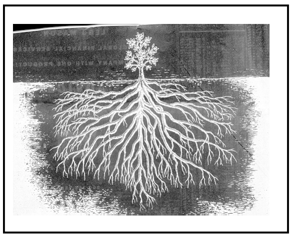
Quality of Life and Management of Living Resources

Silvoarable Agroforestry For Europe



SAFE

Key Actions n° 5.3.1 and 5.4.2

Multifunctional management of forests: Agroforestry

CAP measures and related activities including agri-environmental and socio-economic aspects

Silvoarable Agroforestry for Europe

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1. Objectives and Expected Achievements

Silvoarable agroforestry comprises widely-spaced trees intercropped with arable crops. This project builds on recent findings that indicate that modern silvoarable production systems are very efficient in terms of resource use, and could introduce an innovative agricultural production system that will be both environment-friendly and economically profitable. Growing high quality trees in association with arable crops in European fields may improve the sustainability of farming systems, diversify farmers incomes, provide new products to the wood industry, and create novel landscapes of high value. In support of the European Common Agricultural Policy, the SAFE project will provide models and databases for assessing the profitability of silvoarable systems, and will suggest unified European policy guidelines for implementing agroforestry.

To meet these expectations, the SAFE project will develop biophysical and socio-economic tools to inform farmers and policy-makers of the potential for silvoarable agroforestry to contribute to the integrated and sustainable development of European rural areas. The final target is a coherent 'Agroforestry Policy Options' document which can be used by the EU to frame header and interpretative regulations, and by Member States or Autonomous Regions to assess the effect of forestry or agricultural grants on the uptake of agroforestry in the context of best European practice.

The first main objective of the project is to reduce the uncertainties concerning the validity of silvoarable systems. Data from both traditional silvoarable systems and recent silvoarable experiments will be collated in a modelling framework that will be used to predict the outcomes of silvoarable management scenarios at the plot scale. This objective implies two technological and scientific tasks:

i) to build up a network to monitor the unique resource in silvoarable experiments provided by the participants in the consortium using agreed measurement protocols and database structures;

ii) to design and validate a mechanistic model of tree-crop interactions in silvoarable plots. An inception workshop will allow to compare existing models produced in previous European or International programmes and prioritise the need for new modules. The model will be validated using available experimental data from the consortium, and will be used for predicting the future yields from silvoarable plots at a variety of European sites.

The second main objective is to extrapolate plot-scale results to individual farms or sub-regions, and to provide a unified framework to assess the impact of agricultural prices and EU regulations on the likely uptake of agroforestry. This second main objective implies three tasks:

i) to link the biophysical modelling of a silvoarable plot with economic modelling tools, and to upscale the resulting integrated bio-economic model from the plot scale to the farm and the regional scales;

ii) to identify where, in different European countries, agricultural and forestry policies are conflicting over the silvoarable agroforestry issue;

iii) to define and predict the economic outcomes of a range of scenarios for implementation of silvoarable agroforestry, to compare these outcomes with existing land use profitability, and to consider the wider issues of grant eligibility, environmental impacts, or taxation levels which may constrain the uptake of agroforestry in Europe. At the moment, many European farmers are deterred from establishing modern agroforestry systems because of legal and policy issues, rather than by their lack of profitability. Simultaneously, most traditional silvoarable systems are ignored by the CAP. This cultural heritage of rural Europe is therefore abandoned by farmers, leading to the loss of environment-friendly practices and of valued landscapes. There is, therefore, a clear need to use the experience gained from traditional and modern silvoarable systems across Europe to develop coherent agroforestry policies for the European Union.

To achieve these objectives, the SAFE project groups biophysical experimenters and modellers, economists, and end-users' representatives (farmers' and foresters' unions).

The project will focus on silvoarable systems (trees and crops) as these systems have not been much researched in the past (most effort to date has focused on silvopastoral systems and farm woodland planting), and as arable systems may benefit greatly from the introduction of trees (biodiversity, diversification of incomes, control of crop surpluses, creation of new landscapes).

Landmark achievements that will allow to measure the success of the project include the delivery of a European Agroforestry Policy document and the organisation of users conferences in 8 European countries at the end of the project.

The first challenge of this project is to bring together field experimenters and modellers. Most modelling activities in tree-crop interactions are not yet able to predict the outcome of silvoarable systems of long duration, such as those adapted to temperate areas. But such predictions are necessary to implement agroforestry schemes and regulations. The prediction of long-term evolution of a system is still difficult and further work in terms of the growth of trees and crops in silvoarable plots is needed. It is the intention of this project to make a decisive step towards the prediction of silvoarable plots outcomes, by using the up-to-date accumulated field data of the last decade, uncertainty modelling techniques, and the modelling expertise that has been developed recently by the participants. Four leading integrated modelling approaches of tree-crop interactions currently available are products of participants in the SAFE project. A distinctive trait of the SAFE biophysical model will be to operate at the day time step, allowing multi-years simulation. This integrated time scale is a challenge for eco-physiologists more used to short time steps such as the minute or the hour. The techniques of uncertainty modelling will be applied to improve the model performance and to analyse and estimate the accuracy of long-term system outputs. Spatial modelling with GIS tools will help to predict the possible extension of silvoarable systems in Europe.

The close co-operation of research institutes and farmers' organisations is the second challenge of this consortium. End users and scientists will define together from the very start of the project the framework for data storage, data retrieval and modelling. In this way, the modelling activities will be directed to produce the information required to develop a potential agroforestry directive for the EU that will suit the needs of end-users. End-users partners in the SAFE project either bring a direct knowledge of traditional silvoarable systems, and/or intend to engage in modern forms of silvoarable agroforestry.

Further achievements of the SAFE project will include:

Improving the knowledge on key tree-crop interactions: Below-ground interactions (including competition and facilitation) between trees and crops are poorly understood. An important innovation of the project will be the use of stable isotope abundance techniques to assess rooting patterns and root competition, in an attempt to model the dynamic interaction of expanding rooting systems. Above-ground interactions between trees and crops are better understood, but require a realistic description of tree canopies. The latter will be achieved by numerical simulations of the canopy of 4 key tree species for European agroforestry.

Improving the knowledge in integrated modelling: the link between above- and below-ground modules is new and implies the introduction of regulation modules that will be validated by specific experiments in the available silvoarable plots. A further breakthrough will be achieved using some unique 25-year-old silvoarable plots that will be available for validating the forecasting capacity of the modelling tools. In addition, uncertainty modelling will help to enhance the model forecasting capacity by identification and reducing of the uncertainties of both the integrated biophysical silvoarable model and the silvoarable economic model.

Improving the economic assessment of silvoarable agroforestry: It is widely recognised that the usual discounting analysis may not describe correctly the tree planter's rationale. Making profits or maximising returns may be secondary to aspects such as the regularity of the incomes, the availability of capital for retirement or for investments in the farm and the landscape improvement or sporting value. A set of financial comparison and economic optimisation tools will be used and coupled to the biophysical models, including present values analysis and techniques to take amenity value into account.

Exploring the potential for silvoarable land use: Agroforestry research carried out to date was mostly restricted to the plot/field level. There has been no analysis of the potential extension of agroforestry in Europe. SAFE will provide information on the priority target areas for the specific silvoarable systems investigated at the regional scale and the European scale.

Legal and taxation innovations expected: During the late twentieth century, the advantages of agroforestry systems have been overlooked. Even traditional silvoarable landscapes, whose benefits are widely recognised, have received little attention from policy makers and research organisations. Across Europe the integration of trees and arable agriculture is currently unattractive to farmers, simply because the available grant or subsidy schemes are designed for forestry or agriculture, and don't permit agroforestry. In some countries, agroforestry systems can actually be declared illegal, because they are a category which is not recognised for taxation purposes. This preposterous situation has had unfortunate consequences with some EU-funded silvoarable agroforestry experiments being closed prematurely because local agencies deemed that they were not eligible for agricultural or forestry grants. A mixed or combined status of agroforestry plots is currently not available, neither at the European level nor at the National level preventing both forest and agricultural grant policies to be applied.

A special 'agroforestry status' will be designed for the countries where tax policy and grant availability is dictated by land-use classes. Policies for agriculture and forestry grants should recognise that both silvoarable and silvopastoral systems are 'legal' forms of land-use which should be permitted to be on a 'level playing-field' with conventional agriculture or forestry. This agroforestry status will be designed to avoid any undue accumulation of European grants by landowners or farmers.

2. Project Workplan

2.1. Introduction

The SAFE project will i) assess the production and value of silvoarable systems, ii) forecast the potential of silvoarable agroforestry to be adopted as a new farming system, and iii) suggest guidelines for a coherent package of forestry and agri-environmental incentives which will not disfavour agroforestry when compared with conventional forestry or agriculture. The work-plan consists of 10 work packages (WP), each with deliverables and milestones. A graphical presentation of the project's components (Pert diagram) is shown in Figure 1, and a Gantt chart of the activities within the work packages is presented in Figure 2.

WP1 will provide a common platform for the linked biophysical and economic modelling of silvoarable systems. Quantitative information on existing traditional silvoarable systems (WP2) and ongoing experimentation (WP3) will be collected, allowing parameterisation and testing of above-ground (WP4) and below-ground (WP5) sub-models. WP6 will link the above and below-ground sub-models in an integrated silvoarable plot model. Focussed experiments to collect additional information necessary to parameterise the biophysical growth model will be conducted in WP4 and WP5. WP7 will develop an economic model to evaluate scenarios including year-to-year variability at the plot-scale. WP8 will extrapolate growth and economic predictions to farm and regional scales, allowing evaluation of policies and incentive strategies by WP9. WP10 will monitor the project, and manage the dissemination and exploitation activities.

51% of the man-month resources of SAFE will be allocated to biophysical modelling, and 40% to economic modelling and policy guidelines design. The state of the art appraisal of modelling and of traditional practices covers the remaining 9%.

For the improvement and validation of biophysical models, data from current silvoarable experiments and traditional silvoarable systems will be used. Existing traditional silvoarable systems will be used as the support of focussed experiments on tree-crops interactions by three partners in the consortium. The simulation results will be applied to calculate agronomic and economic benefits of various silvoarable systems in different regions in Europe and to develop coherent agroforestry guidelines for a range of climate, soil and management regimes. The purpose of the biophysical models is to supply data for the economic model. To gain time, the economic model (WP7) will be implemented from the start of the project, using provisional tentative biophysical data that will progressively be replaced by confirmed data from the biophysical modelling activity of WP4, 5 and 6.

2.2. Project structure, planning and timetable

The SAFE project is designed on a 3.5 year duration. The first 6 months are necessary to collate data and agree on a common modelling framework. Two full growing seasons are then necessary to provide data for the biophysical and economic models validation. The last year will be focussed on virtual experiments using the modelling software, on up-scaling studies, and on policy design.

Table 1 : List of participants

Participant 1 : Coordinator ✉ **INRA (Institut National de la Recherche Agronomique)** UMR Systèmes de Culture Méditerranéens et Tropicaux 2, Place Viala, 34060 Montpellier, France	**Dr Christian Dupraz** E-m : dupraz@ensam.inra.fr ☎ 33 (0) 4 99 61 23 39 Fax 33 (0) 4 67 52 21 16
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Participant 6 : Contractor ✉ **CNR (Consiglio Nazionale delle Ricerche** **Istituto per l'agroselvicoltura** Via Marconi, 2, 05010 Porano, Italy	**Dr. Pierluigi Paris** Em : P.Paris@ias.tr.cnr.it ☎ 39-0763 374674 Fax 39-0763 374330
Participant 7 : Contractor ✉ **UEX (Universidad de Extramadura)** E.U. de Ingenieria Tecnica Forestal Avd. Virgen del Puerto, 10600 Plasencia, Spain	**Dr. Gerardo Moreno** E-m : gmoreno@unex.es ☎ 34 27 427000 Fax 34 27 425209
Participant 8 :Contractor ✉ **FAL (Eidgenössische Forschungsanstalt für AgrarÖkologie und Landbau)** Produkt Ökocontrolling Reckenholzstrasse 191, CH-8046, Zürich, Switzerland	**Dr. Félix Herzog** E-m : Felix.Herzog@fal.admin.ch ☎ (41) 1 377 71 11 Fax (41) 1 377 72 01
Participant 9 : Contractor ✉ **APCA (Assemblée Permanente des Chambres d'Agriculture)** Sous-Direction des Politiques Agricoles et rurales 9, Avenue Georges V, 75008 Paris, France	**Mrs Nelly Lecorre-Gabens** E-m:lecorre-gabens @apca.chambagri.fr ☎ 33 (0) 1 53 57 11 43 Fax 33 (0) 1 53 57 10 05
Participant 10 : Contractor ✉ **AUTH (University of Thessaloniki)** Faculty Of Forestry and Natural Environment, Laboratory of Range Ecology 54006, Thessaloniki, Greece	**Dr. Vasilios Papanastasis** E-m : vpapan@for.auth.gr ☎ +30 31 998933 Fax +30 31 992721

Table 2 : SAFE Workpackage list

N°	Work-package Title	Respon sible N°	Person-months	Start month	End month	Deliverables N°
1	Silvoarable modelling strategies	1	24,4	1	6	3,4
2	European silvoarable knowledge base	6	39,2	1	18	5,9
3	Silvoarable experimental network	4	104,9	1	28	11,15
4	Above-ground interactions	1	73,5	4	36	6,16
5	Below-ground interactions	3	73,5	4	36	7,17
6	Biophysical integrated plot modelling	2	78,5	6	42	10,14,18,20
7	Economic modelling at the plot scale	5	67,0	2	42	8,22,23,24
8	Scaling-up to the farm and the region	8	83,0	18	42	12,13,21
9	Guidelines for policy implementation	3	36,6	18	42	19,25,26
10	Project management, dissemination and exploitation	1	20,4	1	42	1,2,27,28,29,30
	TOTAL		600,9			

The person-month allocation to the project includes 55,0 person-months of permanent staff of AC participants, in addition to the 600,9 person-months listed in the A3 financial form.

Table 3 : Leaders of Workpackages

Work Package	Work Package Leader	Partner
1. Silvoarable modelling strategies	Appointed computer scientist	INRA
2. European silvoarable knowledge	P. Paris	CNR
3. Silvoarable experimental network	D. Pilbeam	UNIVLEEDS
4. Above-ground interactions	H. Sinoquet	INRA
5. Below-ground interactions	N. Jackson	NERC
6. Biophysical integrated plot modelling	M. Mayus	WU
7. Economic modelling at the plot scale	P. Burgess	CRAN
8. Scaling-up to the farm and the region	F. Herzog	FAL
9. European guidelines for policy implementation	G. Lawson	NERC
10. Project management, dissemination and exploitation	C. Dupraz	INRA

Areas (methodological issues within WPs)	Scientific Leader	
1. Isotope technology for below-ground interactions	G. Bongi	CNR
2. Computer modelling	N. Dones	INRA-PIAF
3. Tree growth laws in AF	A. Cabanettes	INRA-UAFP
4. End-users' point of view	N. Lecorre-Gabens	APCA

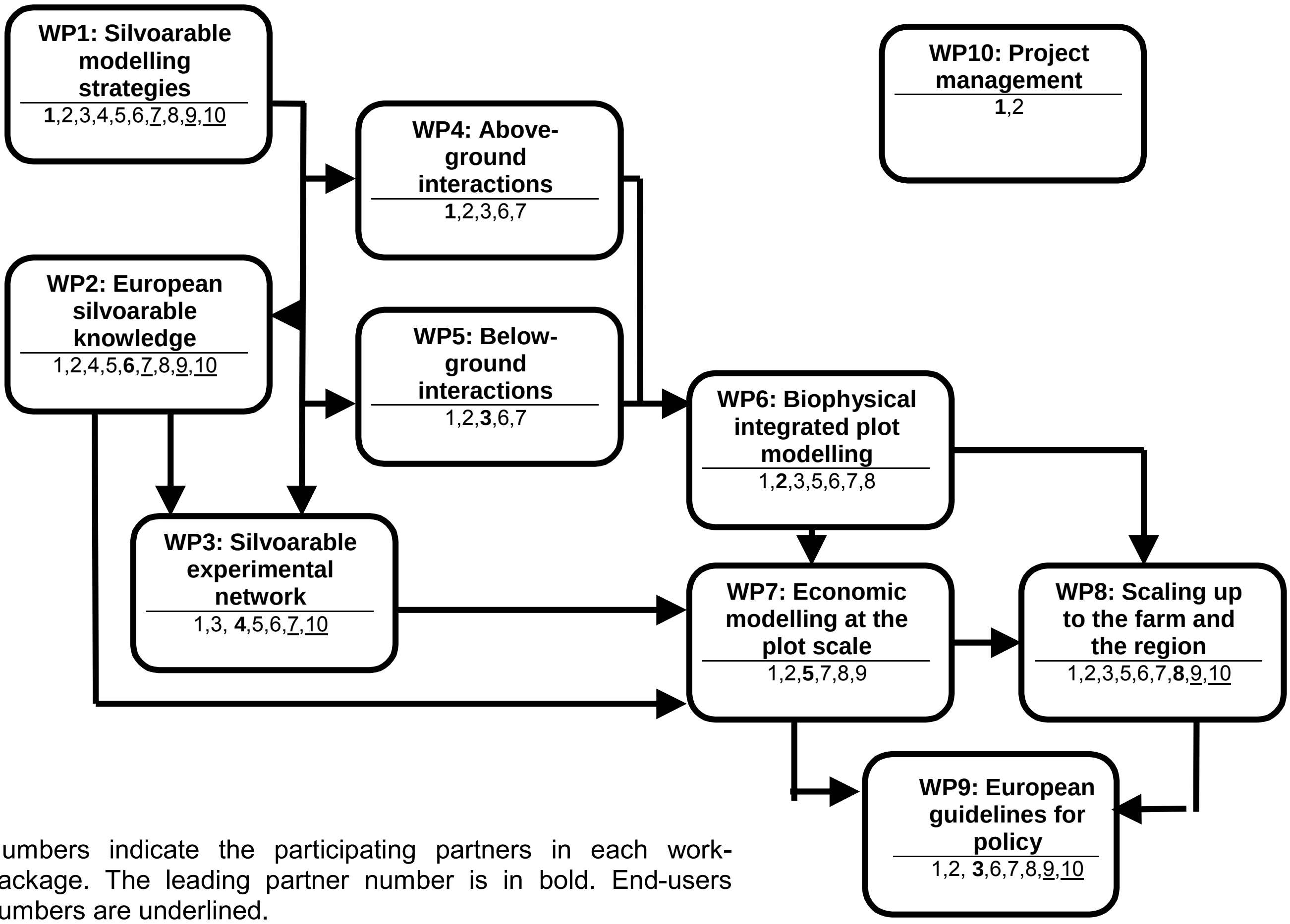
			1	2	3	4	5	6	7	8	9	10	
		COORD	**INRA**	**WU**	**NERC**	**LEEDS**	**CRAN**	**CNR**	**UEX**	**FAL**	**APCA**	**AUTH**	**TOTAL**
WP1	Common modelling strategy		14,9	3.0	2.0	2.0	0.9	1.0		2.0	1.0	2.0	24,4
WP2	European silvoarable knowledge		2,0	6.0		5.0	1.0	13.0	6.0	2.0		14.0	39,2
WP3	Silvoarable experimental network		19,6	2.0	2.0	22.6	14.0	31.0	13.5			7.8	104,9
WP4	Above-ground interactions		58,0	4.0	2.0			10.0	3.5				73,5
WP5	Below-ground interactions		48,0	4.0	6.0			11.0	7.5				73,5
WP6	Biophysical Integrated plot modelling		32,5	47.0	2.0					1.0			78,5
WP7	Economic modelling at the plot scale		15,0	9.0			34.0.		3.0	2.0	9.0		67,0
WP8	Upscaling to the farm and the regional scale		4,0	1.0	6.0		6.0	6.0	3.0	48.0	14.0	4.0	83,0
WP9	European guidelines for policy implementation		5,0	3.0	10.0			8.0	3.0	5.3	8.4	2.0	36,6
WP10	Project management	20.4											20,4
Total	Total person-months on the project	20.4	199,0	79.0	30.0	29.6	55.9	80.0	39.5	60.3	32.4	29.8	655,9
	Including permanent staff from AC contractors			9.0		4.9	2.9		14.0	6.0	8.1	10.0	55,0
Total	Without permanent staff from AC contractors	20,4	199,0	70,0	30,0	24,7	53,0	80,0	25,5	54,3	24,3	19,8	600,9

Table 4 : Allocation of person-months to the workpackages by the SAFE Consortium

These figures were not repeated in the description of each workpackage.

Only Academic and research (scientist and engineer) staff is included for the contribution of permanent staff from AC partner (technicians not included)

Figure 1 : SAFE Project structure : project's components and participating partners



Numbers indicate the participating partners in each work-package. The leading partner number is in bold. End-users numbers are underlined.

Figure 2 : SAFE project timetable

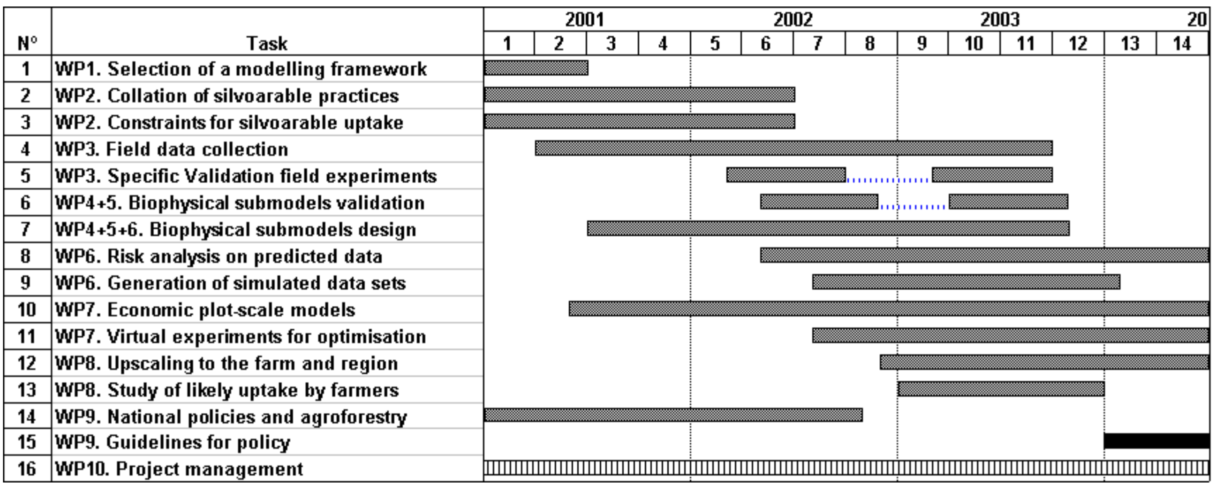


Table 5 : List of the SAFE Activities

N°	WP N°	Activity title	Month
1	M1.1	Plenary workshop to debate the choice of a common modelling platform	6
2	M1.2	WEB site of SAFE installed	3
3	M1.3	Consortium guide for modelling activities and for site characterisation	6
4	M2.1	Identification of still living silvoarable practices in Europe	12
5	M2.2	Assessment of the potential target areas for silvoarable agroforestry in Europe	24
6	M3.1	Start of field measurements	9
7	M3.2	Report of field measurements and analysis of the results of years one and two	27
8	M3.3	Database of look-up tables for model parameters derived in years one and two	31
9	M3.4	Collation of all data for all participating field experiments	40
10	M4.1	Mock-ups of virtual trees for 4 key species available (	24
11	M4.2	Simplified model running at the day time step release	28
12	M4.3	Time-series of potential tree and crop yields with non-limiting water supply	32
13	M5.1	Implement field experiments for validating water extraction modules	9
14	M5.2	Look-up tables and database of parameter data for water extraction modules	24
15	M5.3	Root system characterisation of intercropped trees	36
16	M6.1	Certified data sets as input for the economic model	32
17	M6.2	Land Equivalent Ratios of Silvoarable Systems (measure of their efficiency)	36
18	M6.3	Quantification of the reliability of the integrated biophysical model (	40
19	M7.1	Criteria selected and model structure agreed	12
20	M7.2	Financial templates modified and circulated	20
21	M7.3	Initial investment appraisal for experimental sites completed	32
22	M7.4	Use the model so that a) existing systems are optimised and b) systems for high potential areas are identified and optimised	36
23	M8.1	Build up data structure for GIS modelling	20
24	M8.2	Acquisition and digitising of the spatial data needed	20
25	M8.3	Coupling GIS and SAFE models for spatial data analysis	30
26	M8.4	Economic analysis at the farm / regional scale	34
27	M8.5	Spatial and policy analysis at the European scale	38
28	M8.6	Synthesis of results and delivery to national and European policy makers	42
29	M9.1	Set up of social experiments (silvoarable plots) in countries where the technology is unknown	12
30	M9.2	Collation of existing national and sub-national agroforestry policies and attitudes	24
31	M9.3	Specifications of 'Agroforestry Policy Scenarios' software and structure published	36
32	M9.4	Agroforestry Policy Options report and 'Agroforestry Policy Scenarios' software distributed in paper, CD-ROM and web format	42
33	M10.1	Achievement of the consortium meeting timetable as planned	6 to 42
34	M10.2	Delivery of reports as planned	6 to 42
35	M10.3	End user workshops	2, 32, 40
36	M10.4	End-users conferences in eight participating countries	42

Table 6 : List of the SAFE Milestones

N°	WP N°	Milestone title	Month
1	1	SAFE-WEB site and common modelling platform	6
2	2	Report of still living silvoarable practices in Europe t	12
3	9	Set up of silvoarable plots in countries where the technology is unknown	12
4	2	Map of the potential target areas for silvoarable agroforestry in Europe	20
5	9	Collation of existing national and sub-national agroforestry policies and attitudes	24
7	5	Water extraction modules for the SAFE biophysical model	26
6	4	Mock-ups of virtual trees for 4 key species	28
8	4	Simplified integrated silvoarable model running at the day time step release	28
9	8	Coupling GIS and SAFE models for spatial data analysis	30
10	3	Database of all participating field experiments	32
12	6	Certified biophysical model data sets as input for the economic model	34
14	7	Economic optimisation of silvoarable systems (virtual experiments)	36
13	6	Land Equivalent Ratios of Silvoarable Systems report (measure of their efficiency)	38
15	8	Spatial and policy analysis at the European scale report	40
16	9	Agroforestry Policy Options report and 'Agroforestry Policy Scenarios' software distributed in paper, CD-ROM and web format	42

Table 7 : List of the SAFE Deliverables

N°	WP	Deliverable title	Delivery month	Nature	Dissemina -tion level	Partner in charge
1	D10.2	Intermediate progress reports to the EU	12-24-36	R	RE	INRA-SYSTEM
2	D10.1	Annual reports to the EU	6-18-30	R	PU	INRA-SYSTEM
3	D1.1	Tree-crops interaction models state of the art report	6	R	PU	INRA-SYSTEM
4	D1.2	Common modelling framework platform for SAFE report	6	R	CO	INRA-SYSTEM
5	D2.1	Database of current silvoarable systems in Europe	12	O	PU	CNR
6	D4.1	Light partition and microclimate modules	18	P	RE	INRA-PIAF
7	D5.1	Water partition and uptake module	18	P	RE	NERC
8	D7.1	Silvoarable economic module	18	O	RE	CRAN
9	D2.2	Database of target farming systems	24	O	PU	FAL
10	D6.1	Time-series predictions of tree and crop yields	24	O	RE	WU
11	D3.2	Database of consortium experiments	26	O	PU	UNIVLEEDS
12	D8.1	Spatial database for GIS for scaling up	30	R	RE	FAL
13	D8.2	Economic feasibility of AF in target regions report	30	R	PU	CRAN
14	D6.2	Integrated silvoarable model	34	O	RE	WU
15	D3.1	Guide book to the European experimental resources	36	R	PU	UNIVLEEDS
16	D4.2	Scientific papers on aboveground tree-crop interactions	36	R	PU	INRA-AMAP
17	D5.2	Scientific papers on below-ground interactions	36	R	PU	NERC
18	D6.3	Uncertainty appraisal report	36	R	PU	WU
19	D9.3	Major silvoarable systems of interest in Europe report	36	R	PU	CNR
20	D6.4	Scientific papers on the model	38	R	PU	WU
21	D8.3	Farmers' view on silvoarable issue report	38	R	PU	APCA
22	D7.2	Plot economics of European silvoarable systems report	39	R	PU	CHAV
23	D7.3	Optimum AF systems for different regions report	39	R	PU	APCA
24	D7.4	Scientific papers on socio-economic studies	40	R	PU	CHAV
25	D9.1	European land status for the agroforestry plot proposal	40	R	PU	INRA-SYSTEM
26	D9.2	'Agroforestry Policy Options' document	42	R	CO	NERC
27	D10.3	Final report to the EU	42	R	PU	INRA-SYSTEM
28	D10.4	Video film on European agroforestry	42	O	PU	INRA-SYSTEM
29	D10.5	Prototype of user-friendly SAFE model	42	P	RE	INRA-SYSTEM
30	D10.6	End-users conferences in eight participating countries	42	O	PU	APCA UEX CNR CRAN GPG FINIS ASKIO FAL

Deliverables are in order of delivery date. WP indicate the work package responsible for the delivery. In addition to the deliverables, scientific papers on the methodologies and results of experimental and modelling studies will be published. At regular intervals updated versions of the models will be delivered, but the model improvement will continue till the final project phase.

2.3. Description of the workpackages

Work-package 1:	**Silvoarable modelling strategies**
Start and completion month	1 - 6
Workpackage leader	**Contracted computer scientist (INRA)**
Total Person-months	24,4; see Table 4 for details

Objectives

The main objectives are to identify modelling strategies and to build a common modelling platform for the project. This platform will be an essential tool for participants, and will be implemented on a Web-site as a rolling document to facilitate communication between the participants. The extensive experience of modelling of tropical silvoarable systems will be included. At present five different modelling approaches to tree-crops interactions have been identified in the world literature. Four have been developed by participants in the project, including two developed in a complementary silvopastoral FP4 project (1992-1996). These approaches will be compared and confronted with end-users' requirements (farmers, foresters and policy-makers) to identify the common modelling platform. WP1 will be led by a contracted computer scientist deliberately without a link to any of the contractors involved in modelling.

Tasks and methodology

WP1 comprises 4 tasks :

T1.1. Collate modelling strategies and identify appropriate models and sub-models. This is a collaborative effort supported by the unique modelling experience and already developed models of the participants.

T1.2. Develop a modular modelling framework and assign programming languages and data formatting instructions to WP4 and WP5 to ensure compatibility. Define time and space resolution of the models to achieve the integration of all relevant biophysical aspects and the expected long-term simulation target.

T1.3. Define the interface characteristics for linking the biophysical and the economic models. Select economic criteria to be included in the final model. Define silvoarable constraint criteria for evaluation of field experiments and practices.

T1.4. Open a WEB site for the project to share data, modules and the model platform.

Deliverables

D1.1. Tree-crops interaction models state of the art report (public)

D1.2. Common modelling framework platform including documentation and technical report (public)

Milestones and expected results

M1.1. Plenary workshop to debate the choice of a common modelling platform (month 6)

M1.2. WEB site of SAFE installed (month 3)

M1.3. Consortium guide for modelling activities and for site characterisation (month 6)

Work-package 2:	**European silvoarable knowledge**
Start and completion month	1 - 18
WP leader	**P. Paris (CNR)**
Total Person-months	39,2; see Table 4 for details

Objectives

To collect and analyse available information on European silvoarable agroforestry with the following objectives:

O2.1. To collate the information gained in earlier studies including EU projects that would be relevant to silvoarable systems and could fill gaps in the research of SAFE. No previous EU project dealt with silvoarable systems, but projects on poplar and walnut cultivation, farm forestry and silvopastoral systems will be reviewed. The most prominent European silvoarable systems will be documented, including intercropped poplars in valleys, oak parks and intercropped fruit and nut tree orchards (walnut, chestnut, apple, pear and peach). Study programmes of implementation of timber trees within farmlands and traditional agroforestry systems for landscape conservation are available. Special attention will be given to temperate silvoarable systems that have been recently adopted widely in temperate non-European countries such as the *Paulownia*-wheat system in China (about 3 million hectares set up in 25 years) and the walnut-cereal system in North-America.

O2.2. To collect historic data from existing systems required for validating the plot-scale yield model and economic evaluation. Special attention will be given to plots older than the experimental plots managed by the contractors. Innovative pioneer farmers or foresters installed such plots. Aged 10 to 80 years, they will provide a unique data resource.

Tasks and methodology

WP2 tasks include the collation of (historic) European silvoarable knowledge and its presentation in form of a database on a Web-site for common use by the participant.

T2.1. Collate historic data from both traditional silvoarable practicess. and previous long-term silvoarable experiments, including experiments closed prematurely (due to the difficulty of maintaining long-term experiments). Synthesise data on the biological productivity and the financial return, and where possible, the soil and climatic conditions pertaining at these traditional sites, as required by the WP1 guidelines. Those data will be made ready for input

T2.2. Collate information on European databases of silvoarable constraint criteria for dissemination of silvoarable systems: soil type and structure, soil hydraulic characteristics, climate exposure, climate variability as deduced from algorithms that will predict daily climatic variables for target sites in Europe.

Deliverables

D2.1. Documented database of current silvoarable systems in Europe including time-series of tree-growth and intercrop yield in documented sites in a variety of European locations.

D2.2. Documented database of target farming systems, including constraints to be used for scaling-up in WP8, and farm stratification and data about farmer behaviour.

Milestones and expected results

M2.1. Identification of still living silvoarable practices in Europe (month 12)

M2.2. Assessment of the potential target area for modern silvoarable agroforestry in Europe (month 24).

Work-package 3	**Silvoarable experimental network**
Start and completion month	1 - 28
WP leader	**D. Pilbeam, UNIVLEEDS**
Total Person-months	104,9; see Table 4 for details

Objectives

The objective is to supply data from field experiments to modellers. These data will be data from previous years of established silvoarable agroforestry experiments of SAFE participants and current data collected during the duration of the project. About 200 hectares of silvoarable experiments are provided by the consortium in 5 different European countries, and in 12 different locations. To our knowledge, this is almost the full European experimental silvoarable resource available to date. The project will capitalise on experiments set up in previous programmes, including the EU-sponsored FP4 programme. Specific objectives of WP4 are:

- O3.1. To provide field experimenters with a forum to exchange know-how and expertise.
- O3.2. To manage field experiments in a sound and concerted way. Duplicated experiments will be identified if any. Emphasis will be given to complementary and well-documented experiences.
- O3.3. To provide a unified protocol for basic field measurements accessible to the consortium so that comparable analyses can be done.
- O3.4. To provide accurate and quality controlled data from field experiments for model parameterising and testing

Tasks and methodology

WP3 comprises 3 tasks:

- T3.1. Collect data from existing experiments as required by the modelling activity. The data will be obtained from Mediterranean and temperate regions and will consist of three types: a) biophysical data to simulate above and below-ground tree-crop interactions; b) data on the productivity of trees and crops and c) management data for economic modelling. Three management areas can be distinguished: arable crop, trees and tree row under-storey. Important aspects to study are: labour costs and consumable costs under various design and management practices. Look-up tables of parameters and time series of data will be provided to modellers through the WEB-site.
- T3.2. At the SAFE experimental sites specific information needed to parameterise the biophysical model will be collected. Special attention is given to seven additional aspects: impact on solar radiation and wind velocity; determination of water sources using stable isotopes of H and O; determination of tree transpiration using sap flow in tree roots and trunks; evaluation of tree leaf area for transpiration and shade; description of root architecture by root excavation or root coring; assessment of nutrient extraction with isotopic tracers; impact of management practices on competition such as sound crop timing or crop choice.
- T3.3. Validate models with the field data in a dynamic interaction with modellers.

Deliverables

- D3.1. Guide book to the European experimental resources
- D3.2. Documented database of consortium experiments, including time-series of data collected since implementation.

Milestones and expected results

- M3.1. Start of field measurements (month 9)
- M3.2. Report of field measurements and analysis of the results of years one and two (month 27)
- M3.3. Database of look-up tables for model parameters derived in years one and two (month 31).
- M3.4. Collation of all data for all participating field experiments (month 40)

Work-package 4	**Above-ground interactions**
Start and completion month	4 - 36
WP leader	**H. Sinoquet (INRA)**
Total Person-months	73,5; see Table 4 for details

Objectives

To design and validate submodels for above-ground tree-crop interactions that are relevant to both crop and tree growth. Emphasis will be given to light and transpiration partitioning between trees and crops. The light model will take into account the main determinants of the above-ground interactions, i.e. spatial distribution of foliage, leaf and soil properties, and microclimate variables above the canopy. For the inclusion in the module in the integrated biophysical model, the final above-ground model should be compatible with the below-ground model and be as simple as possible. The above-ground models will be derived from comparisons between existing models, where the most sophisticated one will serve as a reference to test assumptions and then to derive a simple model.

Tasks and methodology

WP4 comprises next to the modelling activities the identification and performance of experiments to derive specific model parameters.

T4.1. Characterisation of the above-ground space occupied by trees and crops, in 3 target experimental sites as identified by WP3, with measurements of the dynamics of foliage distribution: crown volume and leaf area density for trees and leaf area index for crops. Estimates will be based on fisheye photographs taken at a number of dates in year 1 and 2.

T4.2. Select and modify an appropriate model for describing, analysing and predicting partitioning of light and transpiration between trees and crop. The resulting transpiration model will take into account light microclimate as predicted by the light module and measured microclimate variables (air temperature, humidity and wind speed). Mechanistic models will be used to formulate and test the approximations of more ‘coarse grained’ (or simple) model. Water availability will be considered as non-limiting at this model level. Water status and related plant regulation aspects will be introduced in WP6.

T4.3. Improve or design a model for the effect of the tree-crop canopy on local microclimate, i.e. the 'forest ambience' (air temperature, humidity, wind speed). Collation of algorithms for generating daily climates from public domain synoptic weather records will be performed.

T4.4. Improve or design a model for tree development, in particular for occupation of space by the tree canopy. The model should compute canopy development from resource acquisition. Given the state of the art, the model will be based on empirical relationships established from field measurements to derive potential growth curves that will be affected by the resource acquisition as predicted by the model.

Deliverables

D4.1. Light partition and microclimate sub-models, their documentation and technical report

D4.2. Report on aboveground tree-crop interactions

Milestones and expected results

M4.1. Mock-ups of virtual trees for 4 key species available (month 24)

M4.2. Simplified model running at the day time step release (month 28)

M4.3. Time-series of potential tree and crop yields with non-limiting water supply (month 32)

Work-package 5	**Below-ground interactions**
Start and completion Month	4 - 36
WP leader	**N. Jackson, NERC**
Total Person-months	73,5; see Table 4 for details

Objectives

To design and validate submodules for below-ground tree-crop interactions that are relevant to both crop and tree growth. Trees and crops in mixed plots compete for soil resources (water, nutrients), but also explore resources that would be unavailable in monocultures. The spatial and temporal distribution of tree and crop root systems and their uptake of water and nutrient resources form the key to understanding inter-specific relationships in mixed cropping systems. This knowledge can explain why sustained yields of intercrops were observed in our experimental plots, making silvoarable systems with widely spaced trees a sustainable arable system, and not a stepping-stone to afforestation.

Tasks and methodology

WP5 comprises next to the modelling activities the design of experiments to derive specific model parameters.

T5.1. Design and writing of a simplified model for water extraction and sharing between a tree and a crop, taking into account water interception by the canopies, water redistribution by stem-flow and through-fall, transpiration, and water redistribution in the soil profile by water migration and water transportation by the rooting systems. This model will be able to take into account the dynamic colonisation of the soil by the crop roots which is specific to silvoarable systems with annual crops. The model will allow assessment of the possibility of silvoarable systems in reducing nitrate leaching to water tables.

T5.2. Validation of the simplified model by using more detailed models that are available but could not be used in the general model. Two models will be used for calibration; a 2D model using a fixed detailed root map, and a 2D model using a dynamic, aggregated root map. The “minimum energy” criterion will be introduce to drive the water extraction process. These models will be calibrated and validated on the target tree-crop systems identified by WP2.

T5.3. Specific experimental protocols will be designed to be set up on existing silvoarable plots of target systems identified by WP3, using water flux characterisation (sap flow in roots and stems; soil water content monitoring; natural stable isotope tracing). The experiments will be monitored by WP3.

Deliverables

D5.1. Water partition and uptake module, documentation and technical report

D5.2. Report on below-ground interactions

Milestones and expected results

M5.1. Implement field experiments for validating water extraction modules (month 9).

M5.2. Look-up tables and database of parameter data for water extraction modules (month 24).

M5.3. Root system characterisation of intercropped trees (month 36)

Work-package 6	**Biophysical integrated plot modelling**
Start and completion month	6 - 42
WP leader	**M. Mayus (WU)**
Total Person-months	78,5; see Table 4 for details

Objectives

The linkage of below-ground and above-ground sub-models into one **integrated biophysical modular silvoarable model** is a scientific challenge. It will include quantitative descriptions of the interactions and feedbacks between the two sub-models. A further challenge is the year-to-year memory effect on tree growth as a result of the competitive and facilitative (favourable) effects of the crop component during previous years. The application of dynamic system theory and uncertainty analysis will help to achieve more realistic model predictions. The integrated biophysical model will be carefully validated and evaluated. The model will then be applied to analyse the effect of alternative management scenarios of silvoarable practices on long-term yield productivity and stability.

Tasks and methodology

The silvoarable model will be developed within the modelling framework assigned in WP1. Functional relations for important interactions and feed-back among model components, such as microclimate, transpiration and water uptake by roots, will be identified and elaborated in co-operation with WP4 and WP5. Wherever possible, physically and physiologically realistic approaches will be used, but simplified relations may have to be incorporated to a) facilitate realistic parameterisations where warranted by the availability of data and or sensitivity analysis and b) to allow the final linkage to an economic model (WP6). The tasks will be:

T6.1. To conceptualise the models, evaluate and simplify for link it to an economic model, identify and quantify interactions and feedback between components.

T6.2. To provide a strict framework for data exchange between the above and below-ground models for the daily and annual intervals, and to ensure compatibility between the two main model components. The interface will include a model for dry matter accumulation and partitioning between tree and crop components. The model for dry matter accumulation will be based on the light model derived in WP4 and take into account the plant water status and plant regulations as provided by WP5.

T6.3. To design specific experiments for parameterisation and validation of the integrated model

T6.4. To evaluate the performance of the model on the basis of available information from existing experimental plots, and apply the model for analysis of the effect of different management scenarios on long-term yield stability and indicators of soil fertility.

T6.5. To develop or adapt existing uncertainty modelling techniques (e.g. sensitivity functions, Monte Carlo simulations) to establish and improve the accuracy of the model or sub-models. Those techniques are already successfully applied on simulations of physical processes, but are new for the evaluation of biophysical functions and descriptions.

T6.6. To calibrate and validate the integrated model, using appropriate time-series of experimental data provided by WP3, and to include risk analyses of the simulated data. To validate the integrated model in the range of soils, climates and management regimes represented by available target experiments.

T6.7. To parameterise the model for a range of tree and crop mixtures, suitable for different parts of Europe.

Deliverables

D6.1. Data sets (Time-series predictions) of tree and crop yields under documented site conditions, for incorporation in the economic module (WP7)

D6.2. Integrated silvoarable model (documentation and technical report)

D6.3. Methodology and uncertainty appraisal report (documentation and technical report)

D6.4. Report on the data obtained with model simulations

Milestones and expected results

M6.1. Certified data sets as input for the economic model (month 32)

M6.2. Land Equivalent Ratios of Silvoarable Systems (measure of their efficiency) (month 36).

M6.3. Quantification of the reliability of the integrated biophysical model (month 40)

Work-package 7	**Economic modelling at the plot scale**
Start and completion Month	2 - 42
WP leader	**P. Burgess (CRAN)**
Total Person-months	67,0; see Table 4 for details

Objectives

The financial benefit to farmers of silvoarable agroforestry, relative to arable cropping and conventional woodland planting, is a key factor determining the uptake of agroforestry systems. The overall objective of this work package is to develop an economic model and financial templates that can be linked to the biophysical model to investigate the long-term financial benefits and costs of different agroforestry systems at a plot level. The overall objective is to develop an economic model and financial templates that can be linked to the integrated biophysical model to investigate the financial benefits and costs of different silvoarable systems at a plot level. The resulting **bio-economic plot scale models** form an essential precursor to examining the biophysical and economic feasibility of agroforestry at farm and regional scales (WP8). Silvoarable plots combine short term revenues from the crops and long term revenues from the tree. Both are physically linked by the tree-crop relationships that will be described in the biophysical model. The linkage of the biophysical model and of the economic model will therefore allow optimisations studies of silvoarable technologies. The specific objectives of WP7 are:

O7.1. To achieve a literature analysis on the optimisation of dual systems with short (crop) and long (tree) term components linked by a mechanistic relationship.
O7.2. To develop an economic model and financial templates that can be integrated with the biophysical model.
O7.3. To use the bio-economic model to determine the long-term financial benefits and costs of optimal silvoarable systems at (a) the network sites and (b) selected high potential sites.

Tasks and methodology

T7.1. To review existing financial models of agroforestry, cropping and farm woodland systems.
T7.2. To select and develop an economic model and templates which can be linked with the biophysical model described in WP6. Where necessary, we will improve the bio-economic model to address problems raised by the validation.
T7.3. To use templates to identify and quantify inputs, outputs, costs and revenues for the silvoarable network systems, and existing arable and forestry enterprises for different parts of Europe.
T7.4. To use the model to identify the most profitable agroforestry systems (e.g.: tree species; tree spacing) for the network sites, and their sensitivity to changes in prices and grants.
T7.5. To determine the optimum silvoarable system for other selected high-potential locations by using the model to assess the impact of changes in biophysical parameters (eg: site quality as reflected in tree and crop growth) on profitability.

Deliverables

D7.1. Silvoarable economic module: long-term financial plot-scale module linked to biophysical models: software, documentation and technical reports.
D7.2. Report on plot economics of European silvoarable systems.
D7.3. Report on optimum agroforestry systems for different regions.
D7.4. Synthesis report on socio-economic studies.

Milestones and expected results

M7.1. Criteria selected and model structure agreed (month 12)
M7.2. Financial templates modified and circulated (month 20)
M7.3. Initial investment appraisal for experimental sites completed (month 32)
M7.4. Use the model so that a) existing systems are optimised and b) systems for high potential areas are identified and optimised (month 36)

Work-package 8	**Upscaling to the farm and the region scales**
Start and completion date	18 - 42
WP leader	**F. Herzog (FAL)**
Total Person-months	83,0; see Table 4 for details

Objectives

The objective is to assess the potential spatial extension of (silvoarable) agroforestry systems in Europe in terms of biophysical and economic feasibility. To achieve this, biophysical and economic models will be linked using a geographic information system (GIS). The spatial up-scaling will be made at two scales. At the farm scale, yield predictions and economic assessments will be investigated for characteristic experimental sites (prototype farms representative for the region under investigation) of three European countries and different management scenarios. The economic analyses will be done from the farmers' perspective. At the region (European) scale, a ‘coarse-grained’ assessment of the potential extension of agroforestry across Europe will be made, based on spatial analysis and additionally on policy analysis. Improved computer and software packages, providing techniques to represent decision criteria and multiple constraints, which influence different stakeholders like landowners and policy-makers, will be applied.

Tasks and methodology

T8.1. Establishment of a spatial database with respect to land use, climate and topography in a geographic information system (GIS Arc/Info) for the farm scale (aerial photographs, topographic maps, digital data, soil maps and climatic data) and the regional (European) scales. For the farm scale most data must still be made available in digital form. At the regional European scale, most of the data is already digitally available.

T8.2. Extrapolate plot-scale predictions to farm and regional scales using existing national farm survey information and physical spatial databases of soils, topography and climate. The model developed in WP6 will predict crop and timber yields at the plot scale. It will be validated for a range of environmental conditions (soil, climate). Those conditions will be identified from spatial databases build in T8.1.

T8.3. Investigate the financial and non-financial constraints on sample farmers’ (who currently grow arable or tree crops) awareness of agroforestry and their objectives and constraints (resource endowments). Collect data in test areas to constitute the necessary basic information for the prediction of the potential implications of different encouraging / deterring scenarios. Investigate the likely uptake of agroforestry given yields and revenue streams predicted from the silvoarable model. In the test regions, workshops will be conducted to discuss the feasibility of agroforestry, as resulting from task T8.2 with farmers, extension service workers and local politicians.

Deliverables

D8.1. Spatial database for GIS for scaling up (farm scale, and regional scale).
D8.2. Report on the economic feasibility of silvoarable agroforestry in target regions.
D8.3. Report on farmers’ view on silvoarable issue.

Milestones and expected results

M8.1. Build up data structure for GIS modelling (month 20)
M8.2. Acquisition and digitising of the spatial data needed (month 20)
M8.3. Coupling GIS and SAFE for spatial data analysis (month 30)
M8.4. Economic analysis at the farm / regional scale (month 34)
M8.5. Spatial and policy analysis at the European scale (month 38)
M8.6. Synthesis of results and delivery to national and European policy makers (month 42).

Work-package 9	**Developing European guidelines for policy implementation**
Start and completion Month	18 - 42
WP leader	**G. Lawson (NERC)**
Total Person-months	36,6; see Table 4 for details

Objectives

WP9 will produce a synthesis report on Silvoarable Agroforestry in the context of economic and social changes to agricultural and forestry policies being implemented in Agenda 2000 (e.g. 1257/99), and provide guidelines to Member States and Autonomous Regions on the potential uptake of agroforestry systems. It will describe the effect of subsidiarity on farm-forestry practices, and use the socio-economic model to investigate the potential effects on agroforestry uptake of different legal structures, financial incentives and market price levels. National forestry and agricultural policies will be scrutinised in order to:

O9.1. Describe and classify the existing diversity in direct and indirect (dis)incentives to agroforestry across the EU;
O9.2. Analyse reasons for current agroforestry policy (e.g. 2080/92) and prospects for change
O9.3. Collate, at a national or regional scale, benefits to farmers and policymakers of possible changes in the interpretation of rules for the implementation of EU forestry and agri-environment Regulations

Tasks and methodology

T9.1. Document problems encountered by farmers in setting up new silvoarable plots in 5 different European countries. This will achieved by USERS partners that will monitor social experiments consisting in creating silvoarable plots within the framework of the present day agricultural and forestry policies.
T9.2. Collate national government policies on silvoarable agroforestry. Scrutinise the national policies for bottle-necks on agroforestry (silvoarable and silvopastoral) implementation, and possible conflicting rules between forestry and agricultural policy.
T9.3. Comment on current and proposed changes in EU forestry and agricultural policy based on regional scenario testing using the models. Design a policy framework for the implementation of a European agroforestry scheme based on the data from the models.
T9.4. User participants in three different countries (NL, D, GR) where modern silvoarable technology is unknown will set up silvoarable plots as a social experiment. This will help identify practical and juridical obstacles when preparing the Policy Guideline document. This task will be launched from the beginning of the SAFE programme (month 6).

Deliverables

D9.1. European land status for the agroforestry plot proposal
D9.2. Publication of 'Agroforestry Policy Options' document to guide the EU DGVI, Member States and Autonomous Regions on the environmental and economic impact of agroforestry systems and the effect that agricultural policy changes has on these.
D9.3. Distribution of CD-ROM with biophysical model, manual, tutorial, environmental databases, economic databases, and the bio-economic model

Milestones and expected results

M9.1. Set up of social experiments (silvoarable plots) in countries where the technology is unknown (month 12)
M9.2. Collation of existing national and sub-national agroforestry policies and attitudes (month 24)
M9.3. Specifications of 'Agroforestry Policy Scenarios' software and structure published (month 36)
M9.4. Agroforestry Policy Options report and 'Agroforestry Policy Scenarios' software distributed in paper, CD-ROM and web format (month 42)

Work-package 10	**Project management, dissemination and exploitation**
Start and completion month	1-42
WP leader	**C. Dupraz (INRA)**
Total Person-months	20.4; see Table 4 for details

Objectives

The SAFE dissemination plan will include : a close co-operation with national policy makers at the government level; the organisation of dissemination forums in all the participating countries at the end of the contract; the release of materials for silvoarable technology awareness targeted at policy makers.

The SAFE management aims at complying with the strict timetable as indicated in the Gantt diagram, with an emphasis on the organisation of the consortium meetings and the production of the status reports, the progress reports and the final report.

A key control implement of the SAFE project will be the contracting of a full-time computer scientist who will be in charge of the model development (code writing, compatibility of sub-models) of the SAFE models, in close co-operation with all the contractors, under the responsibility of the project co-ordinator.

Tasks and methodology

T10.1. Organisation of the consortium workshops.

T10.2. Production of biennial progress reports and the final report.

T10.3. Co-ordination of the dissemination activities including updating the rolling document for dissemination plans/reports. The rolling document includes copies of all publications produced within the project as well as a summary of all activities.

T10.4. Co-ordination of exploitation activities including updating the rolling document for exploitation plans/reports and the production of the Video on European agroforestry.

Deliverables

D10.1. Intermediate progress reports to the EU every 6 month

D10.2. Annual reports to the EU. (compiled by the Project Co-ordinator with the help of work-package leaders) and based on the rolling plans/reports. It includes summaries of all deliverables and reports for the respective milestones.

D10.3. Final report to the EU

D10.4. Video film on European agroforestry

D10.5. Prototype of user-friendly SAFE model (software, manual)

Milestones and expected results

M10.1.Achievement of the consortium meeting timetable as planned (month 6, 12, 24, 36, 42)

M10.2.Delivery of reports as planned (month 6, 12, 18, 24, 30, 36, 42)

M10.3.End user workshops at month 2, 20 and 40.

M10.4.End-users conferences in the seven participating countries at month 40-42.

3. Role of participants

The SAFE consortium consists of 10 contractors and 8 sub-contractors from 8 European countries and manages experimental sites in 5 European countries (Table 8); 6 are USER partners (from France, Germany, Greece, Netherlands and Spain) and 12 are research SUPPLIER partners (from France, Indonesia, Italy, the Netherlands, Switzerland, Spain and the UK). In this section the role of each partner in the project is described highlighting their contributions to the different WPs.

Table 8. List of SAFE partners with areas of proficiency (N°: Partner Number, U/S: User/Supplier)

				Expertise / Contribution			
Country – Institute – Town		**N°**	**U/S**	**Silvoarable experiments**	**Agroforestry modelling: biophysical**	**Agroforestry modelling: Economic**	**Agroforestry Policy**
France, F							
INRA		1	S				
System	Montpellier			✔	✔		✔
Amap	Montpellier				✔		
Piaf	Ct-Ferrand				✔		
Uafp	Toulouse			✔			
Apc	Antilles			✔	✔		
APCA	Paris	9	U			✔	✔
CHAV	Paris	SC3	U			✔	✔
Netherlands, NL							
WU	Wageningen	2	S		✔		
GPG	Arnhem	SC4	U				✔
United Kingdom, UK							
NERC		3	S				
CEH	Edinburgh				✔	✔	✔
CEH	Wallingford				✔	✔	
UNIVLEEDS	Leeds	4	S	✔			
CRAN	Silsoe	5	S	✔		✔	
BEAM	Bangor	SC5				✔	
Italy, I							
CNR	Porano	6	S	✔	✔	✔	✔
Spain, E							
UEX	Plasencia	7	U	✔	✔		✔
LOURI	Lourizan	SC6		✔			✔
FONDO	Plasencia	SC7		✔			✔
Greece, GR							
AUTH	Thessaloniki	10		✔			✔
ASKIO	Askio	SC8	U	✔			✔
Germany, D							
FINIS	Baek Prignitz	SC2	U	✔			✔
Switzerland, CH							
FAL	Zürich	8	S			✔	✔
Indonesia, IN							
ICRAF	Bogor	SC1	S		✔	✔	

The responsibility for Deliverables was included in Table 6, and was not repeated in this section.

3.1. Partner 1: Institut National de la Recherche Agronomique (INRA, France)

In addition to co-ordination, INRA will involve 5 Research units : **SYSTEM** and **AMAP** (Montpellier), **PIAF** (Clermont-Ferrand), **UAFP** (Toulouse) and **APC** (Guadeloupe, West Indies). INRA will sub-contract to **ICRAF** (Bogor, Indonesia) some methodological aspects of agroforestry modelling.

✉

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SYSTEM, Systèmes de Culture Méditerranéens et Tropicaux, 2 Pl. Viala, 34060 Montpellier Cdx 1, France

PIAF, Physiologie Intégrée de l'Arbre, 234, av. du Brezet, 63039 Clermont-Ferrand Cedex 2, France

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Contribution to Work Packages (WPs)

WP1. Silvoarable modelling strategies (14,9 person-months)

INRA will lead this work package. A computer scientist appointed by the programme will lead the evaluation phase of available modelling resources. He/she will be responsible for the final choice of a common modelling platform for the whole project, and will design and master the SAFE Web site.

WP2. European silvoarable knowledge (2,0 person-months)

INRA will provide accumulated data from French current silvoarable practices. These data will be compiled and made available to the consortium. INRA has also located some pioneer farmers who have been involved in silvoarable practices during the last 30 years. These sites will provide a unique opportunity to validate models with data from mature intercropped stands.

WP3. Silvoarable experimental network (19,6 person-months)

INRA (SYSTEM and UAFP) manages a comprehensive silvoarable field trial network established in 3 French regions: South-east experiments (SYSTEM) comprise about 200 ha of silvoarable agroforestry. South-west experiments (UAFP) in the Midi-Pyrénées area include the Lézat site in Ariège with *Sorbus domestica* and *Alnus cordata* trees and summer intercrops (soybean), and the Grazac site in Tarn with *Prunus avium* and hybrid *Juglans* trees intercropped with leguminous and graminaceous crops. Centre-west site: Les Eduts (Charente) features silvoarable commercial plots aged 25 years in 2000 with mature trees and continuous cereal intercrops. They were established by a pioneer farmer, and will be used as a validation site for models developed by the consortium.

INRA will be responsible for monitoring the sites in accordance with the recommendations issued by WP1 during the first workshop. The time-series of data recorded on these sites will be made available to the consortium.

WP4. Above-ground interactions (58,0 person-months)

INRA is leading this work package and will provide expertise in three complementary directions with respect to complexity and time steps:

1.Referenced detailed simulation “mock-ups” of trees (AMAP)

Detailed mock-ups of the 4 most important tree species for SAFE will be provided, based on measurements in experimental plots. These mock-ups will be used as reference descriptors of use of space by trees, and will be used to test the validity of simplified models described below. The architectural models of *Prunus avium* and of *Populus sp*. can be calibrated relatively simply according to measurements on the experimental plots studied within this project. Some extra work will be necessary for *Acer pseudoplatanus* and for *Juglans nigra* x *regia*. In addition, the architecture of *Sorbus domestica* will be studied to include this valuable species in silvoarable schemes in Europe. Plant mock-ups will provide "virtual experiments" to calibrate the light interception modules. The different plot variables will be simulated, stochastic variability will be introduced, and the parameters of the light interception modules will be calculated on the numeric mock-ups. Detailed mock-ups will be compared to simpler, less time-consuming and memory-requiring, "degraded" mock-ups. A relatively small amount of field validation will be necessary.

2.Elaboration of simplified tree-crop models running with daily steps.

The above-ground space occupied by trees and crops will be characterised in the 4 core experiments of the SAFE programme (Restinclières in France, Leeds in England, Porano in Italy, Plasencia in Spain), using fisheye photography to measure the dynamics of crown volume and leaf area density for trees and leaf area index for crops (AMAP, PIAF). Appropriate models for describing, analysing and predicting light and transpiration partitioning between trees and crops at the day step will be selected and adapted to the SAFE philosophy (APC, PIAF). AMAP mock-ups will be used as the reference model to control the value of simplified models. Rain water interception and redistribution by the tree canopy will be included in the model if found relevant (APC). Dry matter accumulation will be included in the model taking into account plant status and regulation by water stress and availability of nitrogen (APC, PIAF, SYSTEM).

3.Dynamic models of tree growth with annual steps

Such models are required to predict the outcome of mature silvoarable stands, in particular with regard to the crop productivity. AMAP and UAFP will select and improve a model for tree development, with an emphasis on canopy extension. Given the state of the art, the model will be based on empirical relationships established from canopy measurements on older stands (WP2). Models of resource acquisition and use developed in WP6 will influence interactively the accumulated yearly growth of the trees.

WP5. Below-ground interactions (48,0 person-months)

INRA has a valuable expertise in characterising water competition in the field (SYSTEM) and in modelling root competition between species at various intervals of time and space (APC). This was achieved mainly with fixed root maps. The scientific challenge of WP5 in SAFE is to obtain a model running with a daily step. This model should provide quality data of tree-crop competition for below-ground resources and will be designed in close co-operation with NERC and sub-contractor ICRAF. Most of the effort will be concentrated on water competition, as nitrogen is usually non-limiting in fertilised silvoarable systems. Specific experiments using stable isotopes (^{15}N, ^{18}O) will be designed to characterise the rooting system of both intercropped and non-intercropped trees, including mycorhizal links between trees and crops. This effect will be included in the model and may be a key point for prediction of silvoarable productivity in the long term.

WP6. Biophysical integrated plot modelling (32,5 person-months)

To ensure a satisfying linkage of above- and below-ground models, INRA (APC, PIAF, SYSTEM) will work with WU on the design of the framework for data exchange between the above- and below-ground sub-models with daily and annual steps. INRA (SYSTEM, UAFP) will run the integrated model using appropriate time-series of data provided by their experiments. INRA (SYSTEM, UAFP) will parameterise the model for the tree and crop mixtures available in their experiments. INRA will also conduct specific site experiments to validate the integrated modelling during the third year of the SAFE project. INRA will finally produce time-series of predicted outcomes from silvoarable plots in their experimental areas, and will compute Land-Equivalent Ratios (LER) of silvoarable plots as a measure of their biophysical effectiveness.

WP9. European guidelines for policy implementation (5,0 person months)

INRA (SYSTEM) is involved in a French Governmental commission that suggested some guidelines for legal aspects of silvoarable agroforestry in France. INRA will provide the outcomes of this previous activity to the consortium teams involved in the policy aspects.

Role of sub-contractor 1 to INRA: International Centre for Research in Agroforestry (ICRAF)

✉ ICRAF-S.E.Asia, P.O.Box 161, Bogor 16001, Indonesia

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ICRAF will bring his world-leading experience on state-of-the-art modelling of agroforestry systems. ICRAF will provide conceptual assistance in the SAFE modelling activity (WP1) by participating in the inception meeting (month 6, Wageningen) and the yearly workshops (month 14, Montpellier; month 26, Leeds; month 32, Berlin). ICRAF will chair the methodological modelling sessions and bring its expertise to achieve a consensus between the participants on modelling issues.

ICRAF will share the experience in developing the WaNulCAS model and its linkage to databases for soil, crop and tree parameters to the SAFE partners. ICRAF will make the WaNulCAS software available for test runs (WP4 and 5) to validate the SAFE model. ICRAF will make specific adjustments to the WaNuLCAS model as deemed relevant by the SAFE partners (WP6), and especially for the below-ground compartments. ICRAF will be involved in model modules design, coding and parameterisation, as agreed in the start-up meeting. ICRAF will parameterise tree species and their shoot/root ratios on the basis of fractal branching descriptions, providing the methodology (first project meeting), supporting the application and helping to troubleshooting if and where needed. ICRAF will provide simple ways of accounting for labour and money flows in the SAFE economic model (WP7). ICRAF will prepare simulations with the WaNuLCAS model for specific SAFE project sites and experiments, for comparison with new models to be developed in the SAFE project.

The ICRAF deliverables are :

- Up to date WaNulCAS modelling experience report (month 6) to be delivered at the inception workshop, including a method to describe competition for belowground (water, nitrogen and phosphorus) resources in a quantitative way for use in the models that will be used/developed in the SAFE project. .

- Guidelines for integration of biophysical and economic data (month 16)

- Modules for implementation in the SAFE model as agreed at the inception workshop : probably a below-ground Water and Nitrogen uptake module (month 24)

- Simulations of 3 SAFE experimental sites, to be used as comparison for the SAFE model (month 32).

Role of sub-contractor 2 to INRA: Forestry Consultancy Agency CHAVET,

✉ 61, Av. de la Grande Armée, 75782 PARIS Cedex 16, France

Scientific team : Principal investigators

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The CHAVET consultants will provide a land-owners' point of view on the economics of silvoarable agroforestry.

Contribution to Work Packages

WP1. Silvoarable modelling strategies (1 person-month)

CHAV will take care that the modelling strategy adopted will enable the provision of relevant data to French foresters end-users.

WP7. Economic modelling at the plot scale (15 person-months)

Silvoarable plots combine non-independent short and long term outputs. A literature analysis of the optimisation of such dual systems will be completed. The impact of technical actions on the long term fate of the system will be studied with a view to assess the impact of early years management on long term profitability of the system. Qualitative and quantitative models will then be elaborated.

WP8. Scaling-up to the farm and region (4 person-months)

Upscaling plot results to the farm level imposes to take into consideration the farmer point of view, including incomes and wealth. Trees in silvoarable systems are assets while the crops provide annual cash. A quantitative model linking the annual cash revenue and the increasing asset value of the tree stand will be elaborated, in the context of a non-perfect financial market. Inheritance taxation policies may affect largely the asset value of tree stands and will be brought into the analyse. The model will allow the comparison of the integrated silvoarable system as compared to the usual separation of forest and farmland, on a same area basis.

WP9. European guidelines for policy implementation (4 person-months)

When developing European guidelines for implementation it is of primary importance to provide sound technical standards to potential users. In silvoarable agroforestry, such standards include basic decisions such as the distance between the rows of trees or the distance between the trees in a row. The quantitative model to develop in WP8 will allow us to compare different options in silvoarable plot design, with a view to maximise a farmer utility function. It will use data issued from WP6 for describing the relationship between tree density and crop productivity over time. This analyse will further include some uncertainty on 2 key unknown long-term parameters: the ratio between crop and timber prices and the final timber production of the trees. These sensitivity analyses will allow to quantify the risk associated to silvoarable technology, which could be a determinant factor for grant policies.

Deliverables :

- Progress report pointing out the economic criteria for the final model and the model time and space resolution fitting end-user needs (Month 5).
- Qualitative and quantitative elements for the silvoarable economic module (Month 12)
- Literature analysis of dual systems with short and long term outputs optimisation (Month 20)
- Scientific paper including literature analysis and simulation results (Month 40)
- Report on the economic analysis at the farm/regional scale (Month 34)
- Report on economic results including risk and sensibility analysis (Month 38)

Role of sub-contractor 3 to INRA: Centre de Transfert de Lavalette (CTL)

✉ Centre de Transfert, Domaine de La Valette, 1037, Rue Jean-François BRETON, 34090 Montpellier

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CTL will provide field assistance in the monitoring of the Restinclières silvoarable experiment which is the most important silvoarable site of the SAFE consortium. A contracted technician will be available (12 person-months) during the second and third year of the project to manage the additional experiments required by the modelling partners on the site.

The CTL deliverables are :

- Field reports on the Restinclières experimental farm for the second and third year of the project, including data on crop yields and tree growth in the different tree-crop systems (months 18 an 30)
- Special reports on focussed validation experiments of the SAFE model dealing with the water budget of silvoarable systems, based on the walnut-wheat plot (months 36).

3.2. Partner 2: Wageningen University (WU, The Netherlands)

Institute Wageningen University, 6700 AK Wageningen, PO Box 430 The Netherlands
Departments Plant Sciences, Group Crop and Weed Ecology (**CWE**)
Agrotechnology and Food Sciences, Systems and Control Group (**SCG**)

Scientific team : Principal investigators

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Contribution to Work Packages

WU will contribute to the integration of below-ground and above-ground sub-models into one biophysical silvoarable model at plot scale and the improvement of the biophysical and bio-economic models' accuracy. WU will collaborate with Dutch and German user partners GPG and FINIS in WP2.

WP1. Silvoarable modelling strategies (3.0 person months)

CWE will contribute the following modelling expertise to the initial workshop: a) competition models developed at CWE, b) models describing uptake and distribution of water and nutrients resources, c) simulation modelling at different temporal and spatial levels, d) quantitative analysis of agro-ecosystems at higher integration levels. SCG will contribute their expertise on techniques for the evaluation and improvement of model accuracy (uncertainty modelling).

WP2. Silvoarable knowledge (6.0 person month)

The team will provide information on history and policy aspects of agroforestry in the Netherlands and in Germany in co-operation with User partners GPG and FINIS.

WP4. Above-ground interactions (4.0 person month)

CWE has developed the competition modelling framework INTERCOM (simulation models for crop-weed INTERspecific COMpetition) and RECAFS (Model for REsource Competition and cycling in AgroForestry Systems). These models and specific functions will be tested for their applicability in description of aboveground tree-crop interactions in collaboration with NERC and INRA.

WP5. Below-ground interactions (4.0person month)

CWE provides two models for the description of below-ground interactions. INTERCOM displays simple routines for competition for water and nutrients among crop species. A more mechanistic 2D-description of water competition between trees and crops (WIMISA) will be used to validate the SAFE model.

WP6. Biophysical integrated plot modelling (47.0 person months)

WU is leading this WP. For the integration of the above- and below-ground interaction models the linkages and feedback between components will be considered. The identification of weak and uncertain process descriptions of the SAFE model will be achieved using uncertainty analysis (sensitivity functions, Monte Carlo simulations). NERC will contribute with their expertise on the use of Bayesian Belief Networks. The model will be validated for the range of soils, climates and management regimes represented by available target experiments in collaboration with INRA.

WP7. Economic modelling at the plot scale (9.0 person-months)

The Systems and Control Group will apply uncertainty analysis (sensitivity functions, Monte Carlo simulations) for identifying and improving weak and uncertain process descriptions of the bio-economic model.

WP9. European guidelines for policy implementation (3.0 person-month)

In Co-operation with GPG and FINIS, WU will synthesise and evaluate the relevant data and information form Germany and the Netherlands, needed for the development of European agroforestry guidelines.

Role of sub-contractor 1 to WU: Gelders Particulier Grondbezit (GPG, The Netherlands)

Institution : Gelders Particulier Grondbezit, Hommelseweg 490, 6821 LX Arnhem, The Netherlands

Scientific team : Principal investigators

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GPG is a private landowner association, including farmers and foresters which has 450 members and owns about 45 000 ha land. The association represents the interests of landowners to public authorities. A major aim of GPG is to promote land-use systems and management practices that combine sustainable agriculture with a high ecological, cultural and landscape value. GPG will provide a landowners' point of view (including that of farmers and foresters) on the economics of silvoarable agroforestry.

Contribution to Work Packages and Deliverables

GPG will provide economic data and will carry out a survey about Dutch farmers', foresters', and landowners awareness of agroforestry. Work package number and deliverables are given between brackets .

1) GPG will take care that the modelling strategy adopted will enable the provision of relevant data to Dutch farmer and forester end-users (WP1: D1.2).

2) GPG will provide their experience with respect to traditional and novel agroforestry systems and policy for the Netherlands (WP2)

3) GPG will provide economic data (inputs, outputs, costs, revenues and labour requirements) of silvoarable systems in the Netherlands (WP7: D7.2). The data will be used by modellers to develop the financial model.

4) GPG will carry out a survey of farmers', foresters', and landowners' awareness of agroforestry and will investigate the financial and non-financial constraints and benefits of agroforestry and its likely uptake in the Netherlands (WP8: D8.3).

5) GPG will organise the set up of a silvoarable plot as a social experiment, to assess the reactions of Dutch farmers, foresters and policy makers and to provide information on practical and policy problems of implementing such a novel system. From the silvoarable plot as a social experiment, GPG will provide information on conflicting rules between forestry and agriculture policy (WP8: D8.3 and WP9: D9.1).

6) GPG will contribute to the design of a common framework for the implementation of a European Agroforestry scheme in co-operation with the others partners. The experience from the silvoarable plot social experiment as well as the knowledge gained from point 3 and 4 will be used (WP9: D9.2).

Role of sub-contractor 2 to WU: Freies Institut für Interdisziplinäre Studien e.V. (**FINIS**, Germany)

Scientific team : Principal investigators

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FINIS will provide economic data and background information on history and policy aspects of agroforestry in Germany. FINIS work and deliverables are therefore similar to GPGs' in The Netherlands. Its contribution to work package numbers and deliverables is given between brackets.

1) FINIS will take care that the modelling strategy adopted will enable the provision of relevant data to German farmer and forester end-users (WP1: D1.2).

2) FINIS will provide information on history and policy aspects of agroforestry in Germany. The "Streuobst System" in Badenwürtemberg and the "Hauberg Wald System" in Siegerland will be documented. (WP2: D2.1)

3) FINIS will provide economic data (inputs, outputs, costs, revenues and labour requirements) of silvoarable systems in Germany (WP7: D7.2). The data will be used by modellers to develop the financial model.

4) FINIS will provide information on conflicting rules between forestry and agriculture policy in Germany from literature and from a social experiment (see point 5) (WP7: D7.4 and WP8: D8.3).

5) FINIS will organise the set up of a silvoarable plot as a social experiment, to assess the reactions of German farmers, foresters and policy makers and to provide information on practical and policy problems of implementing such a novel system (WP8: D8.3 and WP9: D9.1).

6) FINIS will contribute to the design of a common framework for the implementation of a European Agroforestry scheme in co-operation with the others partners. The experience from the silvoarable plot social experiment as well as the knowledge gained from point 2, 3 and 4 will be used (WP9: D9.2).

3.3. Partner 3: Natural Environment Research Council (NERC, UK)

Institutes involved: Centre for Ecology and Hydrology (CEH)

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CEH-Edinburgh, Edinburgh Research Station, Midlothian EH26 0QB, UK

Scientific team : Principal Investigators

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The **Centre for Ecology and Hydrology** (CEH) is a component research centre of the UK Natural Environment Research Council (NERC). It comprises four institutes, of which two are participating in this proposal (**CEH-Wallingford** and **CEH-Edinburgh**).

Contributions to Work Packages

NERC has a considerable experience in both tropical and temperate agroforestry systems, and will contribute mostly to WP5, WP6, WP8 and WP9. It will have a leading role in the below-ground modelling (Wallingford, WP5) and in the design of European policy guidelines (Edinburgh, WP9).

WP1. Silvoarable modelling strategies (2.0 person-months)

NERC will review modelling strategies, contributing their experience of agroforestry modelling and modular modelling approaches to the development of the common modelling platform.

WP3. Silvoarable experimental network (2.0 person-months)

Preparation of look-up tables of parameters and time series of data will be undertaken in collaboration with INRA, UNIVLEEDS, CRAN, CNR and UEX. This activity will involve identifying data sources and collating databases which will enable users who wish to use the model but lack specific input parameters to choose appropriate values on the basis of more commonly available information.

WP4. Above-ground interactions (2.0 person-months)

Development of a model of microclimate modification by trees in cropped fields within the modular framework adopted in WP1. The approach used will be based on the surface energy balance, which has been successfully applied in the past to sparse crops, savannah and tree-crop mixtures. Where required, algorithms for generating daily climates from European databases of weather records will be collated for use in running simulations.

WP5. Below-ground interactions (6.0 person-months)

NERC (Wallingford) is leading this work package. NERC will develop a model of the water balance of tree-crop mixtures within the modular framework adopted in WP1. This will incorporate simulation of above-ground components (i.e. canopy rainfall interception, runoff and soil evaporation) which affect below-ground components (soil water re-distribution, drainage and water uptake by mixed tree and crop root systems for transpiration). Additionally, NERC will collaborate with UNIVLEEDS, CRAN, INRA, UEX and CNR in collecting data from field experiments for parameterisation and testing, concentrating on water budget components and of partitioning of soil water uptake between tree and crop root systems.

WP6. Biophysical integrated plot modelling (2.0 person-months)

NERC will adapt the models designed in WP4 and 5 to enable integration of them into the unified biophysical model, using appropriate feedback controls and linkages. NERC will contribute to the uncertainty analysis of WU with its expertise in Bayesian Belief Networks.

WP8. Scaling-up to the farm and the region (6.0 person-months)

The bio-economic model will be coupled to a GIS system and test runs for the assessment of the profitability of silvoarable systems and current land use will be made for farms in selected regions.

WP9. European guidelines for policy implementation (10.0 person-months)

NERC (Edinburgh) is leading this work package. The tasks include: a synthesis of national and sub-national land valuation and taxation attitudes to agroforestry as it compares to farm woodland or conventional agriculture; the publication of an 'Agroforestry Policy Options' report to guide the EU DGVI, Member States and Autonomous Regions on the environmental and economic effect of agroforestry systems and the effect that agricultural policy changes have on these; the distribution of CD-ROM (and web-site) with biophysical model, manual, tutorial, environmental databases, economic databases, bio-economic model together forming the 'Agroforestry Policy Evaluation Program' (a user-friendly GIS-based policy testing model for politicians).

3.4. Partner 4: University of Leeds (UNIVLEEDS, UK)

Institute**University of Leeds, UK, Woodhouse Lane, Leeds LS2 9JT**

Department: School of Biology, Ecology and Evolution Group (Agroforestry Research Group)

Scientific team : Principal Investigators

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Contribution to Workpackages

UNIVLEEDS will contribute mainly through its ownership and stewardship of an extant silvoarable agroforestry experiment (7 years old) and its ownership of data from this and an abandoned experiment (10 years old) with a major involvement in WP3 including leading it, and minor contributions to WP1 and 2.

<u>WP1. Silvoarable modelling strategies (2.0 person-month)</u>

Assist in assigning data formatting instructions to WP4 and WP5 to ensure compatibility. Assist in defining time and space resolution of the models to achieve the integration of all relevant biophysical aspects.

Assist in defining silvoarable constraint criteria for evaluation of field experiments and practices.

<u>WP2. European silvoarable knowledge (5.0 person-months)</u>

Collate data from previous long-term UK silvoarable experiments, including experiments closed prematurely (due to the difficulty of maintaining long-term experiments). Synthesise data on the biological productivity, and where possible, the soil and climatic conditions pertaining at these sites, as required by the WP1 guidelines.

<u>WP3. Silvoarable experiment work (22.6 person-months)</u>

UNIVLEEDS will lead this work package and collect data from existing experiments across Europe as required by the modelling activity. The experiments at Leeds include one of clonal poplars intercropped with winter cereals. The data from a former experiment of hardwood species (wild cherry, ash, sycamore) intercropped with winter cereals will also be available to the SAFE consortium. The data will consist of three types: a) biophysical data to simulate above- and below-ground tree-crop interactions; b) data on the productivity of trees and crops (stem growth, yields) and c) management data for economic modelling. The management can be broken down into three management areas - arable crop, trees and tree row under-storey. Important aspects to study are labour costs and consumable costs under various design and management practices. UNIVLEEDS team will assist NERC in the preparation of Look-up tables of parameters and time series of data (Web site).

At existing experimental sites collate specific information needed to parameterise the biophysical model. Special attention is given to seven additional aspects: effect on solar radiation and wind velocity, determination of water sources using stable isotopes of H and O; determination of tree transpiration using sap flow in tree roots and trunks; evaluation of tree leaf area for transpiration and shade; description of root architecture by root excavation or root coring; assessment of nutrient extraction with isotopic tracers; effect of management practices on competition such as sound crop timing, crop choice, root pruning of trees.

UNIVLEEDS will collect data for model validation in a dynamic interaction with modellers.

3.5. Partner 5: Cranfield University (CRAN, UK)

Institute **Cranfield University, Silsoe, Bedfordshire, UK, MK45 4DT,**

Group: Institute of Water and Environment

Scientific team : Principal Investigators

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CRAN will sub-contract to **BEAM (Bio-Economic Agroforestry Modelling)** of the University of Wales some methodological aspects of the economics of plot and farm scale agroforestry.

Contribution to Workpackages

WP1. Silvoarable modelling strategies (0.9person-month)

Assist in the identification of appropriate models and sub-models and the development of a modular modelling framework, in particular with respect to bio-economic models.

WP2. European silvoarable knowledge (1.0 person-month)

Assist UNIVLEEDS and NERC in the collation of data from silvoarable experiments in the UK.

WP3. Silvoarable experimental network (14.0 person-months)

CRAN manages a silvoarable experiment of clonal poplars intercropped with autumn-sown arable crops from which it will collect specific information to parameterise the biophysical model. The data may consist of three types: a) biophysical data to simulate above- and below-ground tree-crop interactions; b) data on the productivity of trees and crops (stem growth, yields) and c) management data for economic modelling. CRAN will assist NERC in the preparation of Look-up tables of parameters and time series of data.

WP7. Economic modelling at the plot scale (34.0. person-months)

CRAN is the leader of WP7, but it will draw on the expertise of the University of Wales as a sub-contracted consultant. CRAN will lead a review of existing financial models of agroforestry, cropping and farm woodland systems in co-operation with CHAV. As a result of this review, CRAN will lead the selection and development of an economic model and templates which can be linked with the biophysical model described in WP6. These templates will be used to identify and quantify inputs, outputs, costs and revenues for the silvoarable network systems, and existing arable and forestry enterprises for different parts of Europe. This will enable CRAN to lead the use of the model to identify the most profitable agroforestry systems (e.g.: tree species; tree spacing) for the network sites, and their sensitivity to changes in prices and grants. Lastly CRAN will lead the use of the model to determine the optimum silvoarable system for other selected high-potential locations in Europe in co-operation with CHAV, APCA, UEX and GPG.

WP8. Scaling up to the farm and regional scale (6.0 person months)

For the UK, CRAN will investigate the financial and non-financial constraints on sample farmers' agroforestry awareness, and the likely uptake of agroforestry given yields and revenue streams predicted from the yield model. CRAN will also work in collaboration with NERC to undertake a pilot exercise to link the farm scale model with a Geographical Information System incorporating ‘Countryside survey 2000’.

Role of sub-contractor 1 to CRAN: BEAM

Institution : University of Wales, Bioeconomic Agroforestry Modelling (BEAM)

University of Wales, Bangor, College Road, LL57 2DG, Bangor, UK

Scientific team : Principal investigator

Name	Tel	Fax	E-mail
Mr Terry Thomas	44 (0)1248 382287	44-(0)1525-863344	T.H.Thomas@bangor.ac.uk

Activity of BEAM sub-contractor (3 person-months)

The BEAM Project at University of Wales, Bangor specialises in the development of bio-economic simulation models of land use systems throughout the world. In this particular case interest is focussed on the development of a farm level model of a silvoarable system in a European setting. The model will have a capacity to indicate the relative profitability of agroforestry compared with existing farm enterprises. It will also have a capacity to simulate and evaluate the economic and logistical impact on farm resources and organisation of the proposed technology at a farm level. BEAM will be working as a subcontractor to Cranfield University, advising on the design of the model and format of technical and financial data required to create it. It will take part in task meetings and make freely available existing forms of project software to task partners in general and Cranfield in particular.

Deliverables expected:

Guidelines for formatting technical and financial data (month 12)

Draft version of the farm level model for further calibration and validation (month 18)

Simulation with the farm model on 3 farm systems from 3 participating countries as selected by WP8 (month 30)

3.6. Partner 6: Istituto per l'Agroselvicoltura (CNR, Italy)

Institute: Consiglio Nazionale delle Ricerche; Istituto per l'Agroselvicoltura; Viale G.Marconi, 2; I-05010 Porano (TR), Italy

Scientific team : Principal Investigators

Name	Tel	Fax	E-mail
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Dr. Francesco Cannata	+(39) 0763-374674	+(39) 0763-374330	F.Cannata@ias.tr.cnr.it
Dr Guido Bongi	+(39) 075/5054271	+(39) 075/5000286	G.Bongi@iro.pg.cnr.it

Contribution to work packages

WP1. Silvoarable Modelling Strategies (1.0 person-month)

CNR will collaborate in identifying appropriate models and modules of silvoarable systems.

WP2. European Silvoarable knowledge (13.0 person-months)

CNR is leading this work package. CNR will collate data gained in earlier studies from both traditional silvoarable practices and previous silvoarable experiments in Italy. CNR will collect and synthesise all information provided by the other partners.

WP3. Silvoarable experimental network (31.0 person-months)

CNR will collect biophysical and economic data from the Institute's silvoarable experiment in Central Italy. CNR will assist NERC in the preparation of look-up tables of parameters and time series of data. Special attention will be given to following aspects: sample collection for determination of water sources (by stable isotopes of H and O) and for assessment of nutrient extraction with isotopic tracers; effect of management practises on competition (crop timing, crop choice).

WP4. Above-ground interactions (10.0 person-months)

CNR will characterise the above-ground space occupied by trees and crops, in a CNR target experimental site in Italy as identified by WP3, with measurements of the dynamics of foliage distribution: crown volume and leaf area density for trees and leaf area index for crops. CNR will collaborate with INRA and NERC to improve or design a model for the effect of the tree-crop canopy on local microclimate and to improve or design a model for canopy tree development.

WP5. Below-ground interactions (11.0 person-months)

In a CNR experimental site (central Italy), CNR will set up experiments using methods for characterising tree and soil water flux (sap flow in roots and stems; soil water content monitoring; natural stable isotope tracing). This will aim to identify soil strata involved in water extraction by intercrops and trees.

WP8. Scaling-up to the farm and the region (6.0 person-months)

CNR will undertake semi-structured interviews on stakeholder and farmer agroforestry awareness and collect information about farmers' agroforestry awareness in collaboration with CRAN. CNR will investigate the financial and non-financial benefits and costs of implementing agroforestry with sample farmers, who currently grow arable or tree crops.

WP9. European guidelines for policy implementation (8.0 person-months)

CNR will collate national government policies on silvoarable agroforestry from Italy and synthesise information on this issue provided by the other partners in co-operation with APCA and NERC. CNR will scrutinise the national policies for bottle-necks on agroforestry (silvoarable and silvopastoral) implementation, and analyse if, where and how, national agricultural and forestry policies enable adoption of agroforestry.

3.7. Partner 7: School of Forestry, University of Extremadura (UEX, Spain)

Institute **University of Extremadura (UEX), 10600, Plasencia, Cáceres, Spain**

Scientific team : Principal Investigators

Name.	Tel	Fax	E-mail
Dr G. Moreno	34-27 - 427000	34-27 - 425209	gmoreno@bme.es
Dr F. J. Pulido	34-27 - 427000	34-27 - 425209	fpulido@unex.es
Dra. Mª P. Rubio	34-27 - 427000	34-27 - 425209	pilar@unex.es
D. A. García	34-27 - 427000	34-27 - 425209	garcia@inia.es

UEX will collaborate with the **Lourizán Forestry and Environmental Research Centre** in Pontevedra (Galicia) and three USER partners in the district of Cuatro Lugares: a private farmer, a local government and a foundation (Found 2001 Global Nature). All partners manage silvoarable oak stands (Dehesas).

Contribution to Workpackages

WP2. European silvoarable knowledge (6.0 person-month)

Data will be collected on previous silvoarable experiments in the Dehesa in semi-arid zones of Spain. Current silvoarable practices in the humid part of Spain will be documented.

WP3. Silvoarable experiment work (13.5 person-months)

UEX will monitor 3 on-farm field experiments: a conventional crop of oats and vetch in a Quercus ilex Dehesa, an ecological crop in the same condition, and a silvoarable scheme for regenerating ageing Dehesa oak stands, where a cereal crop between protected oak seedlings will be compared to more conventional regeneration schemes in grazed and ungrazed stands.

WP4. Above-ground interactions (3.5 person-months)

Same protocol as WP4 for CNR applied to UEX experiments.

WP5. Below-ground interactions (7.5 person-months)

The water budget of a tree-crop system will be monitored. Below-ground aspects of the water budget will include soil water re-distribution, drainage and water uptake by mixed tree and crop root systems. Nutrient and water extraction by trees and crops will be investigated with isotopic tracers in co-operation with CNR, INRA and NERC.

WP7. Economic modelling at the plot scale (3.0 person-months)

UEX will provide management costs for economic modelling following the guidelines provided by WP7, and will apply the SAFE economic model to Spanish conditions.

WP8. Scaling-up to the farm and the region (3.0 person-months)

UEX in co-operation with farmers representatives will survey farmers intention about the practice of intercropping in the Dehesa and the silvoarable strategy for Dehesa regeneration.

WP9. European guidelines for policy implementation (3.0 person-months)

UEX will collate national government policies on silvoarable agroforestry in Spain, and reflect on the European guidelines to ensure that they embrace the specific requirements of Mediterranean countries.

Role of sub-contractor 1 to UEX: LOURI (Lourizan Forestry and Environmental Research Centre)

Institution : Centro de Información y Tecnología Ambiental (CITA). Conselleria de Medio Ambiente. Xunta de Galicia

Carretera de Marín km 3'5, 36080, PONTEVEDRA, Spain

Scientific team : Principal investigators

Name	Tel	Fax	E-mail
F. Silva-Pando	34-986-856400	34-986-856420	silva@inia.es

LOURI will allocate 3.5 person-month to the project

LOURI will collect data about current silvoarable practices in the humid part of Spain (WP2).

LOURI will survey farmers intention about the practice of silvoarable agroforestry in the humid part of Spain, including the target to include silvoarable plots in a strategy against fire risks (WP 8). This will be an input to the elaboration of European guidelines on agroforestry (WP 9)

The following deliverables will be produced :

- Silvoarable practices in the humid part of spain report (month 12)
- Awareness and receptivity of farmers in the humid parts of Spain to silvoarable schemes (month 30)

Role of sub-contractor 2 to UEX: FGN (**FUNDACIÓN 2001 GLOBAL NATURE**)

Institution : 'CENTRO LE EDUCACIÓN AMBIENTAL "LA DEHESA"

Gabriel y Galán, 17, 10694, TORREJÓN EL RUBIO (CÁCERES), SPAIN

Scientific team : Principal investigator

Name	Tel	Fax	E-mail
J. M. Narciso Diaz	34 27 - 455178	34-27 - 455096	chema@agrieco.com

FGN will allocate 4 person-month to the project

FGN will put their silvoarable plots at the service of the SAFE project, providing technical and economic data on the management of their Dehesa farm, and allowing specific experiments as required by the UEX partner. FGN will collate background information on policy aspects of agroforestry in Spain, mainly on Dehesa (WP2 and 7).

FGN will survey farmers intention about the practice of intercropping in the Dehesa in the Extramadura Province, and organise an End-Users meeting (WP8).

FGN will provide the following deliverables to UEX :

- Historical monography of silvoarable practices on their farm, including technical and economic data (month 12)
- State of the art of policies about silvoarable aspects of Dehesa management (month 24)
- A review of farmers attitudes to silvoarable schemes in the Extremadura Province (month 36)

3.8. Partner 8: Eidgenössische Forschungsanstalt für Agrarökologie und Landbau (FAL, Switzerland)

Institute : Swiss Federal Research Station for Agroecology and Agriculture, Evaluation of Ecological Measures, Reckenholzstrasse 191, CH-8046 Zürich, SWITZERLAND

Scientific team : Principal investigators

Name	Tel	Fax	E-mail
Dr. Felix Herzog	41 1 377 71 11	41 1 377 72 01	Felix.Herzog@fal.admin.ch
Dr. Beatrice Schüpbach	41 1 377 71 11	41 1 377 72 01	Beatrice.Schuepbach@fal.admin.ch
Dr. David Dubois	41 1 377 71 11	41 1 377 72 01	David.Dubois@fal.admin.ch

Contribution to Work Packages

WP1. Silvoarable modelling strategies (2.0 person-month)

FAL will contribute to the conceptual phase of model design by including options required for scaling up in the modelling framework (namely possibilities of data aggregation).

WP2. European silvoarable knowledge (2.0 person-month)

FAL will make results from previous investigations on silvoarable systems available to the consortium (Articles from the 19^{th} / early 20^{th} century published in German).

WP6. Biophysical integrated plot modelling (1.0 person-month)

FAL will contribute to the definition of the major types of environmental conditions the biophysical model is to be tested for.

WP7. Economic modelling at the plot scale (2.0 person-month)

FAL will contribute to the concept of WP7, taking into account the selection of economic parameters relevant for scaling up to the farm / regional level.

WP8. Scaling-up to the farm and the region (48.0 person-months)

FAL will lead this work package. FAL will collate the spatial database (soil, climate, topography, land use) in GIS format, scaling up to the farm level for sample farms in agroforestry target regions. The biophysical and the economic models will be applied to the sample farms and scenario calculations will be performed to assess the economic feasibility of different farmer strategies. The database will be provided by partners in the target regions and the evaluation of the results will be done in close collaboration with them. At the European scale, a gross assessment of potential agroforestry conversion areas will be executed through a GIS-analysis based on digitally available geo-information, taking into account socio-economic and policy parameters and constraints. Maps will be produced which reflect the potential for specific silvo-arable techniques according to policy scenarios.

The financial and non-financial constraints on sample farmers and their objectives and constraints (resource endowments) will be investigated, based on information provided by partners in target areas (APCA, GPG, UEX). The likely uptake of agroforestry given yields and revenue streams predicted from the silvoarable model will be analysed. In the test regions, workshops will be conducted to discuss the feasibility of agroforestry with farmers, extension service workers and local executives. This task will be executed in close collaboration with WP2 and with the USER partners.

WP9. European guidelines for policy implementation (5.3 person-months)

The regional scenario testing resulting from WP8 will enter the policy analysis and recommendations elaborated in WP9. Interactive maps at the regional scale (examples) and at the European scale which visualise the result of different policy scenarios will be developed as a component of the ‚Agroforestry Policy Game' (Deliverable 9.3).

3.9. Partner 9: Assemblée Permanente des Chambres d'Agriculture (APCA, France)

Institution Assemblée Permanente des Chambres d'Agriculture, 9, Avenue Georges V
75008 PARIS, FRANCE

Department Politiques Territoriales et Stratégie Environnementale
(Land Management and Environmental Strategies)

Scientific team : Principal investigators

Name	Tel	Fax	E-mail
N. Lecorre-Gabens	33 1 53 57 11 43	33 1 53 57 10 05	nelly.lecorre-gabens@apca.chambagri.fr
F. Liagre	33 3 89 20 97 13	33 3 89 20 90 02	fabien.liagre@wanadoo.fr

N. Lecorre-Gabens is in charge of Forest and Water policies and management, and F. Liagre is specialised in Farm diversification and the inclusion of environmental aspects in farm activities through the new "Contrats Territoriaux d'exploitation" policy that is currently implemented in France. They are both under the supervision of elected farmers representatives.

Contribution to work packages

WP1. Silvoarable modelling strategies (1.0 person-month)

APCA will take care that the modelling strategy adopted will enable the provision of relevant data to farmers end-users.

WP7. Economic modelling at the plot scale (9.0 person-months)

APCA field officer will provide economic data on representative farms of targeted areas for silvoarable dissemination in 3 areas of France (5 farms per region). These data will be introduced in economic simulations using the economic SAFE model. Data from a fore-runner pilot farmers who established silvoarable plots 10 to 25 years ago will be documented in the Charente-Maritime Province.

WP8. Scaling-up to the farm and the region (14.0 person-months)

APCA will scale up predictions of plot outputs to a farm-scale using existing national farm survey information (ROSACE network) and adapted software as provided by the research participants (ARBUSTRA software). This will be applied to farms of three different target French areas including a totally non-forested intensive cereal-growing area in the Paris basin.

APCA will investigate the financial and non-financial constraints on agroforestry awareness of sample farmers, and the likely uptake of agroforestry. Three target areas will be identified in France, and a survey of farmers' attitude to silvoarable technology will be carried out with 30 farmers samples in each area.

WP9. European guidelines for policy implementation (8.4 person-months)

French forestry and agricultural policies will be scrutinised for bottlenecks on agroforestry implementation, and possible conflicting rules between forestry and agricultural policy. A status for silvoarable plots will be suggested. The juridical aspects will require a 5 months study.

APCA will contribute to the design of a common framework for the implementation of a European agroforestry scheme based on the data from the models. This will be done in co-operation with NERC (UK), CNR (Italy), FAL (Switzerland), ASKIO (Greece) and GPG (Netherlands). APCA will organise an end-user conference at the end of the project in France.

3.10. Partner 10: University of Thessaloniki (AUTH, Greece)

Institute : Aristotle University of Thessaloniki, Laboratory of Range Ecology, 54006, Thessaloniki, Greece

Scientific team : Principal investigator:

Name	Tel.	Fax	e-mail address
V. Papanastasis	+30 31 998933	+30 31 992721	vpapan@for.auth.gr

Many traditional silvoarable systems are still currently used by farmers in Northern Greece. AUTH will review the current practices, with the help of the municipality of ASKIO. Systems such as walnut-wheat, walnut-vineyard, oak-wheat, poplar-vegetables, almond-wheat or almond-vineyard systems will be documented. The municipality of ASKIO offers the unique opportunity to survey traditional silvoarable practices that have been discarded in most of Europe. This will allow collection of very useful data for validating the SAFE model, and will provide a good opportunity to assess the possibility of implementing new improved silvoarable systems.

Contributions to work packages:

AUTH will provide data for model validation as well as information about Greek and European policies applied in Greece, with regard to silvoarable systems. AUTH will take care that the modelling strategy adopted will enable the provision of relevant data to Greek farmer end-users.

WP1. Silvoarable modeling strategies (2.0 person-months)

AUTH will participate in the 2 starting meetings of the consortium where the strategies for model formation and implementation will be discussed.

WP2. European silvoarable knowledge (14.0 person-months)

AUTH will study Greek traditional silvoarable systems in order to collect technical and economic data about the productivity and viability of these systems. They will include structural data about intercropping systems in the area.

WP3. Silvoarable experimental network (7.8 person-months)

AUTH will design data collecting protocols from traditional silvoarable systems in its area, with the help from visiting partners from the SAFE consortium. The data will document both the productivity and the management of traditional silvoarable systems. The SAFE project will also provide the opportunity to introduce two new silvoarable demonstration plots in the area that will help to assess the uptake of improved silvoarable systems by farmers with an experience in traditional silvoarable management.

WP8. Upscaling to the farm and the region (4.0 person-months)

AUTH will survey farmers of its area to define the likely uptake of innovative silvoarable systems and the fate of traditional silvoarable systems. It will identify the technical and financial constraints faced by the farmers in running such systems.

WP9. Developing European guidelines for policy implementation (2.0 person-months)

Local, regional, national and European policies will be reviewed in relation to agroforestry. The information collected will be analysed and suggestions will be formulated in collaboration with other partners. The final document on agroforestry policy will be reviewed to address the issues of Mediterranean countries, and to promote the use of traditional silvoarable systems if these systems have proved to be of a productive or environmental value.

Role of sub-contractor 1 to AUTH: Municipality of ASKIO (Greece)

Department involved: Bureau of Planning and Development

✉ Municipality of Askion, Koinotiko katastima, 500 03 Eratyra, KOZANI, GREECE

Name	Tel.	Fax	e-mail address
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A. Batzios	+30 465 31203	+30 465 31203	askio@otenet.gr

The municipality of ASKIO will survey traditional silvoarable practices including walnut-wheat, walnut-vineyard, oak-wheat, poplar-vegetables, almond-wheat and almond-vineyard systems. The study will describe the management schemes, and quantify the area under agroforestry in the area.

The municipality of ASKIO will document biophysical and economic data on three representative silvoarable plots. These data will be made available to the SAFE consortium and will be used to validate the SAFE model.

The deliverables of ASKIO to AUTH will be:

- Traditional silvoarable practices report (month 18)
- Productivity and economic data on 3 target plots of silvoarable practices (month 24)

4. Project management and co-ordination

INRA will co-ordinate the project. Main co-ordination tasks are the co-ordination of the work-plan and the interaction with the EU. Co-ordination activities will include:

- Ensuring a SAFE team spirit among participants
- Organisation of joint planning/review meetings of the participants
- Co-ordination of measurements and modelling activities of the participants
- Follow up of the progress by yearly visits to all contractors
- Preparation and organisation of joint contract reports to the EU, e.g. status reports, progress reports and final report
- Management of dissemination and exploitation actions, including liaison with policy makers at the national and European level
- Distribution of financial support from the EU.

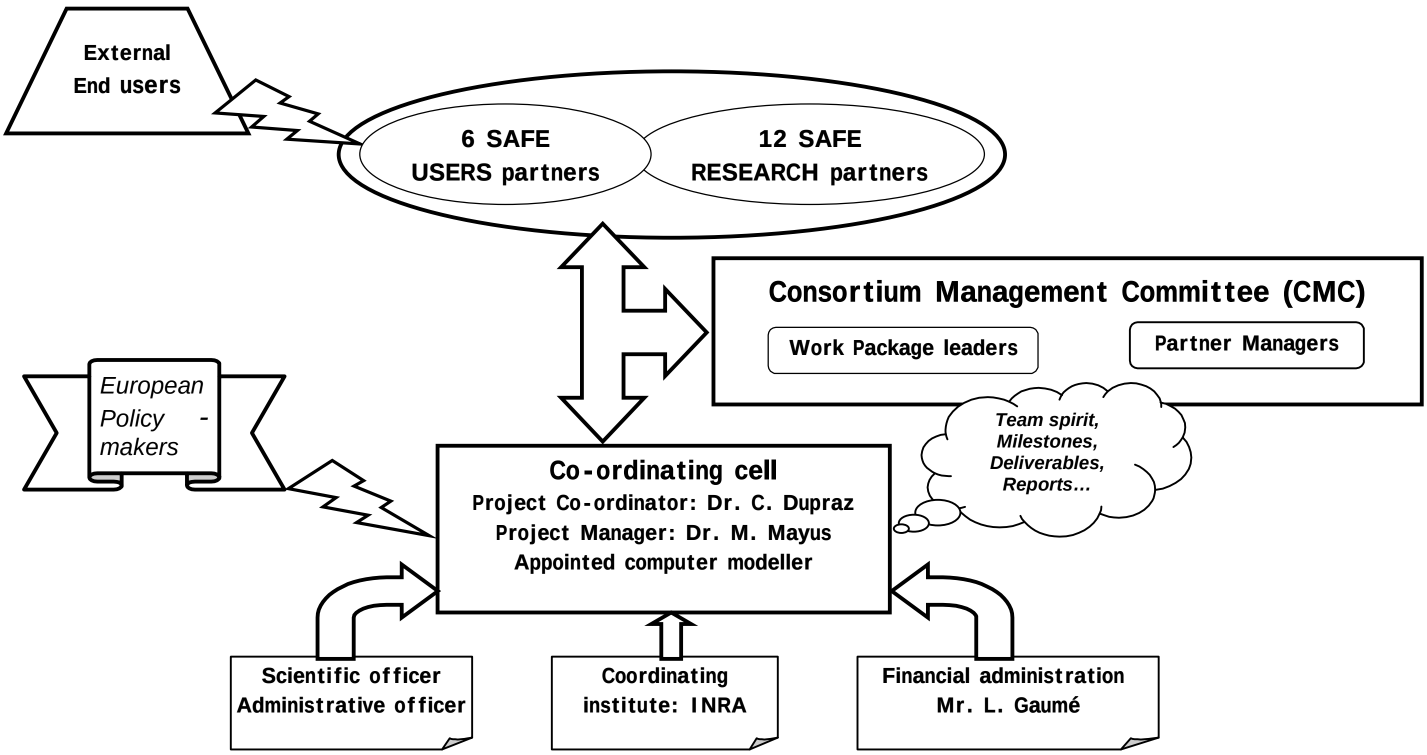

Figure 3 : SAFE consortium management structure.

Dr. Christian Dupraz will act as **Project Co-ordinator**, with financial administration being provided by the Montpellier Research Centre General Secretary of INRA, **Mr. L. Gaumé**. Mr. Gaumé will provide the administration of the financial support in liaison with INRA headquarters at Paris. Dr. Dupraz will concentrate on the scientific leadership of the project. He will be the formal contact point with the EU and with non-consortium third parties, e.g. end-users. He will be assisted by a **Project Manager**, **Dr. Martina Mayus** from Wageningen University. She will take care of the secretarial duties, the communication and organisation tasks, including the key task of soliciting and collating the financial reports and soliciting, collecting, collating and printing the scientific reports.

The consortium will have a Consortium Management Committee (CMC) chaired by the Project Co-ordinator (Figure 3). The CMC will comprise the managers of the 10 partner organisations and the leaders of the 10 work packages (WPs). For achieving management efficiency, one person will not be allowed to be both a partner manager and a work package leader. The partner managers will be in charge of planning, directing and monitoring the work and the allocation of resources at their site as agreed in the work-plan. Every three months the partner managers will provide the work package leaders (WPLs) and the Project Manager with information on the allocation and expenditure of human and financial resources at their site. The partner managers will be responsible for their subcontractors. The CMC will meet at least once every 6 months. The CMC has the overall responsibility for monitoring the work plan and the achievement of its milestones and objectives. The CMC may restructure the work plan in consultation and agreement with the EU to meet the objectives. Each partner is equally represented in the committee.

The WPLs will be responsible for the co-ordination of the work within a WP, for the interaction with the other WPs and for providing the Co-ordinator with the relevant information on the progress of the work.

The project management has been considered as a distinct WP, and a specific workplan has been detailed on page 23. Co-ordination actions will require 20.4 person-month.

Methods for flow of communication

The SAFE project will be a multidisciplinary programme with the challenge of integrating biophysical, economic, social and policy issues. Therefore well "designed" communication flows between participants are considered essential (Figure 4).

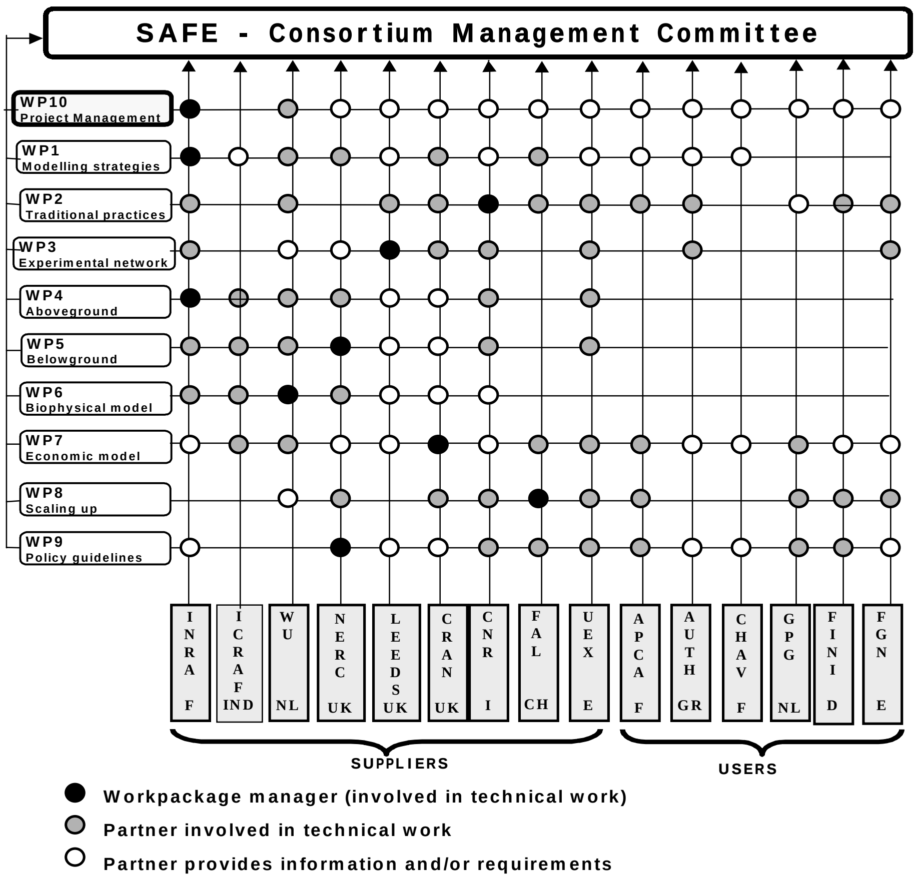

Figure 4: Flows of communication between the SAFE consortium partners.

The SAFE Project will be launched by a work-plan meeting of the CMC. At the onset of the project, a Web site for the SAFE project will be opened and used as i) a closed information exchange platform for members of the project and ii) an open forum for external end-users to comment on the on-going activity of the consortium.

The CMC will meet formally every six months to discuss progress (achievements of intermediate milestones and work package deliverables) and to make recommendations for future work. In-between, the SAFE Web site will be used extensively for information exchange between partners.

Every year, a plenary full week workshop will be organised to share data and work together on modelling aspects. These workshops are considered essential to build up a SAFE team spirit among the participants. The themes of these workshops are listed in Table 9. In addition, three consortium end-users' meetings will be held, one at the start of the project to assess needs, one at the beginning of the third year to frame the final work on guidelines, and one at the end of the project to discuss the final document and encompass dissemination activities. All meetings will be organised by the Co-ordination team with support from the partner managers.

Table 9 : Timetable of the SAFE project meetings

Theme of the meeting	Participants	Month	Duration (Working days)	Location (suggestion)	Number of SAFE participants	Number of invited participants
Launching the Work-Plan	CMC	1	2	Montpellier	20	0
Meeting with end-users: Users' constraints on modelling	SAFE + invited Users	3	2	Paris	15	10
Evaluation of progress	CMC	6	1	Wageningen	20	0
Workshop : State of the art of silvoarable agroforestry modelling; defining a common modelling platform	Plenary	6	5	Wageningen	40	10
Evaluation of progress	CMC	12	1	Wallingford	20	0
Workshop : biophysical modelling and validation	experimenters+modellers	14	5	Montpellier	15	0
Evaluation of progress	CMC	18	1	Plasencia	15	0
Evaluation of progress	CMC	24	1	Porano	20	0
Workshop : linking biophysical and economic modelling	Plenary	26	5	Leeds	15	5
Evaluation of progress	CMC	30	1	Toulouse	15	0
Technical meeting with end-users: economic modelling	End-users + modellers	32	1	Berlin	15	15
Evaluation of progress	CMC	36	2	Zurich	20	0
Workshop : Preparing the guidelines for policy	Plenary	38	5	Porano	20	10
Meeting with end-users: policy guidelines	End-users + modellers	40	1	Cranfield	20	10
Conference : Delivery of the guidelines for policy	Plenary	42	1	Brussels	20	20
8 National End-users open conferences	National participants + relevant WP leaders and scientists	42	1 x 8	France, UK, Italy, Spain, Netherlands, Greece, Germany, Switzerland	10 x 8	8 x 100

Regular contacts between the Co-ordinator and the participants will be achieved by the meetings and workshops. In addition, the WPLs will visit partners with whom they are collaborating, at an early stage of the programme for on-site discussion of research direction, research methodologies and strategies. For day-to-day contact, e-mail and the Web site will be used. All reports and documents will be made with the same portable software to ensure efficient information exchange and reporting.

The appointed computer scientist will install and manage the modelling code development of the SAFE model and ensure a full compatibility of all sub-models. He/she will make working visits to the teams involved in modelling activities. The modelling platform ensures that integration / link of the modelling studies can be realised.

Monitoring and reporting progress

It will be the responsibility of the project Co-ordinator to ensure proper progress of the SAFE project. The milestones and deliverables will be used to gauge the timetable of SAFE. The milestones are identified as key points of reference to check progress. Annual workshops and evaluation of progress meetings will serve as a forum for checking that milestones have been met. Annual full progress reports will be delivered to the EU, as well as 6 month intermediate reports. A key role of the meetings will be to co-ordinate the linking of work packages. Experience shows that the development of process-based models can be slower than expected, and the meetings will ensure that any delay will be anticipated to adjust the work-plan without blocking the progress of some partners. In the case of difficulties arising (e.g. delay in meeting objectives, trouble in resource allocation), the project co-ordinator will either intervene directly or assign a delegated scientist to assist in the area of difficulty. If the problem cannot be solved, it will be addressed by the full CMC aiming to resolve the issue by consensus.

5. Exploitation and dissemination activities

The SAFE project will enhance European expertise on modelling of complex land-use systems and provide information on competitive agroforestry systems. **This knowledge will give direct opportunities for farmers to improve their competitiveness.** Over time, agroforestry farms will become less dependent on crop subsidies, and less susceptible to crop price variations, as timber will generate a significant part of their income. The amenity value of silvoarable parklands in the near future may also be a valuable asset to farm enterprises.

The dissemination plan of the SAFE project targets two different audiences: (i) European governments and (ii) farm and forest end-users.

- European governments (and the European Commission) will be provided with guidelines for policy and will understand the impact of current forest and agricultural policies on the uptake of agroforestry;

- Farm and forest end-users will be provided with a prototype of a user-friendly version of the integrated bio-economic agroforestry model allowing to assess the profitability of agroforestry at the plot and farm scale, and enabling fast and interactive economic analyses. If this prototype attracts the interest of the end-users, a commercial version will be prepared after the end of the SAFE project, with different funding, and with the formal approval of the EC.

- A video programme on silvoarable agroforestry will be prepared during the last year of the project. It will be a useful tool for extension officers involved in implementation of agroforestry, and will supplement the award-winning video released in 1997 by INRA ("The tale of the tree and the wheat"). A CD-ROM on agroforestry technology will be released, using the accumulated material of the SAFE participants (slides, experimental results, and prospective results).

- The research partners in the SAFE programme are committed to assist end-user partners during the final 6 months of the programme and agree to organise 8 stakeholder workshops in eight target areas identified for agroforestry dissemination in the eight countries participating in the project.

6. Ethical aspects and safety provisions

The SAFE project is not within the scope of any of the ethical aspects suggested in the call for proposal. The SAFE project will not make use of any genetically modified organism.