

Title of the EoI: **SUSTAINABLE MANAGEMENT of CULTIVATED FORESTS under ENVIRONMENTAL and TECHNOLOGICAL CHANGES**

Acronym: **FOREVERT**

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Project consortium management : IEFC - <http://www.iefc.net>

RATIONALE

World population increase and economic development in most countries result in a continuously rising demand for wood. The major role of wood is the provision not only of energy but also of raw material for a range of products. Wood is currently the fifth most important product traded worldwide. Vast quantities of wood are harvested to provide fuel, fibres (pulp, paper products, board), sawn timber and veneer (construction, furniture, packaging) and wood is potentially an ideal raw material for a future “ligno-chemical” industry. Resource analyses have concluded that global needs for wood, over the next 40 years, correspond to the logging of 20% to 40% of the total current standing timber inventoried in natural forests (FAO). Most experts agree that new deforestation and excessive wood harvesting in natural and sub-natural forests can be avoided by (a) more efficient use of raw material combined with better use of wood industry residues, and (b) developing new plantation areas combined with improved management of existing cultivated forests. It is estimated that an extra 100 million ha of man-made forests will be needed by the middle of the 21st century to satisfy the potential future demand for wood. This estimate assumes high yields only possible with intensive management of species with a high production potential, that are preferably genetically improved, well adapted to climatic and site conditions, and grown using appropriate silvicultures in a sustainable manner. In the global context, Europe (including the Russian Federation) represents a growing part of the world’s plantation forests (32 million ha out of 187) due to abandoned farm land and dynamic wood industries.

Cultivated forests, which include plantation forests, can be broadly defined as purpose-grown forest stands established in the process of afforestation and reforestation by planting or/and seeding; they are intensively managed, composed of one or two main tree species (indigenous or introduced) and mostly even-aged. Their main function is wood production, but they also contribute directly or indirectly to other important environmental and societal functions. Because of their management intensity, cultivated forests grow faster than sub-natural and natural forests in similar situations: they mature earlier, maximising productivity, optimising carbon sequestration and where appropriate, are quicker to provide soil protection and landscape enhancement. Because wood production is generally the main objective of cultivated forests, the need for wood harvesting in natural or sub-natural forests is thereby reduced in temperate and, theoretically, in tropical zones by substitution in species uses. Cultivated forests provide an increasing part of European wood resources and within the context of dynamic and integrated forestry-wood chains they constitute vital engines of economic development, particularly in disadvantaged regions and rural areas. When combined with value optimisation of wood resource through, for example, the development of engineered wood products, cultivated forests can contribute to the efficiency and sustainability of forestry-wood sectors.

Despite the obvious benefits of cultivated forests, there is a growing concern among European citizens about the sustainability of cultivated forests and their perceived threat to nature. Intensively managed forests are often considered less resistant than natural forests to disturbances such as storms or pest outbreaks, and more susceptible to risks associated with global climate change. As monocultures or plantations of exotic tree species, cultivated forests are also increasingly viewed in a negative light in relation to biodiversity conservation. There is therefore a need to address these concerns, to enhance our ability to provide society with balanced information and to identify and anticipate risks associated with changing environment and human interactions.

At the European level, sustainable management of cultivated forests is part of the resolutions taken by the Ministerial Conferences on the Protection of Forests in Europe (MCPFE), held in Strasbourg (1990), Helsinki (1993) and Lisbon (1998). These resolutions provide the basis for implementing strategies for the forestry sector which enhance the sustainability of forest ecosystems and the sustained use of wood resources.

The sustainable management of forests requires long-term thinking, multidisciplinary approaches and a critical research mass at a European level to ensure long-term goals are met. To achieve the sustainable development of cultivated forests and integrated forestry-wood chains, it is also crucial that societal expectations and the ecological impacts of technological innovations are better understood and assessed, and that pertinent management strategies and tools are developed in parallel. With this vision in mind, we propose an ambitious

European action integrating geographically dispersed research to ensure both the assemblage of critical research mass and the application of results at a regional and European scale. In this way, the proposal supports the underlying principals of the ERA.

OBJECTIVES

The aim of the project is to contribute to European competitiveness and regional development by **enhancing integrated and sustainable management of cultivated forest resources**. The project will generate new knowledge required to implement some of the priority themes of the 6th FP in the area of sustainable development, global change and ecosystems. The outcomes of the project will be: (a) **development of new knowledge** on ecological effects, biotic and abiotic risks and socio-economic implications of environmental change and technological innovations in cultivated forest systems; (b) **improvement of integrated tools and strategies** for the sustainable management and use of cultivated forest resources.

The specific questions that will be investigated concern the effects of changing environment and societal needs on the sustainability of cultivated forests and the parallel development of environmentally-friendly and cost-efficient technological innovations in the production forestry sector:

- how can we improve predictions about the behaviour of cultivated forest ecosystems under different scenarios of environmental and technological change?
- how resilient are cultivated forests to natural hazards such as pest and disease outbreaks or storms, and how can the associated risks be mitigated?
- are cultivated forests a threat to biodiversity and how can we enhance the contribution of cultivated forests to the protection of biodiversity ?
- to which extent is sustainability of cultivated forests compatible with the development of new wood-based products to meet market demands?
- what are the ecological requirements and economic benefits of improved tree varieties?
- how can breeding and silvicultural strategies be improved to deliver high quality wood products?
- is intensive forest management and deployment of genomics and breeding technologies for wood production compatible with society's expectations?
- can forest health be improved through the availability of tools for integrated management?
- how can soil fertility be maintained and are new integrated tools required?
- how can we improve evaluation tools and decision support systems for sustainable management of forests?

To address these questions, the integrated project is organised into four complementary objectives:

1 to optimise breeding strategies and improve genetic resources for enhancing wood quality, forest health and vigour. This will be achieved through better integration of research activities in tree genomics and breeding research at a Pan-European level. This objective will explore synergies between different labs and breeding programmes with the initial goal of developing predictive tools for early selection of wood characteristics. This will require integration of genetic and field information across countries and joint assessment of breeding populations and provenances for the major European cultivated tree species. The work here will include the application of common molecular and genomic tools for assisted selection, assessment of levels of diversity at the gene level, and a better understanding of the genes with importance for traits relevant to wood characteristics with impact across the whole forest-wood chain. Methodologies for assessing environmental and socio-economic impacts of the deployment of improved tree varieties and comparative analysis will also be undertaken investigated for some key cultivated species. This objective will be implemented with some leading industrial partners.

2 to improve evaluation, prediction and prevention of sanitary risks : this objective will develop effective solutions to sanitary problems throughout the cultivated forest cycle that are compatible with the need to produce wood in quantity and quality, and with other functions of cultivated forest such as environment protection, carbon storage, and protection of biodiversity. The proposed research activities within this objective will mainly concern two aspects: the management of established pests and diseases, and the risks associated with exotic pests. The objective will increase our understanding of spatial and temporal dynamics of pests and diseases and will improve modelling tools and monitoring methods. It will focus on the evaluation and prediction of sanitary risk in relation to silvicultural practices and technological innovations and on the development of control strategies principally based on risk prevention. It will aim at environmentally sustainable, largely biologically-based control solutions. It will also develop sanitary risk management strategies and decision support systems to assist in the application of these solutions in different regions and under different

silvicultural models. Leading industrial and government partners will be engaged to explore the potential for applying these solutions.

3 to develop predictive tools for better integrated resource management and use: cultivated forests constitute simplified terrestrial ecosystems that are easier to analyse, monitor and model than more complex systems. Significant progress has thus been made both scientifically and practically. On the scientific side, detailed forest ecosystem models have been developed to understand and predict management and climate impacts on forest behaviour based on a comprehensive description of soil-tree and carbon-nutrient-water interactions at the stand scale. On the practical side, empirical mensuration based growth and yield models and wood quality models have been incorporated into decision support systems or coupled to simulators of wood quality. However, information flow from process-based models to decision-support systems is much less developed, as is the passage from stand to regional scales. This objective will focus on the development of tools for integrating mechanistic models with decision support systems at various spatial scales. Such integrated tools will enable the assessment of environmental as well as economic aspects of sustainability, from tree and stand to regional levels and from raw material quality to wood-based products. This objective will be achieved by developing synergies between research teams across countries and by facilitating integration and sharing of experimental data, remotely-sensed data and field information in order to validate models and to elaborate pertinent indicators of sustainability and recommendations for optimised management practices.

4 to facilitate societal dialogue, informed decision making and dissemination of information: this objective will investigate socio-economic implications of scientific progress in the production forestry sector and societal expectations in relation to the regional development of forestry-wood chains. Research activities will include elaboration of appropriate methodologies in social studies, comparative analyses and development of indicators at pertinent levels considering regional specificity. Dissemination of knowledge from the other components of the proposal will be an important part of this objective in order to provide objective information to end-users and society at regional and European levels; this will be linked with the setting up of pilot zones for SFM¹ in Atlantic European regions. This objective will be further elaborated in the context of current consortium activities and the implementation of *IMACFORD*² accompanying measure for the 5th FP.

Project outputs will include publications, workshops, databases, integrated models, advanced breeding strategies, biotechnologies, risk management strategies, monitoring methods and indicators, decision support systems, and optimised management practices.

GENERAL APPROACH

The proposal is based on a multidisciplinary and integrated approach to addressing a coherent set of scientific questions. It concerns five major interrelated scientific themes and technical topics: (1) forest ecology and management; (2) tree breeding and genomics; (3) entomology and pathology; (4) wood quality ; (5) socio-economics. The proposed IP will concentrate on key commercial tree species for wood production and the approach chosen is twofold: (i) multi-scale integrated approaches from genes to raw material and from tree component to landscape and regional levels using modelling methods and monitoring data; (ii) output oriented approach towards sustainable systems and practices using environmentally friendly and socially acceptable processes and products. Emphasis will be placed on the interfaces between disciplines and scientific themes and on the development of integrated outputs.

Given the large scope of the proposal, the project consortium will be multidisciplinary and will mainly involve partners from public research organisations, as well as private partners from the forestry-wood chain. The organisation³ which will manage the project consortium will provide an ideal platform for interactions with practitioners and will facilitate the development of close working relationship with industry to ensure relevance of the research undertaken.

To address some specific research questions, the proposed IP will be opened to new partners within the scientific contours defined above. Links have also been established with other envisaged actions aiming at integrating and strengthening European research in the same sub thematic priority area:

-integrated projects (**IP**) dealing with the wood-product chain such as *The forestry wood production chain (FORWOOD)* and *Sustainable wood production by optimal usage throughout the wood chain (SUSTAINWOOD)*

¹ Sustainable Forest Management

² IMproving and Advancing Co-ordination of FOrest Research and Development in Europe

³ European Institute for Cultivated Forests (IEFC- regional project centre of EFI- is a networking and technology transfer association)

-networks of excellence (**NoE**) in closely related scientific themes, such as proposed NoEs on *European Forest Genomics, Diversity of European Forest Trees, Contribution of Europe's Forests to Sustainable Development, and Integrating modelling approaches for Forest Ecosystems management.*

NEED AND RELEVANCE

Environmental systems such as forests resources transcend national boundaries and the interdependence of national management strategies for renewable resources is therefore of paramount importance. Expertise gained at a national and, more recently, a trans-European level, should be harnessed to solve the most pressing problems in a climate of cooperative and innovative research in order to enhance the sustainability, quality and productivity of cultivated forests. This can be achieved by co-operation of expert groups at a European level more effectively and with lower overall investment than by national initiatives alone. Moreover, comparative analysis of strategies and results between different types and areas of cultivated forests will be very fruitful.

Questions addressed by this project take into account the evolving societal needs and demands for sound environmental forestry practices, the evolving world wood trade, EU enlargement, and changing climate conditions. In turn the project will support the implementation of international commitments and Community measures on the protection, sustainable management and utilisation of forest resources. Scientific and technological excellence exists throughout Europe to address those questions, but integration effort is needed to bring this expertise together to undertake programmes of research that will link national research efforts, provide new management solutions to meet regional problems, and chart the way forward for the sustainable development of the European forestry sector in the future.

The proposed research activities will mainly contribute to the realisation of the objectives of **Priority Thematic Area 1.1.6.3 Global change and ecosystems**. It will do so by developing strategies across Europe, and clarifying and standardizing concepts, models, tools and indicators for sustainable management of cultivated forests resources, within the context of regional specificity and integrated forestry-wood chains, and with regard to the multipurpose utilisation of forests. The proposed IP addresses specifically the following research priorities of thematic areas :

1.1.6 Sustainable development, global change and ecosystems ... *“sustainable management of Europe’s natural resources and their interaction with human activities..”*

1.1.6.3 Global change and ecosystems « *In the context of global change, strategies for integrated, sustainable management of .. forest ecosystems are of particular importance for the preservation of these ecosystems and will contribute substantially to the sustainable development of Europe* »

- **Strategies for sustainable land management, including coastal zones, agricultural land and forests**
“Research will focus on:... development of strategies for sustainable forest management considering regional specificity; strategies/concepts for sustainable management and multipurpose utilisation of forest and agriculture resources; cost-efficiency of new environmental-friendly processes within the integrated forestry-wood chain“

The project will also contribute to **other research priorities of area 1.1.6** such as biodiversity and ecosystems ; water cycle, including soil related aspects; operational forecasting and modelling; complementary research (development of methods for risk assessment). and to **priority thematic area 1.1.7 Citizens and Governance in a knowledge-based society** by facilitating societal dialogue and ensuring active participation of key societal stakeholders in link with territorial approaches.

SCALE OF AMBITION AND CRITICAL MASS

The project is ambitious given its large scope, expected results and outputs concerning the various components of the forestry sector. To successfully achieve the project’s objectives, scientific excellence has been brought together and a critical mass of resources representing a balanced set of multidisciplinary skills has been gathered. Most partners have developed collaboration in the past and are currently involved in European research activities (COST actions, RTD shared-cost projects and Concerted Actions, Marie Curie training sites, accompanying measures, etc..). Potential partners from Eastern Europe and from outside Europe are also proposed to ensure involvement of world leaders in their disciplines. As the project develops, additional expertise might be required to address some specific issues, in particular in the fields of economy and risks, and new partners will be approached to join the consortium through open calls for participation . Technological development associated with this project involves industrial partners and some potential SMEs partners that have already been identified.

The participants listed below include a group of core partners (steering committee), and other partners which will contribute to the different subprojects. Each operational objective will comprise one or more subprojects which will be fulfilled in close coordination between subproject managers and the steering committee. The project consortium will be managed by an existing organisation which will coordinate funding, communication and dissemination of information using existing facilities .

Core group of scientific partners

country	organisation	contact person/email address	role in the IP / objective n°
France	INRA (Bordx, Orléans, Nancy)	JM Carnus/carnus@pierroton.inra.fr	scientific coordination 1/2/3/4
	IEFC	C Orazio/iefc.aquitaine@netcourrier.com	consortium management 4
Ireland	Univ College Dublin	T Farrell / ted.farrell@ucd.ie	3
Portugal	ISA Lisboa	M Tome / magatome@isa.utl.pt	3
Spain	INIA Madrid	M Cervera/ cervera@inia.es	1
Sweden	Univ of Agric. Uppsala	S Linder / sune;linder@emc.slu.se	2/3
UK	Forest Research	S Lee / steve.lee@forestry.gsi.gov.uk	1
Switzerland	ETH Zurich	F Schmithüsen/ schmithuesen@fowi.ethz.ch	4

Other scientific partners

Austria	Univ. of Agric. Sciences (BOKU, Vienna)		2
Belgium	Univ. Libre de Bruxelles		2
Finland	Univ. of Helsinki		3
France	Afocel, Cemagref, CIRAD, CNRS, Engref, Univ Bordeaux		1/2/3/4
Germany	IFM Univ.Gottingen, BFH Grosshansdorf, Univ. Freiburg		1/2/3
Italy	Univ of Firenze		2
Portugal	IBET, RAIZ, Univ. Cath. Porto		1 / 4
Spain	INIA, Neiker Institute, Univ of Santiago, Univ of Malaga		1/2/3/4
Sweden	Skogforsk		1 / 3
UK	Univ of Wales, Univ of Ulster, Univ of Aberdeen		1/2/3/4

Other countries research organisations : Poland (IBL), New Zealand (NZ FRI)

Industrial partners: ENCE, StoraEnso; and SMEs: CAFSA, IKT.

INTEGRATION

The proposal comprises several forms of integration:

- **vertical integration**, from knowledge to technological development in the production forestry sector,
- **horizontal integration**, considering the multidisciplinary approach proposed,
- **intersectoral integration** and close partnership between public research organisations and industry,
- and **integration of activities** including:
 1. *Research and technological development*: integration of activities will mainly include multipartners sub-projects to implement operational objectives, shared resources and information, exchange and mobility of scientists.
 2. *Innovation related activities*: the project will affiliate several SME's whose activities will be enhanced by the development of new tools and decision support systems and who are capable of marketing products.
 3. *Training* will be facilitated by consolidation of IEFC's existing network and active links with forest industry and end-users; training through research will also be an important aspect connected to this project and tertiary students will be offered pre-doc and post-doc positions through the setting up of a coordinated network of existing and future Marie-Curie training sites.
 4. *Technology transfer and dissemination of information* will be organised through existing networks of key stakeholders and end-users (regulatory authorities, regional authorities, national forest services, cooperatives, tree nurseries, private forest companies, forest owners associations, wood and pulp and paper industries, forest certification organisations, NGO, ...) and will be facilitated by the existence of IEFC.
 5. *Regional development*: the project has strong co-operative links which involve several regions of Atlantic Europe representing 10 million ha of cultivated forests; in particular, the project will be connected with 10 representative forest sites of Atlantic Europe where SFM indicators will be tested at ecosystem and landscape levels, and where dialogue between scientists, industry and end-users will be facilitated.