 http://www.efi.fi/events/extra/2004/nfri/

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We are fully aware of both organisational and topical difficulties related to this paper. For instance, the definition of the 'NFRIs' as used in this report is not self-evident. Also, grouping the research topics under a few major titles does not always do justice to their multidimensional and multidisciplinary nature.

We believe that the orientation of future research will benefit from active debate on the possible directions. Therefore, we would like to invite critical arguments on issues and weightings brought forward in this paper, and alternative points of view to challenge the vision presented here.

The NFRI Task Force wishes to express its warmest thanks to Yves Birot who significantly contributed to the paper and especially its Chapter 2, to Harald Mauser, Bo Jellesmark Thorsen, Eugene Hendrick and Leena Roihuvuo for their valuable inputs, as well as Minna Korhonen and Jarkko Heikkinen for their editing work.

January 2005
Authors

EXECUTIVE SUMMARY

Europe's economy, society and environment are exposed to major internal and external factors and driving forces in an increased globalisation context. These 'megatrends' include i.a. concern for the climatic changes, urbanisation and rural decline. There is a need for renewable energy sources and the necessity of a more sustainable use of natural resources. At the same time, competitiveness is required from all sectors of economy.

The forest and forest industry cluster is based on renewable natural resources, covering one third of Europe's land area. Forest sector includes about 15 million forest owners and contributes to economic welfare by annual production valued at 600 billion EURO and offering four million jobs. In paper industries and many other aspects, the European forest cluster has a leading position in the global scale. However, the role of forests and forest sector vary substantially in different parts of Europe.

Today, our forest cluster is competitive and uses processes which are to a large extent environmentally friendly. It is well founded to state that the forestry and forest sector are in a good position to be competitive and, at the same time, become the first sector meeting the society's demand of full sustainability. Research and Development are of key importance in achieving these goals, and the contribution of the forest sector to a competitive and sustainable Europe can be strengthened by allocating resources to key areas of research, as well as to coordination of research.

A CONCEPTUAL FRAMEWORK FOR FOREST RESEARCH

We propose to identify a few major domains for future forest research. These domains or programmes are neither exclusive from each other, nor self-sufficient.

1. Forest and forest-related ecosystems: understanding and monitoring their dynamics and functioning. This domain covers the dynamics and biodiversity of forest ecosystems – from genes to landscapes, and of other more or less natural ecosystems which are spatially or dynamically linked to forest ecosystems, e.g. wooded grasslands, forest parks in an urban environment. This also includes research on impacts of global environmental changes on the functioning of forest ecosystems.

2. Renewable forest resources: providing competitive goods for manufacturing. This domain covers the up-stream part of the forest-wood chain, including silviculture and forest management, based on tree biology and understanding the ecosystem dynamics. It addresses the cost-effective production and harvesting of renewable timber-related resources – i.e. solid wood and fibres, molecules, and bioenergy – and of non-wood products, e.g. berries, mushrooms and hunted game.

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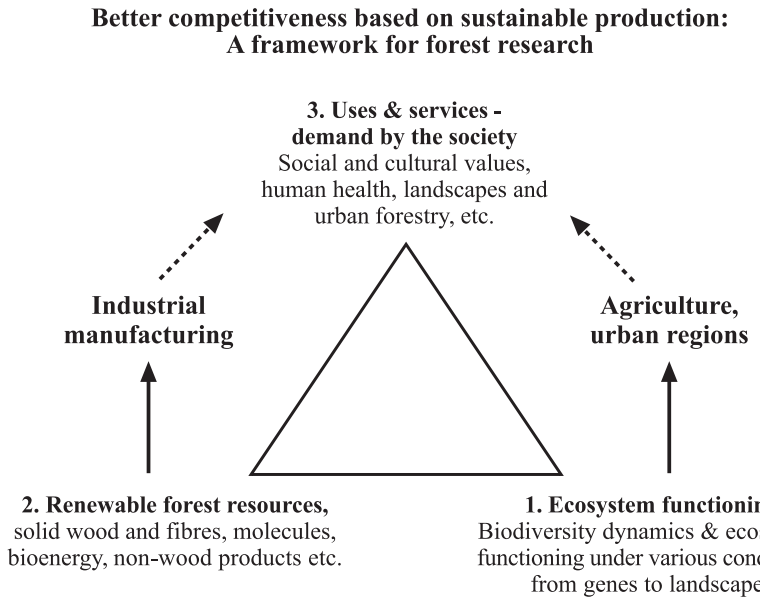

The three corners of the above figure represent the three domains described above. The arrows on the sides represent indirect connection of forests and the society – on the left through products of forest-based manufacturing industries, on the right through other landscapes of land use forms than forests.

3. Uses and services: answering society's widening demands. This domain covers the assessment of ecological, social and cultural values and services provided by forests to the society: it includes topics such as the contribution of trees and forests to human health, the quality of landscapes and urban forestry, the contribution of forests to water quality, etc. It also covers the interdisciplinary research to understand the perception of markets and society of forest-based goods and services.

4. Multifunctionality and sustainability – two concepts closely related to forest management – are emerging on the forest research agenda.

- Sustainable Forest Management (SFM) calls for revisiting and renewing the classical forestry concept of sustainability and, in a fast-changing context, puts a strong emphasis on the time horizon. The research issue is to guarantee the continuous supply of goods and services from the forest resources.
- Multifunctional character of forests, which provide a wide range of resources, products and services for a varied range of users, from individuals to industry, and in a wide range of ecological conditions and economical and social environments. An emerging research issue is: how to manage forests to fulfil – simultaneously or sequentially, locally or at a larger scale – the various needs expressed by society?

These main domains are linked to each other (see figure above and Figure 8), and to other research fields which deal with the downstream part of the forest-wood chain, such as wood physics and chemistry. As forests do not occur in isolation, research connections are

necessary to other landscape components; agriculture, unmanaged grasslands, freshwater ecosystems and urban areas. In social, economic and political context, forest research should follow and contribute to the policy discussion in sectors such as industry, energy, rural development, environment, agriculture etc.

THE WAY FORWARD

Forest research in Europe has only a few large scale research facilities, but its overall total capacity is substantial: app. €300 million per year in national research institutes only, and about the same amount in universities, etc. These resources could be better utilised by improved co-ordination of research efforts between the European countries, throughout the forestry-wood chain and also through linking forest research topics to the broader physical, political and economic landscape.

European forest research is at the front edge internationally. In order to stay in that position and to be able to contribute the goals of a more competitive and sustainable Europe, balanced allocation of resources is needed to cover all the key aspects of forest research: forest ecosystems, the needs of society, and the management of forests in a sustainable and multifunctional manner.

1 INTRODUCTION

Europe's economy, society and environment are and will be exposed to major internal and external factors and driving forces in the context of increasing globalisation. These 'megatrends' are related to important issues such as:

- The increasing movement of society to urban areas, leading to rural desertification, and to the requirement for more amenities by urban citizens.
- The decreasing part of employment in manufacturing industries.
- The growing concern relating to climate change already taking place and its negative consequences, and the need for a strong political commitment for reducing their impact (Kyoto Protocol).
- The necessity for more sustainable production and use of natural resources, and the need for sustainable energy sources.
- The demand for competitiveness in all sectors of economy.

In this context, an increased research effort, leading to the production of new knowledge, is seen as of paramount importance, for two main reasons: *i*) competitiveness of European industry depends heavily on innovation, which in turn is linked to research, *ii*) our modern societies require more and more scientific expertise for "feeding" rationally based policies addressing problems related to: hazards and risks, health, employment, welfare, clean energy and transport, natural resources, land use, etc.

The Forest Cluster in Europe can make a significant contribution to addressing 'megatrends'. Therefore, it is thought that its contribution to a sustainable Europe could be strengthened on the basis of an increased and more coordinated research effort. The present Discussion paper is aimed at presenting the vision of the National Forest Research Institutes for the evolution of the Forest Cluster in Europe and its consequences in terms of research.

National Forest Research Institutes are characterised in Chapter 3. They cover a substantial share of the forest research capacity in Europe, the total annual funding capacity being app. €300 million, of which three quarters are covered by national budget funding. However, other forest research players also have an important role to play: forest faculties and privately funded research organisations form a substantial research resource, perhaps doubling the abovementioned figure. They should be included in the discussion on how forest researchers can be proactive in contributing to the European research agenda, and in finding new potentials for research to contribute to the welfare of society.

A conceptual framework for forest research is presented in Chapter 4 with the identification of three major research domains: the functioning, dynamics and biodiversity of ecosystems; forest management, harvesting and wood-quality component of the forest-wood chain; and the growing variety of other services, be they externalities or not,

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provided by forests to society. Two other horizontal domains complement this framework. The framework outline is followed by a detailed presentation of research topics within each of these domains, to which NFRIs can provide a distinctive contribution, either by gathering and processing information, by providing new knowledge and innovations, by developing and transferring new tools, or by elaborating syntheses and organizing collective expertise that serve to elaborate public policies.

Considering that NFRIs also have national obligations that vary from one country to another, special attention should be paid to assessing the added value – for the institutions as well as for society, as represented by the national governments and the EU – of the cooperation of NFRIs' attempt to answer the major challenges together.

2 THE FOREST AND FOREST INDUSTRY CLUSTER SERVING EUROPE'S SOCIETY AND SUSTAINABILITY: THE NFRIS' VISION[3]

2.1 THE CURRENT STATE

Forests, forest-based industries, the services, goods and products they provide affect directly the daily lives of most, if not all, the 450 million European citizens. Within the EU 25 countries, forests cover 140 millions hectares, or about 36% of land area. Cover ranges from 1% in Cyprus to 71% in Finland. Europe's forests are extending in area, increasing in growth rate, and expanding in standing volume. There are about 16 million forest owners, and over 4 million people are employed directly or indirectly in forests and forest-based industries, mainly in rural areas. Europe produces 28% of the world's paper supply and is a major operator in wood based panels and engineered wood products.

However, forests are much more than producers of commodities. They fulfil numerous social and environmental functions and provide various goods and services beneficial to European citizens, their health and more generally their quality of life: amenities and recreation in urban and rural areas, protection of water quality, protection against natural hazards (landslides, avalanches, flooding). Moreover, forests, with their relatively high degree of naturalness, contain large pools of biodiversity. At the local, regional and global scale, forests and their products contribute positively to an eco-friendly balance for many elements. Regarding climate change, they represent the major carbon reservoir of the terrestrial biosphere and are a significant tool in mitigating the effects of burning fossil fuels.

The main asset of the forest and forest industry cluster, whose importance has been largely underestimated, is that it is based on renewable natural resources, and that it uses processes which are to a large extent environment friendly. For example, forest-based industries are very efficient in recovering, reusing and recycling their materials and products, for the manufacturing of new products as well as for energy production. Rigorous life cycle assessments of forest products have shown that they have a strong comparative advantage vis-à-vis other materials. In brief, forests, their multifunctional role and their related industries have good possibilities for contributing significantly to a sustainable Europe. The forest-based industry sector is in a very good position to become the first sector meeting the society's demand of full sustainability.

Forests and their protection are highly placed on the European political agenda. Since 1990, at the Pan-European level, a continuous political process of Ministerial Conferences (Strasbourg 1990, Helsinki 1993, Lisbon 1998, Vienna 2003) has been ongoing. It aims at defining a common approach to the main challenges of forest protection and their

3 See Birot et al. 2004.

sustainable management, through common resolutions and commitments. Therefore, this political dimension represents a strong background for scientific activities, as it gives a framework for developing coordinated research as a support to the whole process. Although forestry is not included in the Treaty of Rome, which founded the Common Agriculture Policy, a European Forestry Strategy has been elaborated by the European Commission, constituting a platform of commonly agreed principles[4] . European countries have been among the first to elaborate "national forest programmes" and to develop systems of certification of sustainable forest management and of forest product labelling. Forestry and forest-based industries, with their major economic, environmental and social importance, do require a holistic policy formulation to develop and retain their full potential. Also policies in adjacent fields: agriculture, environment, employment, energy, etc., have obviously to be considered.

A snapshot of other features of the forest and forest industry cluster in Europe, their driving forces and their evolutionary trends, is presented below:

a) Forest resources are expanding due to: *i*) rural decline that leads to increasing forest areas related to vegetation encroachment on abandoned land, *ii*) afforestation programmes *iii*) significant growth in standing volume because of an increased productivity (a major finding of scientific research) and under-utilization of forest resources (wood harvest accounts only for 62% of the biological increment). This leads to excessive volume, which, combined with ageing, can be very detrimental in case of catastrophic disturbances.
b) Fragmentation of private forest ownership is a negative factor leading in particular to high costs of wood mobilisation, and contributes to an under-use of other functions, especially public goods and services.
c) Apart from Scandinavian countries, the coupling between the processing industry and the forest producers is weak resulting in a lack of connectivity between the resource and industry requirements.
d) The deterioration of wood prices on the global market, in conjunction with increased production costs (in particular labour costs), often makes forest management unprofitable, whereas an increasingly urbanized society addresses new and multiple demands on forests, but without remuneration mechanisms.
e) There is a considerable change in the weight of functions assigned to forests with more emphasis being put on environmental and social issues, and of so-called close to nature management techniques. The consequences on the forestry wood-chain of this pronounced shift, in terms of quantity and quality of forest resources, and of cost of mobilisation have been insufficiently documented.
f) Research is needed to fully utilise the opportunities offered by science and technology to develop new and advanced products and services based on forests and forestry materials. This also includes the need for introduction of more intelligent manufacturing processes and, in many cases, less capital intensive production units. Such developments should be thought by taking into account the customer needs and the suppliers demands and requirements.

4 http://europa.eu.int/comm/agriculture/fore/comm/649_en.pdf

g) Fuller utilisation of forest biomass as a source for energy will be of utmost importance for the achievement of a fully sustainable Europe.
h) The transfer of research results into practice is a weak point in all sectors, not only in forestry and forest based industries.

Forest and wood based products research in Europe is to a large extent funded and carried out by public organisations, which are, with some exceptions, largely fragmented. In the field of pulp and paper research, the industry has created a few large research organisations. Moreover, many institutions are specialized on narrow elements and consequently there is little interdisciplinarity or integration, inhibiting a more coherent approach and vision of forests and the whole forestry-wood production chain. In spite of European demonstrated strength in the fields of tree biology, forest ecology and management, pulp and paper making processes, wood processing and development of engineered wood products, it is clear that technological and competitive developments in the sector quite often result from many innovations in and along processes and products, rather than from a single breakthrough. The lack of integration of scientific and technological achievements along the forestry-wood-chain is certainly a weak point in the European context. Today, the political will to create a European Research Area, to harmonize the higher education system in Europe, and to integrate new member countries in the EU, call for a better structuring of the forest research system.

2.2 A FORESIGHT FOR THE FOREST CLUSTER

The multifunctional role of forests is certainly an objective to be pursued in the future. However, it has become recognized that multifunctionality should not be sought at the stand or forest ecosystem level, but rather at the landscape or even sub-regional level. Already such patterns exist: Mediterranean forest value is based mainly on soil protection, amenity and recreation and biodiversity conservation; forests in mountains have mainly a protective role, forests in urban areas are managed for public recreation; plantation forests (poplars, pines, Douglas fir) are devoted intensive wood production, while other forest types (hardwoods, conifers) in Central and Northern Europe are managed more extensively. It is most likely that, under a general principle of multifunctionality, many forest areas will be more and more managed with specific objectives. For several regions across Europe, such a specialisation might be the only way to better ensure that the triple goal: ecological, economic and social functions of forests will be met in a balanced and efficient manner. This scenario is certainly the most demanding in terms of forestry oriented research needs, because of the diversity of topics to be covered.

Strengthening the economic (and partly the social) pillar of sustainable forest management, including the wood based industries, should be a priority as emphasized by the last Ministerial Conference on Forest Protection in Europe held in Vienna in 2003. Competitiveness and economic viability of the whole forestry-wood-chain are crucial for Europe. Even though industry has demonstrated its versatility, the risk of "re-location" of some industries is real, as illustrated recently by the "eastward" movement of some woodworking industries. To be sustainable, the forestry-wood chain must be given the conditions of operating in such a way that the stakeholders work in a win/win environment. Optimising the value chain, increasing the integration along the whole chain,

from the forest to the end-product, including recycling, should be a priority. A stronger coupling between wood producers and industrial consumers has to be put into place, in particular in middle and southern Europe. All sections of the wood chain have to be analysed such as: silvicultural operations, sales procedures and transaction costs, harvesting and logistics costs, etc., in order to determine how best to improve competitiveness. However, the economics of forestry will in the future also be based on providing financial support for goods and services that are not marketed today. Quantifying the total value of forests and their functions, and developing instruments for the provision of new income are major challenges.

Current projections are that wood consumption in Europe will grow very slightly over the coming decades, but more so in other global regions. However, the fact that wood resources are growing offers opportunities for forest based industries to increase the market share of wood as a material (in particular structural wood, engineered wood products, composites, packaging and chemicals). In the pulp and paper sector, innovations in surface treatment, as well as the development of new materials could lead to a diversification of fibre-based products, without neglecting the minimisation of environmental impact (water management and waste issues). The development of the wood based energy sector also appears to be promising at medium term; new technologies of combustion including cogeneration of heat and electricity have emerged, as well as the use of new fuel types (e.g. pellets), making the eco-production of energy economically feasible with a positive impact on employment in rural areas. Studies need to be undertaken in order to evaluate the possible impact of such a development, as well as other policy related developments, on the supply of raw material to existing pulp and wood based panel industries. A weak point in the wood based energy chain is the present inefficiency in collecting forest residues for energy purposes. Considering all these factors, a better appraisal of the quantity and quality of wood resources at various spatial and temporal scales is of major importance for the industrial sector.

Forest and trees are long-lived organisms exposed to an evolving environment. Demonstrated global environmental changes have already taken place and will continue, albeit with a degree of uncertainty. Predicting how forests will be affected, determining how their management can help them to adapt to this evolving environment, and how they can contribute to mitigate greenhouse effect are of paramount importance for the future of the forest cluster. These objectives require monitoring forest health, nutrition, greenhouses gas absorption, evolution of populations and communities, in addition to the traditional growth and yield studies. This supposes the emergence of new and integrated forest inventory services, using a combination of innovative technologies. In relation to climate change (increased temperature and summer drought), hazardous events such as wildfires, forest gales, floods with direct and indirect effects (pest outbreaks) could increase in frequency and intensity. Therefore, the integration of risk into forest management is essential; this requires developing better risk assessment, risk management methods, and improved risk sharing instruments.

As European societies have become richer they have placed increasing importance on the social and environmental benefits of forests and forestry – jobs in rural areas, recreation, landscape improvement and biodiversity. But the ability of forests and forestry practices to deliver these benefits is variable and poorly understood. Many benefits arise from the use of traditional methods, but forestry practice has changed and will continue to change. Rising labour costs and the demands of the market increases the pressure for

mechanisation, abandonment of marginal land and ceasing operations which are no longer considered to be cost-effective. This has consequences for rural communities, for traditional landscapes and for biodiversity. Left to the vagaries of the market these so called non-market benefits would not necessarily be supplied in the manner and the quantity which society desires. Without exception governments across Europe intervene and influence decisions on the management of forests by developing forestry policies and implementing these policies through legislation, subsidies or direct management of publicly owned forests. These policies are intended to benefit people across society but the tools for developing, implementing and evaluating policies aimed at providing environmental and social benefits remain primitive by comparison with those used by commercial organisations in the provision of market outputs.

Forest and forest based industry interact with other land uses and socio-economic activities. Therefore, they should not be considered in isolation. For example, biophysical and ecological issues such as biodiversity conservation, or water quality improvement, should be appraised not at the stand or the forest level, but at the landscape or watershed level where forest ecosystems coexist with agro and hydro-systems; urban citizens ask for recreation forest areas; employment by industry depends on local population characteristics, *etc*. More and more it will be essential to consider cross-sector and land use planning issues, at different geographic scales.

The diversification of functions assigned to forests, and to a certain extent the fact that some functions may be predominant, are highly demanding in terms of research effort, very often of an interdisciplinary nature. In addition, forest research deals with long-living organisms and ecosystems whose adaptability to rapid environmental, social and economic changes is difficult. Although the general question remains the same – 'How can forests fulfil the needs of the society in the short and very-long run?'– a lot of new facets are emerging, e.g.:

- What are the short- and long-term responses and reactions of forest ecosystems to a fast changing environment
- How can forest policy and management be adapted so that forests will be able to provide ecological and social services as well as goods?
- How can the forest-wood chain stakeholders competitively meet the needs for forest-based goods and products, and which innovations can produce high quality, consistently produced forest products from a heterogeneous forest resource?

At the same time, new research trends and opportunities are emerging from the very dynamics of science and technology. For example: genomics and biotechnologies provide new ways for looking into the intimate functioning of trees under a changing environment as well as for deciphering their interactions with other organisms and accelerating and optimizing tree breeding. Chemistry and technologies provide a potential for creating new solid wood and fibre-based products, for improving recycling processes in the industry, and for identifying substances that can be useful in various areas (health, quality of life, etc.). Progress in ecology and economy make it possible to quantify and evaluate the environmental externalities associated with trees and forests. The combination of new sensors, information technology and modelling techniques is paving the way for an optimization of the forest-wood chain and for the design of decision support systems. Long-term monitoring systems of ecosystems and landscapes is developing (as a combination of intensive *in situ* observations and more global techniques, e.g. remote sensing).

3 NATIONAL FOREST RESEARCH INSTITUTES IN EUROPE – A CAPACITY TO PROVIDE RESEARCH TO EU POLICY OBJECTIVES

3.1 NATIONAL AND STATE FOREST RESEARCH INSTITUTIONS (NFRIS)

In nearly all European countries there are special institutions for forest research, besides the forest departments of their universities. These federal or state institutes (described in this text as National Forest Research Institutes (NFRIs)) differ in their mandate, duties, legal status and funding. In spite of these differences they have three important things in common:

(i) Their core issue is research on forest ecosystems and their sustainable management to serve the needs of a modern European society.
(ii) Their core mission is to support and to serve economic sectors and policies. Today, this is not only the forestry sector and forest policy – the focus has expanded beyond traditional forestry to a much broader scope including environment, rural development, national sustainability strategies, etc.
(iii) The core tasks and therefore the core competences of European NFRIs are applied forest research, knowledge transfer and long-term forest monitoring.

The applied research issues are described in the other chapters of this Discussion Paper. The knowledge transfer activities of NFRI are targeted at a broad spectrum of customers: practitioners at field level, decision makers in policy, administration and economy, and the general public. As far as forest monitoring activities are concerned, many NFRIs are in charge of the national forest inventory in their country, of the implementation at national level of the European monitoring system within Forest Focus, and of surveys on forest pests and diseases.

In addition to these common core tasks, NFRIs also have to fulfil other duties and activities. It depends on the mandate and position of each institute within its country, to which extent it is also in charge with one or more of the following tasks:

- basic forest and landscape research
- wood research
- research on natural hazards
- training and education
- policy advice
- enforcement authority
- forest planning.

As NFRIs have close connections to the forestry sector they can also support a better transfer and implementation of research into practical forest activities, and, vice versa, the integration of practical requirements into research. NFRIs are typically closely associated

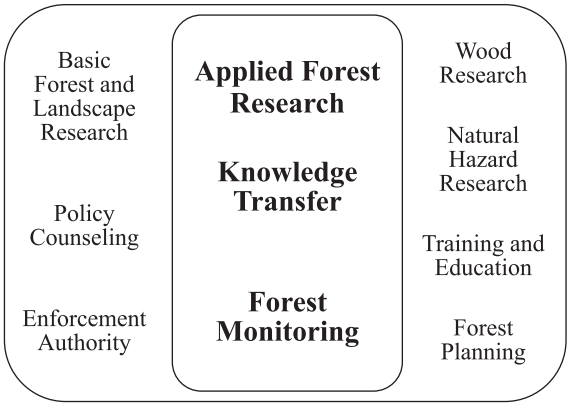


Figure 1. Activities and competences of NFRIs.

with a government ministry. Most of them serve the principal forest authorities, in many countries also the main environmental authorities. There is a regular exchange of information with ministries, which facilitates the application of research results in ongoing decision processes at the ministerial level.

There is a vast potential for exchange of information, experiences and competences as well as for the coordination and integration of various tasks. Moreover, there is a common understanding among NFRIs of the increasing need for improved transnational co-operation, in order to make use of these benefits at the European level.

Intensified cooperation of NFRIs

In July 2004, the Heads of NFRIs of MCPFE-countries convened in Vienna for their first meeting. At this event, representatives of Austria, Croatia, Denmark, Finland, France, Germany, Hungary, Ireland, Latvia, Lithuania, Norway, Poland, Romania, Serbia-Montenegro, Slovakia, Slovenia, Sweden, Switzerland, Turkey, United Kingdom, EFI (European Forest Institute), IUFRO (International Union of Forest Research Organisations) and MCPFE (Ministerial Conference on the Protection of Forests in Europe) were present. They discussed the present challenges, opportunities and problems of forest research in general and of NFRIs in particular. The main outcomes of the meeting are:

a. the commitment to intensify transnational co-operation and coordination between NFRIs;
b. a common initiative for a better integration of forest research within the upcoming 7th FP;
c. the beginning of a common elaboration of new approaches for performance measurement for NFRIs;
d. a decision to continue regular meetings and interchange of ideas.

Beside research needs, every member state and the European Union as a whole also has monitoring and reporting needs and knowledge transfer requirements related to forest

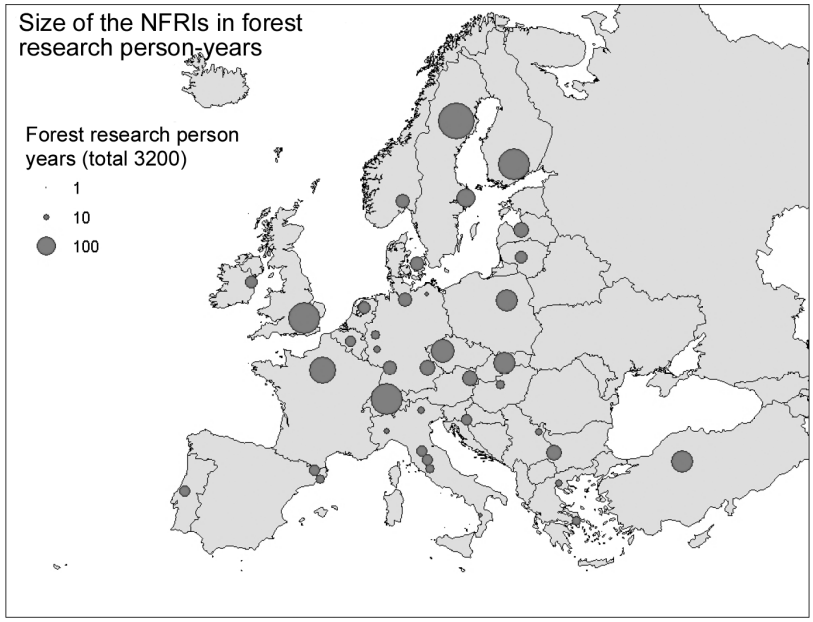


Figure 2. NFRIs participating in the survey on the map of Europe.

issues. A better networking between NFRIs, universities and other institutions, would contribute to the establishment of the ERA within the forest and landscape research sector. Enhanced networking and coordination between forest research organisations will enable the involved partners to carry out their tasks more efficiently.

Characterisation of the research capacity of NFRIs

There is a wide range of national institutions dealing with forest related research issues in Europe. Some 50 institutions are engaged in forest research as a main activity.

The Vienna meeting revealed that there is a large diversity among the various national and state forest research institutions, in terms of size, of mandate and position within their own country, of research profile (basic *vs.* applied), of funding profile (share of external funding), and of European cooperation strategy.

In order to analyse and synthesize information on the profile of the national and state forest research institutions and on the attractiveness of the various instruments that are available to foster cooperation among these institutions as well as with other organizations, a questionnaire was circulated among the Vienna meeting participants. The results also chart the capacity, topics, the share between applied vs. basic research profile of the participating institutions.

Forty six NFRIs were approached in a questionnaire survey, of whom 34 replied (see Appendix 2). NFRIs cover about half the forest research capacity in the 26 countries concerned. They are almost exclusively funded by public sources. In the year 2003

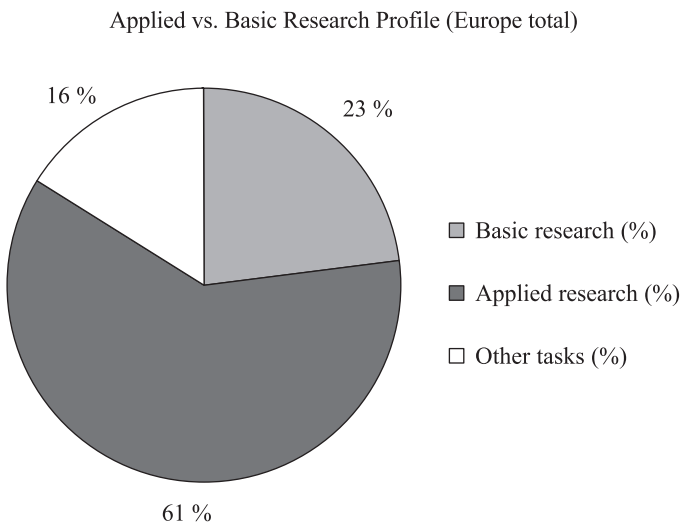


Figure 3. The share of applied research is dominant in NFRIs.

approximately 3200 person-years (includes researchers with academic degree working on forest-related topics) were deployed for forest research at the participating 34 institutions. While the fields investigated covered a wide range of activities those covered by 80 to 90% of the institutes were:

- Forest technologies (silviculture, harvesting, operations, transportation…);
- Forest ecology and forest management (soil science, biodiversity, ecological risk analysis, inventory and monitoring);
- Forest genetics, physiology and pathology;
- Forest protection;
- Forest economics, socio-economics of forestry.

Approximately 65% of the institutions deal with questions around forest policy, whereas a substantial proportion of NFRIs (about 50%) are also involved in wood science research. The institutions clearly deal more with applied than basic research. Besides research many institutes have additional duties to fulfil, such as long term scientific monitoring of forests, knowledge transfer to foresters and other groups, policy advice, landscape research, law enforcement, training, education and extension, forest management planning etc. Overall, these additional tasks cover one sixth of the resources of the answering institutes, with some variation between countries and institutes.

The funding structure of the institutions involved in the survey consists of:

74% national funding;
4% EU funding;
22% funding from other sources.

The annual amount of available resources to the participating NFRIs (34 out of 46) totals more than €298 million, of which over €220 million is covered by national budget funding.

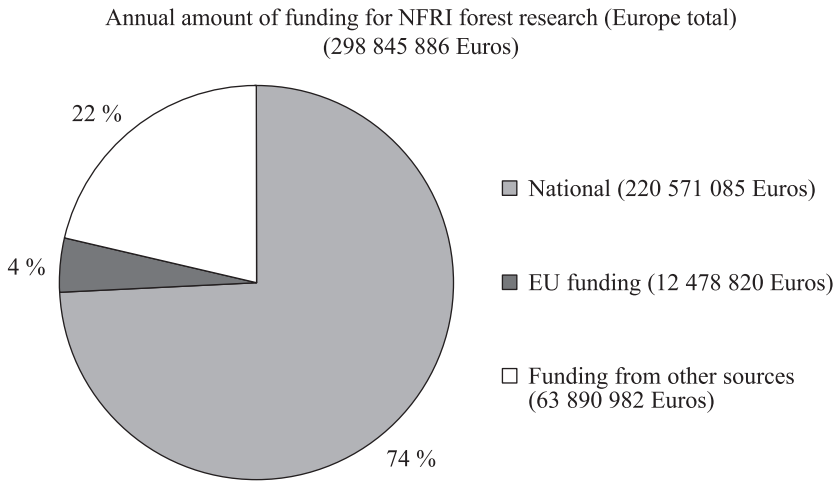
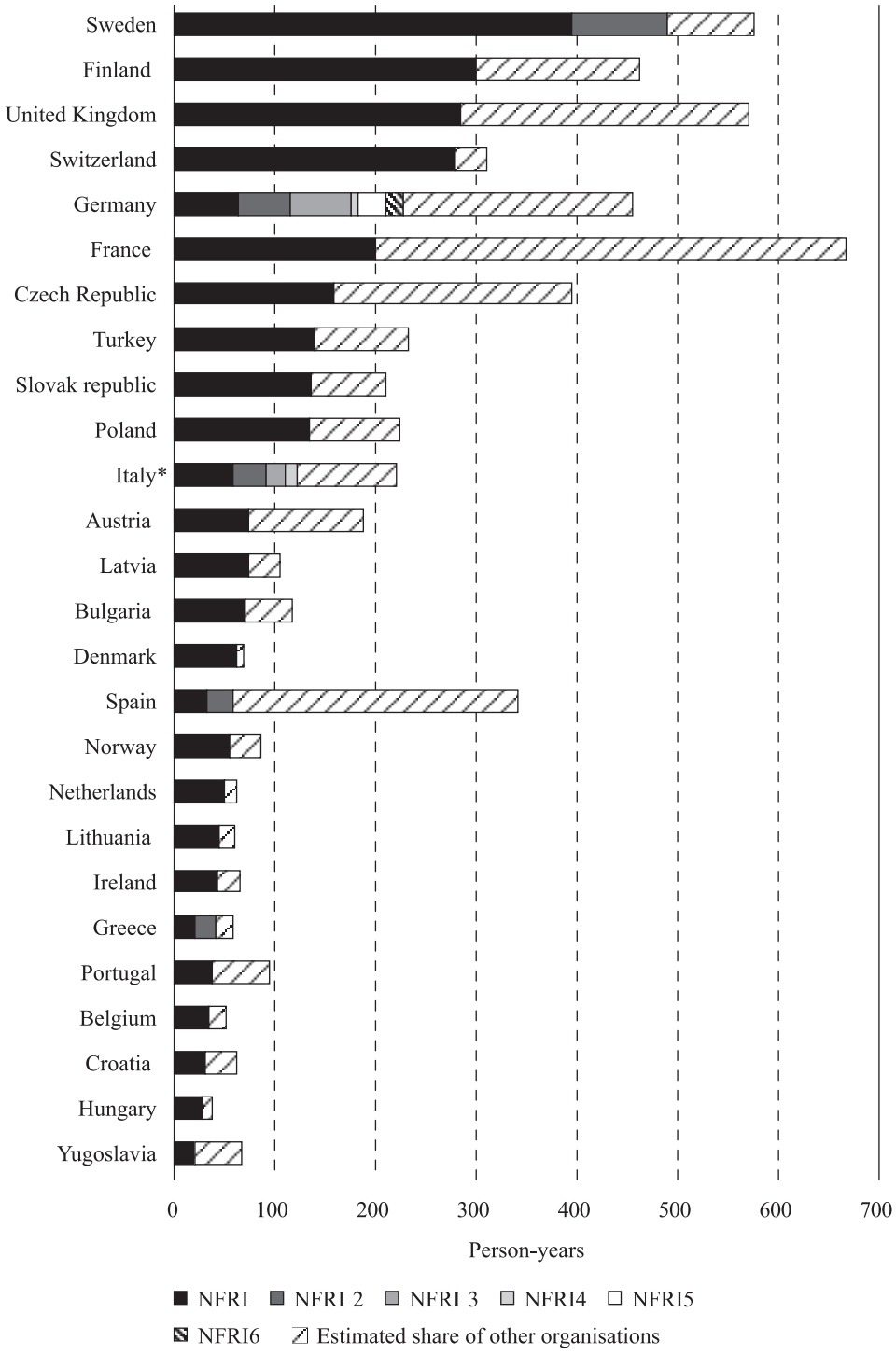


Figure 4. National budget funding total is nearly 300 million € annually (as per the answers provided by 34 institutes).

Even though the share of EU-funded research is small, it is an important source of funding for many institutions. Approximately 70% of the institutions stated that they would be interested in applying for funding under FP6 and FP7 instruments.

The results of the survey depict a rather large research community (46 NFRIs) with a substantial amount of resource capacities both in terms of personnel (estimate: 3000 researchers) as well as financial possibilities (estimate: up to €300 million per year). On the other hand it is clear, that forest research institutions are fragmented. They are unevenly distributed throughout Europe. Many resources are narrowly specialized, which results in a lack of interdisciplinarity and integration. A lack of harmonisation hinders the sharing and the exchange of data in order to address regional or global problems. This also results in a duplication of work. As a consequence this leads to a lack of knowledge and appreciation of forest research capacity and potential.

On the other hand the possibilities of the sector in research should not be underestimated. There is a wide range of expertise, knowledge and know-how in the different various disciplines and institutions. Another advantage of NFRI's is that they are well embedded into the public forest administrations, as well as forest ownership. Their close contact with practical forest issues ensures the relevance of the topics they address. Knowledge transfer, one of the key issues of applied forest research that is of increasing importance, is therefore much easier compared to other institutions with a more academic background such as universities. Interdisciplinary and multidisciplinary research is one of the strengths of NFRIs. Another strength is the existence of well structured long term monitoring data on forest related issues ranging from environmental, recreational to social and socio-economic. At least some of the monitoring data are already assessed using standardized schemes within a Europe-wide network (Level I, Level II). A further standardization of other data assessments and especially of the evaluation of the data could strengthen NFRIs and improve its output.



* The Italian figures are based on questionnaire results of IBAF-CNR and a professional estimate by Prof. Scarascia-Mugnozza.

Figure 5. Share of NFRI's in forest research per country (as per the answers provided by 34 out of 46 institutes).

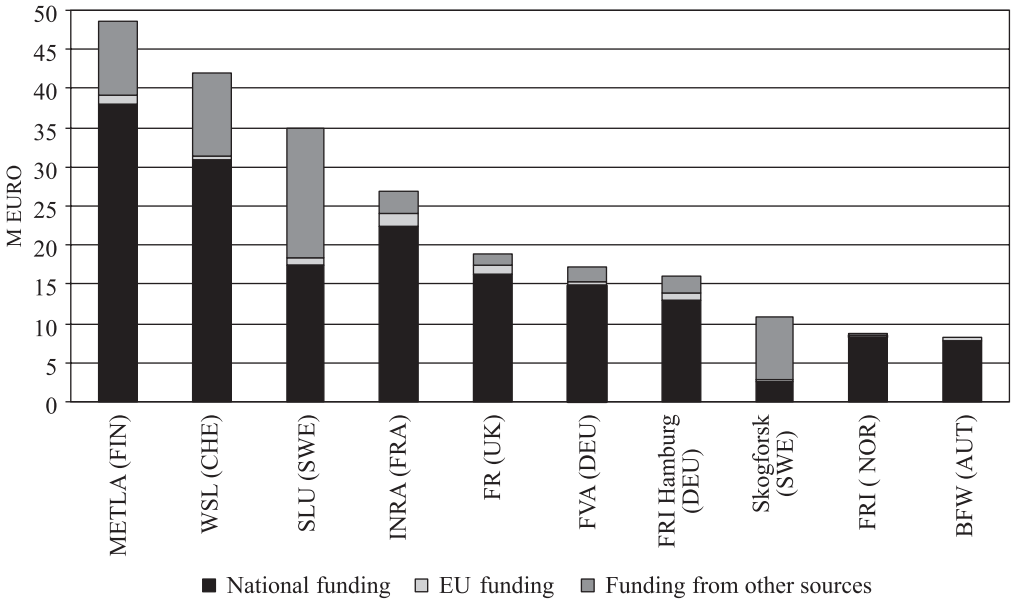


Figure 6. Funding structure (top ten, based on the answers provided by 34 institutes The figures of all institutes that replied the questionnaire are presented in Appendix 2).

3.2 NFRIS' CONTRIBUTION TO EU RESEARCH POLICY OBJECTIVES

As far as research funding by EU DG R&D is concerned, the landscape has changed considerably for forest research within the past couple of years along with the 6th Framework Programme: the niches for forest research are few compared to earlier framework programmes. Forest research in Europe faces new challenges, and there is a need for it to team up with other sectors (e.g. agriculture, land use planning etc) in multidisciplinary projects. Also, forest related research issues are largely fragmented within the EU structure: not only within the Framework Programme, where topics related to multifunctional management of forests and forest-based industries are now found in the work programmes of two different Thematic Priorities (Priority 6 "Sustainable development, global change and ecosystems" and Priority 3 "Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices", and, to some extent, in cross-cutting research activities) but also in several Directorates General: Agriculture, Environment, Energy, Enterprise.

Although European National Forest Research Institutes vary in size and in scope, as can be seen from above, they represent a powerful research capacity that can support EU research policy objectives, for example through undertaking research on topics such as those listed under the following chapters. For many NFRIs, the traditional STREP – type projects are better geared to their capacity and structure than the new instruments (NoEs, IPs).

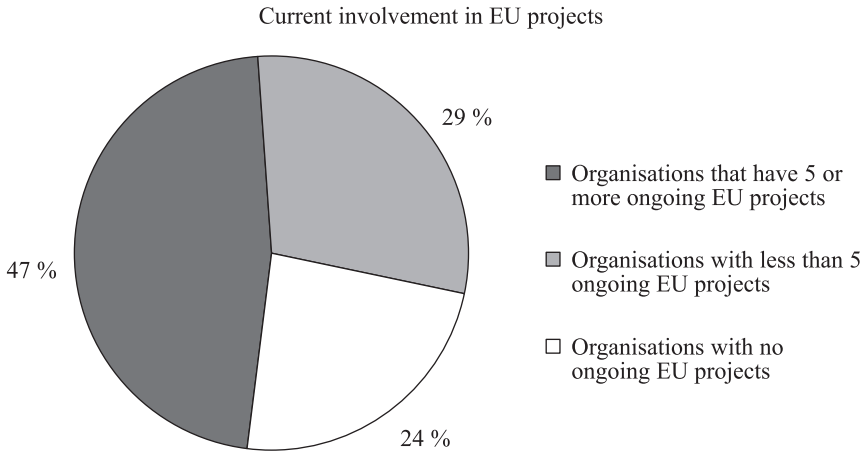


Figure 7. Nearly half of the NFRIs are involved in more than 5 EU-projects.

The EU overall aim to create a European Research Area creates sets new possibilities for integrated co-operation and sharing of responsibilities among European NFRIs: European co-operation of research programmes, sharing of infrastructures, designing large integrated projects and networks. What can be done, in order to facilitate NFRIs contribution to forest research on a European level? The available instruments and topics are abundant (cf. Appendix 1). Here we are making an attempt to present a potential strategy for co-operation between NFRIs as well as other research institutions, and have listed those instruments that seem most promising for the NFRI's. These options are further elaborated in the following chapters.

4 A CONCEPTUAL FRAMEWORK FOR FOREST RESEARCH

In this context, we propose to identify a few major domains for future forest research. These domains or programmes are neither exclusive from each other, nor self-sufficient.

1. Forest and forest-related ecosystems: understanding and monitoring their biodiversity, functioning and dynamics under a changing environment. This domain deals primarily with the biodiversity of forest ecosystems – from genes to landscapes, including the soil compartment, trees and other organisms such as wildlife, fungi and bacteria – and of other more or less natural ecosystems which are spatially or dynamically linked to forest ecosystems, e.g. wooded grasslands, forest parks in a urban environment, lakes and rivers, etc. The major questions are to understand the short- and long-term reactions of ecosystems to changes in the environment, how these changes modify biodiversity and alter the biogeochemical functioning of the ecosystems.

2. Renewable forest resources: providing competitive goods for manufacturing. This domain covers the up-stream part of the forest-wood chain, including silviculture and forest management based on tree biology and ecosystem dynamics, and addresses the cost-effective production and harvesting of renewable timber-related resources – i.e. solid wood and fibres, molecules, and bioenergy – but also of non-wood products, e.g. berries, mushrooms and hunted game.

3. Uses and services: answering society's widening demands. This domain covers the assessment of ecological, social and cultural values and services provided by forests to the society: it includes topics such as the contribution of trees and forests to human health, the quality of landscapes and urban forestry, the contribution of forests to water quality, etc. It also covers the interdisciplinary research to analyse and forecast the perception and markets of forest based goods and services.

These three main domains are linked to each other, to other research fields which deal with the forest-wood chain, such as wood technology, information technology, molecular biology and chemistry (which are vital for forest industries), and to territorial approaches that include other landscape components such as agriculture, freshwater ecosystems and urban areas.

In Figure 8, the three corners represent the three domains described above. The arrows on the sides represent indirect connection of forests and society: on the left through goods and products provided by forests and forest-based manufacturing industries; on the right through the social and environmental services provided by forests, land use forms and landscapes.

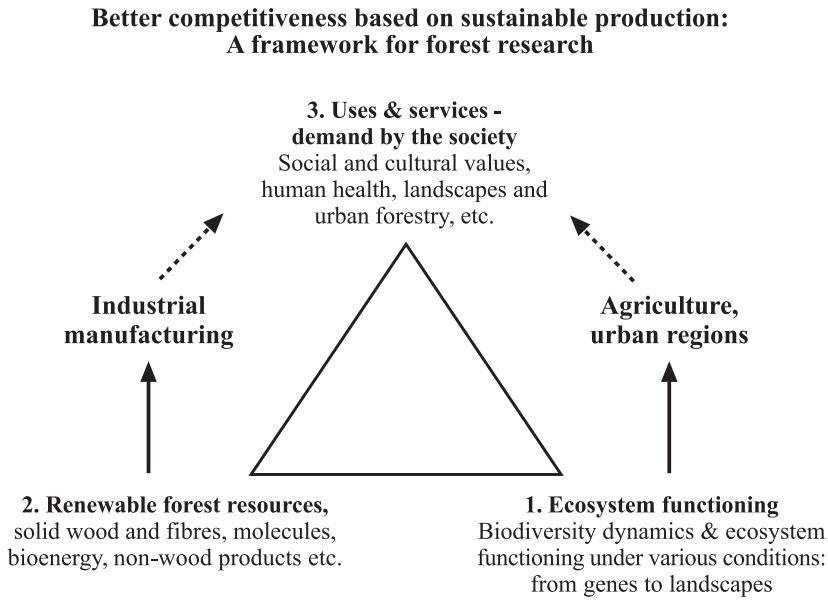


Figure 8. A conceptual framework for forest research.

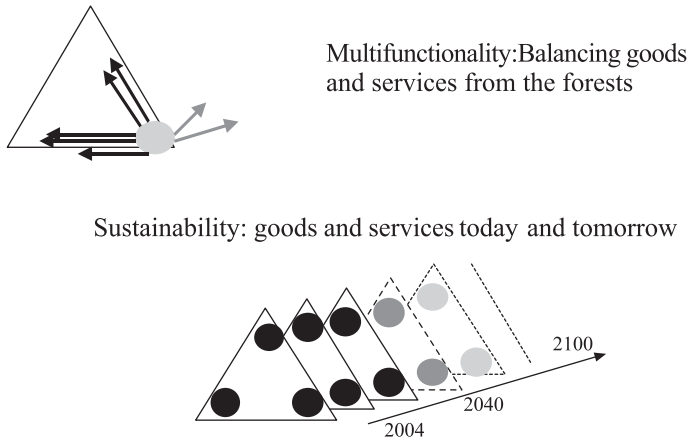


Figure 9. Multifunctionality and sustainability.

4. Linked with the second domain 'forest management', two additional, complementary and closely-coupled domains are emerging on the forest research agenda.

- **Multifunctionality.** As stated above, forests provide a wide range of resources, goods and products, services and uses, e.g. wood and fibres, fuel, fodder, mushrooms, berries

and nuts, soil protection, water regulation, genetic resources and recreational and aesthetic values. Those who benefit from these products, resources and services are also varied: from individuals to industry and collective groups. Simultaneously, forests exist in a wide range of ecological conditions, and forestry is carried out in various economical and social environments, with different needs for forest functions. As a result of this diversity of situations, an emerging research issue is: how to manage forests to fulfil, simultaneously or sequentially, locally or at a larger scale, the various needs expressed by the society?

- **Sustainable Forest Management.** SFM has been defined as 'stewardship and use of forests, maintaining their biodiversity, productivity, regeneration capacity and vitality, to fulfil, now and in the future, ecological, economic and social functions' (Ministerial Conference on the Protection of Forests in Europe, Helsinki, 1993). SFM is not a brand new concept, but it calls for revisiting and renewing the classical forestry concept of sustainability and, in a fast-changing context, puts a strong emphasis on the time horizon. Furthermore, SFM is part of a larger scientific and cultural stream, the science of sustainability, developed to face the need for a sound, scientific foundation for the management of the biosphere natural resources. The goal for research is to guarantee the continuous supply of goods and services from the forest resources.

5 ECOSYSTEM FUNCTIONING: ECOLOGICAL RESEARCH FOR ADDRESSING THE EMERGING ENVIRONMENTAL ISSUES

The biosphere is undergoing an unprecedented environmental transformation that has never occurred in such a proportion and velocity, for at least the last 400,000 years. The major cause of such changes is, most likely, humankind. Trees and forests, as important and perennial constituents of the biosphere, play a decisive role in stabilizing the fluxes of energy and matter through the terrestrial biomes. They need to be marshalled as fundamental elements and tools for an urgent, proactive strategy for climate change mitigation and adaptation, pollution remediation and environmental amelioration. Research on trees and forest ecosystems should, therefore, become a key and determinant factor for the development and diffusion of a societal structure and an economic organization based on biological resources for industry, energy and environment.

5.1 MAJOR AND EMERGING RESEARCH ISSUES

Deciphering and integrating basic biological functions and processes

Understanding and quantifying biological tree processes, at the physiological and genomic scale, subtending propagation, assimilation, growth, competition and development of trees and of their interactions with natural and anthropogenic influences; this knowledge will be crucial for underpinning science to a bio-based and sustainable development;

Investigating mechanisms and processes of multi-organisms interactions to understand and control the role wildlife in tree biology and forest ecology, i.e. impacts of pests on trees and tree resistance, mycorrhizal symbiosis, reciprocal interactions between tree and animal populations.

Forests as reservoirs and drivers of terrestrial biodiversity

- Assessing and monitoring forest biological resources (trees and other vegetation, fauna, fungi, bacteria);
- Understanding the adaptive and evolutionary mechanisms that drive the dynamics of the genetic, species and ecosystems biodiversity at various spatial and temporal scales.
- Developing scientific bases for the identification and integrated management, at landscape scale, of natural reserves and parks;
- Assessing the functional role of biodiversity, i.e. the role of genetic, species and ecosystem diversity in biogeochemical cycles and fluxes;

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- Assessing and predicting the impact of forest management on the various components of forest biodiversity;
- Monitoring, understanding and predicting the dynamics of invasive species and emerging diseases in a connected world, and assessing the risks associated thereto.

Forest and wooded lands as components of landscapes

- Monitoring and predicting the dynamics of (plant and animal) populations and communities within landscapes, assessing the impact of fragmentation thereon;
- Developing landscape management for biodiversity conservation and evolution in response to environmental pressures;
- Assessing trees and forests linkages to water bodies (watershed management), agricultural lands (soil erosion prevention), industrial and urban areas (water supply), and atmosphere (pollution remediation);

Forest-environment interactions

- Elucidating forest-atmosphere interactions: exchanges of energy and matter at the ecosystem and regional scales, carbon and nitrogen cycles, and their coupling;
- Assessing the role of forests in the cycles of atmospheric pollutants (e.g. ozone) and aerosols: interactions with biogenic and anthropogenic volatile compounds, absorption of gaseous pollutants by forest ecosystems;
- Assessing and elucidating the interactions between forests and the hydrological cycle: effects of forest ecosystems on rainfall, runoff regulation and soil erosion prevention; impacts of drought and salinity, fighting desertification;
- Monitoring and understanding the ecological impacts of fire, including greenhouse gas emissions, assessing fire risk, developing fire prevention and post-fire restoration techniques.

Forests, forest products and global change

- Monitoring, understanding and predicting the short- and long-term impact of global environmental change on the functioning of forest ecosystems (fluxes and biogeochemical cycles) as well as on their composition, structure and dynamics (ecophysiological stresses, adaptation and evolution of trees and other organisms, etc.).
- Assessing the role of forests in the global biogeochemical cycles related to climate change: interactions between climate change and other environmental changes.
- Assessing the potential of forests and forest products for mitigating climate change through carbon management and bioenergy in their various forms: creating appropriate plant material, identifying adequate silvicultural techniques, designing instruments for a socially optimal use of forests and forest products as a sink (optimization of carbon sequestration optimally, assessment of the consequences for various industries and regions).
- Designing and assessing adaptive forest management strategies and techniques to face global change, including integration of forest management in regional land use planning adapted to climate changes.

5.2 ROLE OF NFRIS

NFRIs are major operators for this type of research, which requires consistent data collection and analysis over long periods of time. In most countries, NFRIs carry out a major part of forest ecosystem monitoring activities in their countries, including National Forest Inventories and long-term *in situ* experiments.

Major challenges consist of:

- in harmonizing methodologies of forest inventories and monitoring at the regional, national and European scales, including every components of life;
- in linking data, information and models that operate at different scales, e.g. in using national forest inventory data for extrapolating the results obtained on long-term experimental sites where a lot of detailed measurements are performed;
- in strengthening the component of research that deals with the interactions between trees and other organisms (e.g. pathogens) and of tree adaptation to environmental stresses;
- in strengthening the cooperation with organizations and disciplines which deal either with other types of ecosystems (e.g. agricultural ecosystems, freshwater ecosystems, enlargement to landscape approaches), with the physical components of the environment (e.g. climatologists, hydrologists), or with the social and economic aspects related to assessing the uses of biodiversity, adapting forest management to global change (see below);
- in compiling and organizing existing information and knowledge, and in making it available not only to forest managers and owners but also to other stakeholders and the whole society;
- in developing new research tools and large-scale scientific infrastructure for jointly (e.g. by multidisciplinary, European research teams) studying forest responses to natural and anthropogenic environmental disturbances.

6 RENEWABLE FOREST RESOURCES: PROVIDING COMPETITIVE GOODS FOR MANUFACTURING

In many countries, wood production is still the first, but not the sole, objective of forest management. Research in silviculture and forest management used to be related to the optimization of timber production (according to site conditions, genetic origins and silvicultural techniques), to the characterization of wood quality and to the subsequent optimization of wood transformation. New approaches developing in two directions: developing a more systemic view of forest production, which includes all the steps from tree growth and ecosystem functioning to wood transformation and product end-of-life; reverse engineering approaches which aim at adapting and optimizing transformation processes and ecological production systems to get *a priori* defined end-products.

Optimizing the forest-wood chain: product-oriented research on forest management and techniques

- Analysing and optimizing reforestation, silvicultural, harvesting and pre-manufacturing processes, for the allocation of wood material supply for energy, wood and fibre chains in various conditions;
- Monitoring and screening heterogeneous wood resources and designing systems for the optimal allocation of raw materials to manufacturing products with *a priori* defined characteristics;
- Investigating the genetic and environmental control of tree growth, wood formation, timber quality and wood basic properties (combining biotechnology, genomics, genetics, physiology and ecophysiology for understanding the molecular and cellular determinism of wood formation);
- Exploring the diversity and the potential uses of 'tree molecules' (i.e. molecules found in wood, bark, roots and leaves).

Systematic approach of products life-cycle

- Coupling product-oriented life-cycle analysis with environmental assessment of silviculture in order to compare alternative silvicultural scenarios: developing relevant databases and models; connecting forest management schemes and end-of life and recycling (e.g. of paper, but also massive wood products) in life-cycle and sustainability analysis;
- Designing techniques for ensuring the downstream traceability from forest to wood-based end products;
- Developing methods for sustainability impact assessment.

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Role of NFRIs

It is a strength of NFRIs that they are closely linked with – some of them even embedded in – public forest administration and have good working contacts with forest owners and forest-based industries. As a consequence, forest planning, silviculture and logging, and topics such as optimization of harvesting regimes, modelling tree growth and timber quality are well-established long-term research topics. Traditionally, a large part of NFRI resources has been used for applied research with the aim to find the best methods to manage forest stands and to improve the performance of the genetic resources used for plantations. Such research is still needed as forest practices adapt to fast-changing ecological, social and economic contexts. NFRIs are the main drivers and operators of the classical downstream approach: the main challenge here is to design and to (technically and economically) assess new systems for mixed and uneven-aged forests. NFRIs are well suited for such tasks as they have both tradition and infrastructure to carry out long-term experiments to test and verify scientific hypotheses related to management schemes.

On the other hand, NFRIs are not the main drivers of reverse engineering approaches, which start with the definition of end-product properties and move backwards to processes, timber quality, forest management and tree biology. Due to the long-term nature of tree growth and the intrinsic heterogeneity of wood, such approaches do not directly apply to forest production. Nevertheless, new approaches are being developed which may result in a closer association of experts in tree biology, wood technologists and chemists. It is an area where NFRIs need to strengthen their collaboration with both basic research in biology and technological research on wood and fibres.

7 EXPLORING SOCIAL VALUES AND SOCIETY'S DEMANDS

The demand of the European citizens for social and environmental externalities is leading to an increasingly multifunctional role of forests. The perception of forestry by public at large and social and economic services provided by forests are major and emerging research issues. The special aspect of this set of forest research is that the research target and material is as much the people and society as the forest itself.

Social and environmental services provided by forests:

- the potential of forest camps, cottages, *etc*., as scenic and friendly environments for treating life-style complaints such as depression, anxiety, weight and related cardiac and vascular diseases;
- the aesthetic values of forests and landscapes and their importance in relation to human well-being;
- negative externalities such as allergies due to tree pollen or forest insects;
- the economic value of forest based recreation activities, and developing research on e.g. how to develop and promote recreational services;
- the scientific bases for a landscape approach to support a sustainable tourism;
- the role of forests in protecting living space against natural hazards.

Perception of forestry, wood-based products and noon-wood goods

- Perception of forest-based products (of which many are parts of interacting value chains, e.g. construction, housing, the media value chain, the food value chain), with a link to forest industry-driven research.
- Analysing social and cultural values towards forests in post-industrial society, and societal demands on the multi-functionality of forests.

Forest Policy and Economics

Forest policy issues, closely linked to economics, are an important aspect of society especially where forest ownership consists of large number of private forest owners; political and economic instruments are needed to attract private actors to aim towards commonly agreed goals.

- Developing policy instruments and assessing their effectiveness in achieving the objectives of forest management policies towards societal goals.

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- Cross-sectoral policy impacts on forests and forestry, e.g. rural development, energy, biodiversity conservation, etc.
- Competitiveness of forest enterprises (small, medium and large-scale)
- Analysing the consequences of the European patterns of forest ownership, dominated by small forest owners and, in the new member countries with increasing privatisation.

Role of NFRIs

NFRIs are significant drivers and operators of research on these issues, especially from the production and activity point of view. However, the sector has relatively few in-house researchers in social sciences and this will only change gradually. Therefore, it is important that the NFRIs participate in multidisciplinary projects where these competencies are present. Generally, NFRIs need to increase their co-operation with researchers from disciplines such as economics, policy development and analysis, sociology, medicine, etc.

As far as forest management aiming at providing social services is concerned, the NFRIs aim at being the major drivers and operators in this type of research, however, they need to strengthen their competences and increase co-operation with research institutions specialising in social and human sciences.

8 MULTIFUNCTIONALITY AND SUSTAINABILITY

Forest management can be defined as controlling the joint production of commodities, goods and services from the forest resource to fulfil the needs of forest owners, society and other stakeholders. Multifunctionality and sustainability are integral parts of forest management goals and practices. As the cornerstones for the spatial and temporal reconciliation of forest-related services and activities, they have been, more or less explicitly, at the core of European forestry for centuries.

However the increasing weight of environmental and social issues gives a new impetus for investigating the concept of multifunctionality. Multifunctionality includes all possible forest functions – which vary across ecosystems and societies – in addition to wood production, e.g. carbon stock, biodiversity, fishing, hunting, mushrooms, berries, recreation, ecotourism, protective functions, etc.

Simultaneously, the recognition of ongoing environmental changes and the emphasis put on sustainable development call for a renewed analysis of sustainable forest management, including the long-term assessment of the performance of silvicultural regimes (at the stand level) and of management and planning strategies (at the forest and regional levels, but also at higher levels of integration).

Services related to the multifunctionality of forests

- assessing the possibility for converting monocultures to more mixed forest and designing systems to reach such a goal: balancing between demands from society and global change;
- assessing the role of forests as a conserver of biodiversity values: comparison of forests with other ecosystems;
- assessing the role of forests and forest industries in preserving cultural and social values in rural Europe;
- evaluating forest externalities (e.g. erosion prevention, protection against wind or avalanches);
- designing management schemes adapted to such goals and integration of the production of wood and of other goods and services (e.g. biodiversity, fishing/hunting, mushrooms, berries, recreation, ecotourism, protective functions) at forest stand and at landscape level.

Decision support tools and forest management schemes to fulfil varying production demands on the forest resource

- developing tools for forest managers to facilitate analysis the short- and long-term impacts of forest management to forest-related ecological, social and economic processes under global change;
- analysing of the trade-offs between various forest functions, and developing multi-criteria analysis and decision-support methods in cases of multiple, conflicting goals;
- developing risk management tools, including environmental and economic risks; i.e. methods for minimising the impacts of natural hazards and for recovering from them;
- addressing the segregation/integration dilemma: global comparison of systems where forest productive, environmental and social functions are either spatially segregated or locally integrated;

Role of NFRIs

Traditionally, efficient wood production methods on a sustainable basis have been the focus of forest research carried out by NFRIs. Today, that goal may concern only intensive tree plantations. Over recent decades, more emphasis has been put on producing a combination of goods and services from forests. Production functions (as growth models for trees and stands) have been derived for various non-wood goods and services: however, one of the scientific bottleneck lies in our capability to articulate these functions, to jointly predict their immediate and long-term outputs, and to design suitable trade-offs under multiple goals and constraints.

For this task, NFRIs have a unique infrastructure, including long-term forest site experiments and databases. Using the available data, methods have been developed to integrate all these aspects to meet the demands of forest owners and other decision-makers. However they need to reinforce their skills in social and economic sciences.

9 RESEARCH INFRASTRUCTURE AND CAPACITY BUILDING

The capacity of European forest research is substantial, and in an international comparison the European forest research is at the front edge. The sectoral nature of forest research and the increasing weight of intersectoral policies call for both disciplinary and cross-disciplinary approaches. Consequently, forest related research is carried out by different organisations. While the core of forest science is found in the National Forest Research Institutes and in University forestry colleges and faculties, a substantial part of forest related research is carried out in other university departments specialised in generic scientific disciplines, the findings of which can be applied in forestry and forest science, and in privately-funded research organizations.

9.1 OVERCOMING THE FRAGMENTATION OF THE EUROPEAN FOREST RESEARCH

Forest research in Europe must be characterised as fragmented, with very few large scale research facilities. With the exception of the countries where forest resources are a substantial basis for economic development, the national financial support for forest research is limited. However, in a European context, the total capacity is impressive: app. € 300 million annually in National Forest Research Institutes and perhaps a doubling of this figure if forest related research in universities and industry-oriented technical centres is included.

These resources could be better utilised by improved co-ordination of research efforts between the European countries throughout the forestry-wood chain and also through linking forest research to other relevant disciplines. The existing and new instruments provided by the European Union and the European Science Foundation offer potential tools for integrating research efforts. Listed below are some existing and potential platforms and tools that could be used for improving European forest research co-operation:

- Building upon the COST Forestry and Forestry Products platform and the ongoing FP6 initiatives,
- Participation in and integration through the Forest Focus programme;
- Participation in and integration through Integrated Projects and Networks of Excellence (such as the 'forest-wood chain IP', 'EvolTree NoE' and 'AlterNet NoE' for tree and forest biodiversity, 'CarboEurope IP' for forest-carbon interactions, etc.;)
- Participation to existing ERA-Nets: 'WoodWisdomNet' (which focuses on wood but also includes projects that are related to tree biology, forest management and environmental

changes); 'Biodiversa' for biodiversity science (considering trees and forests as drivers of continental biodiversity); 'Plant genomics' (making sure that trees, their specific functions and features [e.g. perenniality and wood formation] and their associated organisms [e.g. symbiotic and pathogenic fungi] are taken into account);

- Proposal of a specific ERA-Net on forest ecology and management (with a special focus on the impacts of global changes).
- Contribution to Technological Platforms: NFRIs are active contributors to the Technology Platform for the European Forest-based Sector. They are also, at least some of them, potential contributors to the Plant Genomics and Biotechnology Platform, and probably also to some other Platforms.
- Sharing and integrating resources and facilities: biological collections, experimental networks, monitoring systems, databases and models, virtual laboratories, such as
  - o Creating centres to conserve biological resources and sharing existing tree breeding experiments; revitalizing networks of provenance and progeny tests for tree breeding and testing climate change responses;
  - o Sharing existing growth and yield plot networks and extending these networks to new situations (mixed and uneven-aged stands);
  - o Integrating existing ecosystem functioning monitoring sites and creating new such sites in mixed and uneven-aged stands;
  - o Creating new landscape functioning monitoring sites (e.g. model forests, long-term ecological research sites);
  - o Creating and distributing ecological databases, e.g. in systematics (for biodiversity studies) or in phytoecology (for conservation purposes or for assessing long-term floristic changes);
  - o Developing open-source software platforms for modelling trees, forests and landscapes, with the possibility to couple databases, scenarios and simulation software;
  - o Using the existing systems of surveys on forest pests and diseases and quarantine species.
- Forest information services for researchers, experts and public: Improving access to existing information, data and model libraries, demonstration packages for training and education. Examples are Global Forest Information Service (GFIS) and European Forest Information System (EFIS).

Many of these initiatives are in the process of being realised at a small scale, thereby contributing to the integration of European forest research. However, to be able to reach a true European Research Area in the field of forestry, a much more ambitious agenda is needed. A proposal from the Heads of the NFRIs is to build on and expand the objectives of the already existing European Forest Institute (EFI). EFI, with its 140 member organisations – including NFRIs, Universities and forestry stakeholders – is in the process of changing its legal status to an intergovernmental organisation. EFI has its own, limited research capacity at the headquarters in Joensuu, and Project Centres in seven European countries (Austria, Denmark, France, Germany, Portugal, Russia and Spain). However, EFI's true strength lies in the forest research carried out by its member network, which forms the largest existing network in forest research in Europe. Given adequate mandate and resources into co-ordination of these research efforts, a true European Research Area in the field of forest research can be achieved.

9.2 HUMAN RESOURCES DEVELOPMENT AND NETWORKING BETWEEN ORGANIZATIONS

The enlargement of the forest research agenda and the harmonization of higher education diplomas in Europe should result in closer ties of NFRIs with the higher education system and with other research organizations:

NFRIs should increase their co-operation with forest faculties and get more involved in research training schemes, e.g. through participating to SILVA-Network, favouring the European certification of Forestry curricula and promoting European doctorate degrees in forest science, etc.

Forest research should also form strategic alliances towards other fields of research (e.g. agriculture, environment, engineering, social sciences, *etc*.), which also means that NFRIs should extend and strengthen their links with universities.

The need to promote integrated approaches covering the whole forestry-wood chain, for improving the performance of the sector, and to consider forests as a part of wider landscape together with agriculture and urban areas should result in the development of interdisciplinary programmes and in an increase of the mobility of scientists among NFRIs as well as between NFRIs and other research organizations (e.g. through Marie Curie programmes, but also through jointly operated research actions).

On the other hand, forest research should develop its capacity to transfer its results to stakeholders, taking into account their wide diversity, and to orientate its programs according to their changing needs:

NFRIs traditional strong links to practitioners should thus be maintained and better structured. Knowledge transfer to forest managers, owners, contractors, entrepreneurs, and extension offices is becoming an increasingly important issue for a better utilisation of results of research. Reciprocally, the expression of research needs by these stakeholders should be favoured;

The role of NFRIs in acquiring new data, disseminating information, in transferring and implementing knowledge, in proposing innovations should be improved and emphasised, especially with regard to the definition and monitoring of national and international policies.

References

Birot Y., Levlin J.E., Paschalis P., Resch H. 2004. *A knowledge based Forest and Forest Industry Cluster: an asset for sustainable Europe*. The contribution of COST Technical Committee on Forests and Forestry Products. pp. 6

APPENDIX 1. MOST RELEVANT EU FP6 AND ESF INSTRUMENTS AND SCHEMES

Integrated Projects, IP

An integrated project is an instrument to support objective-driven research, where the primary deliverable is new knowledge. By mobilising a critical mass of resources, integrated projects can also be expected to have a structuring effect on the fabric of European research. Each project contains an integrated set of activities within a coherent management framework. The project should include a research component and, as appropriate, technological development and/or demonstration components, as well as perhaps a training component. The value of the activities integrated by a project is expected to range up to many tens of millions of euros. The project duration is typically 3 to 5 years.

More information: http://www.cordis.lu/fp6/instr_ip.htm

Networks of Excellence, NoE

NoE are designed to strengthen scientific and technological excellence on a particular research topic. They aim to overcome the fragmentation of European research by:

networking together the critical mass of resources;
networking the expertise needed to provide European leadership.

NoE will also have a mandate to spread excellence beyond the boundaries of its partnership. Projects may include a training component. The duration is typically up to 5 years (maximum 7 years). The magnitude of projects is typically millions of Euros, which is in form of a grant for integration.

More information: http://www.cordis.lu/fp6/instr_noe.htm

Networking of national or regional programmes (ERA-NET)

The objective of the ERA-NET scheme is to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States through:

the networking of research activities conducted at national or regional level, and
the mutual opening of national and regional research programmes.

The scheme will contribute to making a reality of the European Research Area by improving the coherence and coordination across Europe of such research programmes. The scheme will also enable national systems to take on tasks collectively that they would not have been able to tackle independently. Participants in ERA-Nets are funding organisations and 'program owners' rather than organizations which carry out research activities (this is an important eligibility criterion that has to be checked carefully).

More information: http://www.cordis.lu/coordination/era-net.htm

Infrastructures

Research infrastructures scheme includes: (*i*) transnational access to major research infrastructures for research teams and individual researchers; (*ii*) integrating activities by combining cooperation networks; (*iii*) design studies: feasibility studies and technical preparatory work for new infrastructures with European dimension.

More information: http://www.cordis.lu/infrastructures/

Marie Curie actions – Human resources and mobility

The Marie Curie is a mobility scheme supporting the development of human resources in the European research system through grants to individual researchers or host organisations, through Research Training Networks, Conferences and Training Courses. Research Training Networks is a potential co-operation scheme for NFRI co-operation.

More information: http://www.cordis.lu/fp6/mobility.htm

Specific Targeted Research Projects, STREP

This instrument comes under the banner of the "traditional instruments". The Specific Targeted Research Projects are an evolved form of the shared-cost RTD projects and demonstration projects used in FP5. Specific Targeted Research Projects aim at improving European competitiveness or meeting the needs of society or Community policies. They can take the following forms:

A RTD project designed to gain knowledge or improve existing products, processes or services.
A demonstration project designed to prove the viability of new technologies but which cannot be commercialized directly.

Duration is typically between 2 to 3 years.

More information: http://www.cordis.lu/fp6/instr_strp.htm

Coordination Actions, CA

Coordination Actions cover activities such as the organization of conferences, meetings, performance of studies, exchange of personnel, exchange and dissemination of good

practices, setting up common information systems and expert groups. Expected funding is up to several hundreds of thousands of euros, with 100% EU contribution.

More information: http://www.cordis.lu/fp6/instr_ca.htm

Specific Support Actions, SSA

The main purpose of Specific Support Actions is to support the implementation of FP6, to potentially help the preparation of future Framework Programme, to stimulate, encourage and facilitate the participation of SMEs, small research teams, newly developed and remote research centres, and organizations from the new member states. The projects within the priority themes may cover the following: conferences, seminars, studies and analyses, working and Expert Groups, operational support and dissemination, information and communication, or a combination of these as appropriate

More information: http://www.cordis.lu/fp6/instr_ssa.htm

Specific actions to promote research infrastructures

The primary objective of this instrument is to support the integrated provision of infrastructure related services to research communities at EU level. It will aim to mobilise a large number of stakeholders in a given class of infrastructures by combining within a single contract:

Networking;
Research Teams in universities and other public research organizations;
Industry;
Equipment manufactures (e.g. SMEs).

Specific projects for SMEs

Their main purpose is to promote the participation of SMEs. There are two main parts to this instrument:

Co-operative Research Projects (CRAFT), carried out by RTD performers for the benefit of a number of SMEs from different countries on common specific problems or needs.

Collective research projects, carried out by RTD performers on behalf of industrial associations or industry groupings in sectors where SMEs are prominent. Aim: To expand the knowledge base of large communities of SMEs.

More information: http://sme.cordis.lu

OTHER CHANNELS, OUTSIDE THE EU FRAMEWORK PROGRAMMES

COST Actions (now under European Science Foundation, ESF)

COST – European Cooperation in the field of Scientific and Technical Research – is the oldest and widest system for research networking in Europe. COST is a system for

research collaboration covering 34 Member States plus one cooperating state, Israel, and is active in 13 scientific domains. The mission of COST is to strengthen Europe in scientific and technical research through the support of European cooperation and interaction between European researchers. It aims to strengthen non-competitive and pre-normative research in order to maximise European synergy and added value.

The Forest Inventory COST Action ENFIN is a good example of how the COST structure can be used as a platform for NFRI co-operation.

More information: http://cost.cordis.lu/src/home.cfm

European Science Foundation ESF

The European Science Foundation promotes high quality science at a European level. It acts as a catalyst for the development of science by bringing together leading scientists and funding agencies to debate, plan and implement pan-European initiatives. It arranges Calls for research projects, seminars, exploratory workshops, individual grants, *etc*. The recent "EuroDiversity" is a good example of ESF programmes that can involve NFRIs.

More information: http://www.esf.org

APPENDIX 2. THE SUMMARY OF THE QUESTIONNAIRE RESULTS

	Funding Structure						
	Institution	Country	3.1. Total annual amount of funding for forest research (Mio €)	3.2.Total forest research funding		3.3. External funding	
				a) national	b) external	a) EU Funding	b) From other sources
1	Finnish Forest Research Institute – Metla	Finland	48.5	37.9	10.6	1.3	9.3
2	Swiss Federal Institute of Forest, Snow and Landscape Research (WSL)	Switzerland	42.7	31.0	10.9	0.3	10.6
3	SLU – Faculty of Forest Sciences	Sweden	35.0	17.5	17.5	0.9	16.6
4	INRA, National Institute for Research in Agronomy (Institut National de la Recherche Agronomique)	France	27.0	22.5	4.5	1.6	2.9
5	Forestry Commission Research Agency	United Kingdom	18.8	16.3	2.5	1.3	1.3
6	Forest Research Institute Baden-Württemberg (FVA)	Germany	17.2	14.9	2.3	0.5	1.8
7	Federal Research Centre for Forestry and Forest Products, Hamburg	Germany	16.0	13.0	3.0	1.0	2.0
8	The Forestry Research Institute of Sweden (Skogforsk)	Sweden	10.8	2.7	8.1	0.1	8.0
9	Norwegian Forest Research Institute	Norway	8.6	8.1	0.5	0.3	0.2
10	Federal Forest Office and Research and Training Centre for Forests, Natural Hazards and Landscape (BFW)	Austria	8.3	7.8	0.5	0.5	-
11	Center of Forest, Landscape and Planning (Skov&Landskab) Royal Veterinary and Agricultural University	Denmark	8.0	5.0	3.0	0.6	2.4
12	Alterra Green World Research	Netherlands	7.5	5.2	2.5	1.0	1.5
13	Head of Research and Development	Turkey	5.5	5.5	-	-	-
14	Research Institute for forest ecology and forestry Rheinland-Pfalz	Germany	5.2	4.9	0.3	0.2	0.2

	Funding Structure						
	Institution	Country	3.1. Total annual amount of funding for forest research (Mio €)	3.2.Total forest research funding		3.3. External funding	
				a) national	b) external	a) EU Funding	b) From other sources
15	Institute for Forestry and Game Management	Belgium	4.7	3.8	0.4	0.1	0.3
16	Forest Research Institute, Warsaw	Poland	4.5	1.8	1.8	0.01	2.7
17	Bavarian State Institute of Forestry	Germany	3.5	2.9	0.6	0.6	0.03
18	Forestry and Game Management Research Institute	Czech Republic	3.3	3.0	0.3	-	0.3
19	Forest Research Institute	Hungary	2.8	1.5	1.3	0.1	1.2
20	Northrhine-Westfalian Agency for Ecology, Land and Forestry	Germany	2.5	2.5	0.03	0.03	-
21	National Forest Research Station (EFN)	Portugal	2.4	2.3	0.1	0.1	0.02
22	COFORD, National Council Forest Research and Development	Ireland	2.3	2.3	-	-	-
23	Forest Research Institute, Jastrebarsko	Croatia	1.7	0.8	0.8	-	-
24	Institute of Agro-environmental and Forest Biology – Italian National Research Council (IBAF-CNR)	Italy	1.6	1.0	0.6	0.4	0.2
25	Forest Research Institute Zvolen	Slovak republic	1.6	1.2	0.4	0.01	0.4
26	CREAF (Center for Ecological Research and Forestry Applications	Spain	1.5	0.3	1.2	1.2	0.8
27	Forest Research Institute of Athens	Greece	1.5	1.3	0.3	0.2	0.02
28	Forest Technology Centre of Catalonia	Spain	1.4	0.7	0.7	0.6	0.1
29	Forest Research Institute (FRI) - National Agricultural Research Foundation (NAGREF)	Greece	1.4	1.1	0.3	0.3	0.01
30	Latvian State Forestry Research Institute „Silava“	Latvia	0.9	-	0.9	0.03	0.9
31	Administrative Office for Forests and Large Protected Areas of Mecklenburg-Western Pomerania	Germany	0.8	0.7	0.1	0.01	0.1
32	Lithuanian Forest Research Institute	Lithuania	0.6	0.5	0.2	0.1	0.1
33	Forest Research Institute – Sofia Bulgarian Academy of Sciences	Bulgaria	0.4	0.3	0.1	0.004	0.1
34	Insitute for Forestry	Yugoslavia	0.3	0.2	0.01	-	0.01
	Total		298.8	220.6	76.4	13.3	63.9