FORSEE PROJECT

A network of 10 pilot zones to test and improve criteria and **indicators** for sustainable forest management at regional level in Atlantic European countries

Rationale and Workplan

Interim report
July 2005

Christophe Orazio
(Project Manager)

FORSEE Project (20) *www.iefc.net*

Project co-financed by the European Union
A community initiative
FEDER - INTERREG IIIB *Atlantic Area*

CONTENTS

I. FORSEE RATIONALE AND DEVELOPMENT (BY C. ORAZIO) 10

A. A JUST ON TIME PROJECT 10
B. PROJECT DEVELOPMENT 10
1. General Scheme 10
2. Pilot zones selection (done) 11
3. FORSEE indicator list setting up (done) 11
a) Making the choice 11
b) The result 12
4. FORSEE specific studies definition (done) 12
5. Protocols definition (almost done) 13
6. FORSEE specific studies execution (in progress) 13
a) The specific studies for Criteria 1 13
b) The specific studies for Criteria 2 13
c) The specific studies for Criteria 4 13
d) The specific studies for Criteria 5 14
e) The specific studies for Criteria 6 14
7. Data collection for the indicator assessment (In progress) 14
a) Maps (Task 2.1) 14
b) Stand data to be collected on the field (Task 2.2) 15
(1) Device 15
(2) Data collected in the NFI plot includes: 15
(3) Data collected in the snags satellite includes: 15
c) Statistics for socioeconomic indicators (Task 2.3) 16
8. Cost assessment (to be achieved) 16
9. Dissemination (In progress) 16

II. SELECTED SET OF INDICATOR FOR TEST AND IMPROVEMENT 17

A. LIST OF INDICATORS BY TASKS 17
B. LIST OF INDICATORS BY PRIORITIES IN THE REGIONS 19

III. REPORT OF THE EXPERT GROUP OF CRITERION 1: FOREST RESOURCES AND CARBON (BY M. TOMÉ AND A. COLIN) 21

A. FUNCTIONING OF C1 GROUP 21
1. Objectives 21
2. Participants 21
3. Criterion 1 expert group meetings 21
a) Bilbao NEIKER – 27 February 2004 21
b) Lisbon ISA – 19 May 2004 21
4. Comments 21
B. LIST OF INDICATORS CHECKED BY THE EXPERT GROUP: 22
1. Lists used as references 22
2. List of indicators checked by the group 22
C. LIST OF INDICATORS NOT SELECTED BY C1 EXPERT GROUP 22
D. LIST OF APPROVED INDICATORS FOR C1 23
1. Considerations on the terms "Forest types" and "availability for wood supply" 23
2. Forested area indicators 23
a) Main Issue 23
b) Regional adaptations 24
3. Wood volume indicators 28
a) Main issue 28
b) Regional adaptations 28
4. C stock indicators 32
a) Main issue 32
b) Regional adaptations 33
E. SPECIFIC STUDIES 41
1. IRELAND 41
a) Introduction 41
(1) Selected Region 41
(2) Forest Area 41

(3) Growing stock 41
b) FOREST INVENTORY DESIGN 42
(1) Carbon Stock of woody biomass and soils 42
(2) Aboveground biomass 42
c) STUDY DESIGN 42
(1) Belowground biomass 42
(2) Soil 42
(3) STUDY DESIGN 42
2. NAVARRA 43
a) Introduction 43
b) Material and Methods 43
(1) Field work (in the natural environment) 43
(a) Aerial Biomass 43
(b) Belowground Biomass 44
(2) Laboratory work 44
(3) Office work 44
c) Comparison with other methods used in biomass estimation 46
d) Conclusion 46
3. PORTUGAL CENTRE 46
a) Introduction 46
b) Main objective 46
c) Working packages: 48
(1) WP1. Tasks for development/improvement of carbon stocks in forests for the main forest types in Lousã 48
(a) Biomass equations – *indicator 1.4.1* 48
(b) Carbon stock in understory – *indicator 1.4.5* 48
(2) WP2. Tasks for development/improvement of carbon stocks in litter and soil 48
(a) Litterfall and decomposition – indicator 1.4.4 48
(b) Soil carbon stock – indicator 1.4.2 48
(3) WP3. Tasks to be undertaken for the development of a methodology to monitor carbon stocks in uncultivated areas – indicator 1.4.5 : 48
(4) WP4. Tasks under the KYOTO Protocol's range 49
(a) Land use evolution at Lousã – *indicator 1.1.* 49
(b) Growth models – indicator *1.2* 49
(c) 3. Prediction of future carbon stocks under alternative scenarios of management 49
F. WORK PLAN OUTLINE 49
1. VI.1 List of indicators or tasks to be achieved for the criteria 49
a) AQUITAINE 49
b) IRELAND 49
c) NAVARRA 50
d) CASTILLA Y LEON 50
e) GALICIA 50
2. VI.2 Regional organisation: 50
3. Expert group time chart 50

IV. REPORT OF THE EXPERT GROUP OF CRITERION 2 - FOREST HEALTH (BY JULIO DIEZ CASERO) 51

A. FUNCTIONING OF THE GROUP 51
1. Participants 51
2. Comments 51
B. LIST OF INDICATORS CHECKED BY THE EXPERT GROUP: 52
1. Lists used as references 52
2. List of indicators checked in the group 52
C. LIST OF INDICATORS NOT SELECTED BY THE EXPERT GROUP : 52
D. LIST OF APPROVED INDICATORS 53
E. SPECIFIC STUDY OF CASTILLA Y LEON 54
F. WORKPLAN OUTLINE 55
1. VI.1 List of indicators or tasks to be achieved for the criteria 55

V. REPORT OF THE EXPERT GROUP OF CRITERION 3: FOREST PRODUCTS (BY ROQUE SOLLEIRO) 56

A. FUNCTIONING OF C3 GROUP 56
1. Objectives 56
2. Participants 56

3. Criterion 3 expert group meetings ... *56*
a) Bilbao NEIKER – 26 February 2004 ... 56
b) Palencia ETSIA – 24 June 2004 ... 56
4. Comments ... *56*
B. LIST OF INDICATORS CHECKED BY THE EXPERT GROUP: ... 57
1. Lists used as references ... *57*
2. List of indicators checked by the group ... *57*
C. LIST OF INDICATORS NOT SELECTED BY C3 EXPERT GROUP ... 57
D. LIST OF APPROVED INDICATORS FOR C3 ... 59
E. SPECIFIC STUDIES ... 68
F. WORK PLAN OUTLINE ... 68
1. VI.1 List of indicators or tasks to be achieved for the criteria ... *68*
G. CONCLUSION ... 68

VI. REPORT OF THE EXPERT GROUP OF CRITERION 4 – BIODIVERSITY (BY HERVE JACTEL) ... 69

A. FUNCTIONING OF THE GROUP ... 69
1. Participants ... *69*
2. Meeting ... *69*
3. Comments ... *69*
B. LIST OF INDICATORS CHECKED BY THE EXPERT GROUP : ... 69
1. Lists used as references ... *69*
2. List of indicators checked in the group ... *69*
C. LIST OF INDICATORS NOT SELECTED BY THE EXPERT GROUP : ... 70
D. LIST OF APPROVED INDICATORS ... 71
E. SPECIFIC STUDIES ... 74
1. Comparison of the "Vienna Indicators" values with species richness and abundance at the stand level 74
2. Comparison between the relevance of the "Vienna Indicators" and the "Habitat Indicators" for biodiversity evaluation in forest ... *75*
F. WORKPLAN OUTLINE ... 76
1. VI.1 List of indicators or tasks to be achieved for the criteria ... *76*
2. VI.2 Regional organisation: ... *76*
3. Expert group time chart ... *76*
G. CONCLUSION ... 77

VII. REPORT OF THE EXPERT GROUP OF CRITERION 5 (BY INAZIO MARTINEZ) ... 78

A. FUNCTIONING OF THE GROUP ... 78
1. Participants ... *78*
2. Meetings ... *78*
3. Comments ... *78*
B. PART II LIST OF INDICATORS CHECKED BY THE EXPERT GROUP ... 79
1. 2.1 Lists used as references ... *79*
2. 2.2 List of indicators checked in the group ... *80*
a) 2.2.1. Long Term Indicators ... 80
b) 2.2.3 Water Quality indicators ... 82
C. PART III LIST OF INDICATORS NOT SELECTED BY THE EXPERT GROUP ... 83
1. Long Term Indicators ... *83*
2. Water Quality Related Indicators ... *93*
D. LIST OF APPROVED INDICATORS ... 102
1. Long Term Indicators ... *102*
a) INDICATOR PACKS TO BE MEASURED AT EACH REGION ... 110
2. Short term indicators ... *110*
a) Sampling Strategy ... 110
b) List of selected Indicators ... 110
c) Perturbation Categories Validation Parameters (optional) ... 113
3. Water Quality Related Indicators ... *116*
E. EXPERT GROUP TIME CHART ... 118
F. CONCLUSION ... 118

VIII. REPORT OF THE EXPERT GROUP OF CRITERION 6: MAINTENANCE OF OTHER SOCIO-ECONOMIC AND CULTURAL FUNCTIONS AND CONDITIONS OF FORESTS (BY AMÉRICO M. S. CARVALHO MENDES) 119

A. OBJECTIVES OF THE GROUP 119
B. FUNCTIONING OF THE GROUP 120
1. Group coordinator 120
2. Participants 120
3. Meetings and other forms of exchange of information 120
a) General comments 120
b) List of meetings and other forms of exchange of information 120
(1) All regions meeting 120
(2) Regional meetings (sub-group for Aquitaine) 120
(3) Communication through e-mail between the group coordinator and the other group members 121
C. LIST OF INDICATORS CHECKED BY THE EXPERT GROUP 121
1. Orientations for the selection of indicators 121
2. List of indicators checked in the group 121
D. LIST OF INDICATORS NOT SELECTED BY THE EXPERT GROUP 123
E. LIST OF INDICATORS APPROVED FOR TESTING IN ALL REGIONS 124
F. LIST OF OPTIONAL INDICATORS 135
G. INSTITUTIONAL FRAMEWORKS, LEGAL AND REGULATORY FRAMEWORKS, INTERNATIONAL COMMITMENTS, FINANCIAL INSTRUMENTS AND INFORMATIONAL MEANS 136
H. SPECIFIC STUDIES 136
1. AQUITAINE 136
2. NORTE DE PORTUGAL 137
I. WORKPLAN OUTLINE 138
1. List of indicators or tasks to be achieved for the criteria 138
2. Regional organisation 138
3. Expert group time chart and deliverables 138
a) Workpackage 1 : State of the Art comparability study 138
b) Workpackage 2: Exploratory specification study 138
c) Workpackage 3: Recommendations report 139
d) Workpackage 4: Specific studies 139
J. CONCLUSIONS 139

IX. APPENDICES 140

A. ANNEXES CRITERIA 1 140
1. Annex C1.1 Bibliography 140
B. ANNEXES CRITERIA 2 141
1. Annex C2.1 Satellites suggested for sanitary risk estimation 141
2. Annex C2.2 Instructions: 143
a) Assessable crown 143
b) Discolouration 143
c) Cankers: 144
d) Dieback: 144
e) Miners: 144
f) Cracks: 144
g) Direct action of men: codes: 145
3. Annex C2.2: Bibliography 145
C. ANNEXES CRITERIA 4 146
1. Annex C4.1: Bibliography 146
D. ANNEXES CRITERIA 6 146
1. Annex C6.1 Estimation of the total economic value of Portuguese forests for 2001 (baseline work for the specific study of Portugal North) 146
a) Scope of the estimates 146
b) Direct use values 147
(1) Timber harvested 147
(2) Net growth in timber stock 149
(3) Cork 150
(4) Resin 150
(5) Honey 150
(6) Pine nuts 150
(7) Chestnuts 150

(8) Carob 150
(9) Arbutus berries 150
(10) Elderberries 151
(11) Mushrooms 151
(12) Plants 151
(a) Forest products for intermediate consumption in animal production 151
(b) Grazing resources under forest cover 152
(c) Grazing resources in scrub land 152
(d) Litter lying on the forest floor 153
(13) Comparison between the value of forest goods used as intermediate consumption in animal production and the value of animal production 153
(14) Net growth in the production capacity of non wood forest goods 153
(15) Forest hunting benefits 154
(a) Hunting permits 154
(b) Gaming services paid by hunters in hunting zones with excludable access 154
(c) Membership fees to associative hunting areas 154
(16) Informal forest recreation 155
c) Indirect use values 155
(1) Carbon storage 155
(2) Protection of agricultural soil 155
(3) Protection of water resources 156
(4) Forest landscape and biodiversity conservation 157
(a) Forest landscape conservation in protected areas 157
(b) Public expenditure for forest landscape and biodiversity conservation 157
d) Forest negative externalities 158
(1) Costs of forest fires 158
(2) Costs of forest fire prevention 158
(3) Social costs of forest fire fighting 158
(4) Costs of losses in wood and non wood forest production 159
(5) Costs of the restoration of burnt forests 159
(6) Other negative forest externalities 159
2. Annex C6.2: Definition of the concepts of forest sector and forest cluster for indicator 6.5 based on the NACE classification Rev. 1.1 adopted by EUROSTAT 160
a) Forest sector 160
b) Forest cluster 161
3. Annex C6.3: Employment in the Portuguese forest cluster in 1995 163
a) Underestimation of forest employment in official statistics 163
b) Relative position of the forest cluster in total employment 163
c) Presentation of the results 164
d) Sources and methodology 165
4. Annex C6.4: Preliminary thoughts for the specific study on employment in the forest cluster of Aquitaine (By Dominique D'antin de Vaillac, Bordeaux 4) 167
a) Les limites de l'appareil de mesure français : le recensement partiel des seuls emplois salariés de la filière bois - papier. 167
b) Les définitions classiques de l'emploi et leur application à la forêt 169
(1) L'emploi direct lié à l'exploitation des produits marchands issus de la forêt. 169
(2) L'emploi direct lié à la constitution , à l'entretien, ou à la mise en valeur de la forêt 169
c) La Forêt comme support d'activités (et d'emplois) qui n'existeraient pas sans elle: l'approche canadienne 171
d) L'estimation de l'emploi à partir des flux de production: l'approche britannique 172
5. Annex C6.5: Bibliography 174
a) Bibliography of general interest for all indicators 174
b) Bibliography for indicator 6.1 175
(1) Of specific interest for the Portuguese regions 175
(2) Of specific interest for the Spanish regions 175
c) Bibliography for indicator 6.3 175
(1) Of general interest 175
(2) Of specific interest for the Portuguese regions 176
(3) Of specific interest for the Spanish regions 176
d) Bibliography for indicator 6.5 177
(1) Of general interest 177
(2) Of specific interest for the Portuguese regions (references for the baseline paper on employment in 1995) 178
(3) Of specific interest for Aquitaine 178
e) Bibliography for indicator 6.6 179
(1) Of general interest 179
f) Bibliography for indicator 6.10 179

(1) Of general interest 179
(2) Of specific interest for the Portuguese regions 180
g) Bibliography for indicator 6.4 and for the specific study of Portugal North 180
(1) Of general interest 180
(2) Of specific interest for the Portuguese regions 189
E. PROJECT PARTNERSHIP 193
1. Organisations and budgets *193*
2. Region and participants *193*

TABLES

TABLE 1 : SCIENTIFIC REGIONAL STUDIES OF FORSEE PROJECT 12
TABLE 2: LIST OF INDICATORS TESTED IN FORSEE PROJECT 18
TABLE 3: LIST OF INDICATOR PRIORITIES BY PILOT ZONES....20
TABLE 4: SUMMARY OF NATIONAL AND INTERNATIONAL REPORTING FOREST DEFINITIONS 41
TABLE 5 : ECONOMIC VALUES OF FOREST PRODUCTS IN CONTINENTAL PORTUGAL (2001)....150
TABLE 6: TOTAL AND MEAN ANNUAL PRODUCTION OF ACORNS IN CORK OAK AND HOLM OAK STANDS IN 1995 (SOURCE DGF 2001) 151
TABLE 7: ESTIMATE OF THE FORAGE PRODUCTION OF GRAZING GROUNDS UNDER FOREST COVER IN CONTINENTAL PORTUGAL, IN 1995 152
TABLE 8: THE VALUE OF CROPS PRESERVED DUE TO THE SOIL PROTECTION PROVIDED BY FORESTS (SOURCE INE 2003E) 155
TABLE 9: TOTAL PUBLIC COSTS OF WATERSHED MANAGEMENT FOR THE PORTUGUESE INTERNATIONAL RIVERS PLANNED FOR THE PERIOD 2001-2020 (MILLION ESCUDOS) 156
TABLE 10: RATES OF FOREST COVER, FOREST COVER CORRECTION FACTORS FOR SOIL EROSION RATES AND THE ANNUAL PUBLIC WATERSHED MANAGEMENT COSTS AVOIDED BY THE EXISTENCE OF FOREST COVER (THOUSAND ESCUDOS) 157
TABLE 11: EMPLOYMENT IN FORESTRY AND FOREST INDUSTRIES (NUMBER OF EMPLOYEES IN EQUIVALENT FULL TIME WORKERS) [SOURCE: INE 2003C] 163
TABLE 12: EMPLOYMENT IN THE FOREST CLUSTER IN CONTINENTAL PORTUGAL IN 1995 165
TABLE 13: EMPLOYMENT IN ACTIVITIES DIRECTLY RELATED TO CORK OAK (SOURCE AGRO GES- 1997) 165

FIGURE 1 : FORSEE PROJECT MAIN STEPS 9
FIGURE 2: FIGURE 1: OUTLINES OF THE ASSESSABLE CROWN SHOWING WHICH AREAS OF DIEBACK TO INCLUDE AND EXCLUDE 143
FIGURE 3 : SHAPES OF DISCOLOURATION 144
FIGURE 4: OUTLINE SHOWING WHICH IS DEAD CROWN. 144

I. FORSEE RATIONALE AND DEVELOPMENT (by C. Orazio)

A. A just on time project

To start a project on criteria and indicator for sustainable forest management of forest could have been considered has useless after the Lisbon conference and the first certified forest defining with high precision this concept.
Yet the implementation of these criteria quickly appears as being a more complex task than expected:

- Lots of data are not available, mainly related to non wood aspects: non wood products, cultural value, public access…
- Some of the indicators by their definition or their implementation are often not relevant, because they can change independently from the real status of forest sustainability: number of staff in charge of forest health observation, part of forestry in the GDP, defoliation….
- Some of the indicators requires an improved knowledge of forest ecosystem functioning and are based on too empirical concepts : impact of regeneration status on biodiversity,

As a consequence, the users of indicators will not select in the impressive existing lists of indicators[1] the best indicators because they are lacking reference tools, but the more convenient: the one known as more favourable or the one for which data are available. Doing so it the whole concept of indicators that is threatened because instead of introducing objectivity, the opulence and the choice that it imposes turn an objective tool in a subjective process.
So it clearly appears that the concept of indicators has been applied before being validated and requires a huge effort of expertise based on scientific knowledge, considering relevance and feasibility of the existing indicators. This is the main aim of FORSEE project.

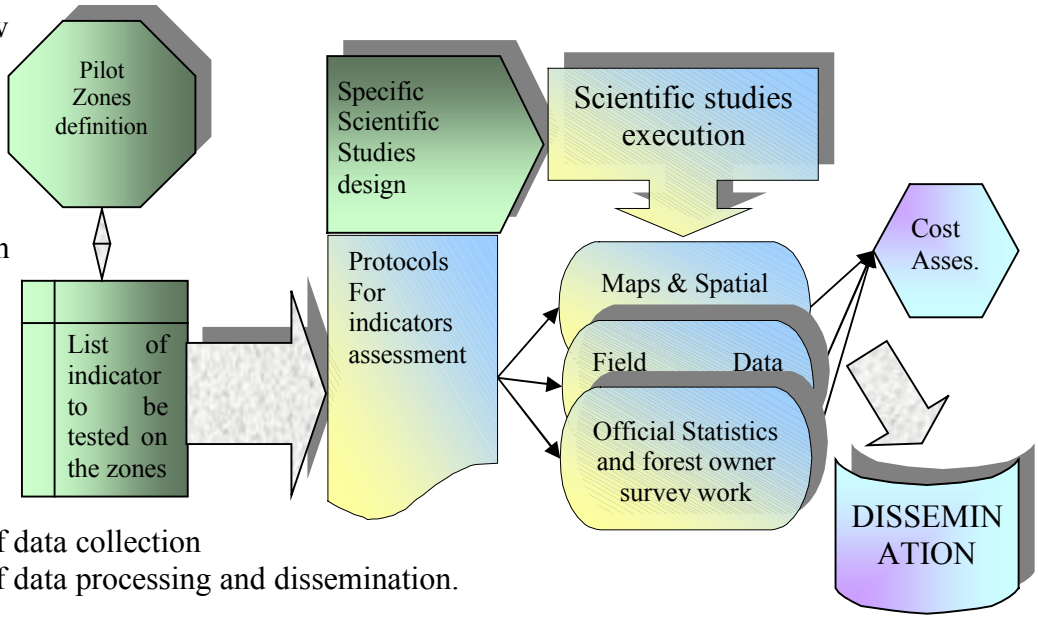
B. Project development

1. General Scheme

Figure 1 : FORSEE project main steps

The graph below summarizes the main phases of the project that are detailed forward
To simplify we can consider that the project can be split in three main phases:

- One year of work planning
- One year of data collection
- One year of data processing and dissemination.



[1] Check online some of the indicator lists available on www.iefc.net sustainable dev.

2. *Pilot zones selection (done)*

Initially, the design of the FORSEE network was established to be able to compare landscape level certification and management unit level. So half of the pilot zones were about 1000ha and based on forest ownership, and the other part was more than 10000 hectares zones for more global approach. But following the work of the expert groups, it appeared that at the management unit level the forestry tools are already efficient but that most of the new parameters to integrate in the concept of sustainability don't' make sense at the management unit level : biodiversity, economics, employment, …. So in a few months all the regions proposed large pilot zones of thousands of hectares to give a pertinent result at the test and to assess methods that can be applied at large scale like administrative or natural regions.

About the shape of the pilot zones, no determinant criteria has been selected. In some of the cases, the limits are natural borders like watersheds or climatic zones, in others cases, they are administrative limits like municipalities or counties. And sometimes they are totally artificial just taking into account cost efficiency and representativeness.
At the stage, it seems that being to strict on the shape of the pilot zone doesn't make sense, and that we will be obliged to be flexible on the pilot zone limits: some of the indicators will me be estimated in a larger area, or in a smaller area included.

3. *FORSEE indicator list setting up (done)*

a) *Making the choice*

The choice of the indicator to test or improve was **focused on pan European interministerial process**, but a large range of indicators (Montreal process, PEFC, FSC, LIFE project …) has been submitted to the expert groups so that they can keep open minded checking the indicators that needed to be improved in FORSEE project.

In Pan European process for sustainable forest management, indicators are organised in chapters called criteria :

- C 1: Maintenance and Appropriate Enhancement of Forest Resources and their Contribution to Global Carbon Cycles
- C 2: Maintenance of Forest Ecosystem Health and Vitality
- C 3: Maintenance and Encouragement of Productive Functions of Forests(Wood and Non-Wood)
- C 4: Maintenance, Conservation and Appropriate Enhancement Of Biological Diversity in Forest Ecosystems
- C 5: Maintenance and Appropriate Enhancement of Protective Functions in Forest Management (notably soil and water)
- C 6: Maintenance of other socioeconomic functions and conditions

One of the most important aspects in the choice of this indicator was relevance: make us sure that the indicator we will work on is related to sustainability of forest management in the pilot zone, and that the changes in its estimations reflect a change in the same way of the forest system. At this stage, we consider that there is too much uncertainty in the estimation process to be able to benchmark.
The second aspect interfering in the choice process, was the feasibility, constraint introduce by the project timeframe and resources. The experts were invited to select only indicators that had a chance to be assessed in the context of the project.
On an other hand, we wanted to focus on indicators that need an improvement, so we existing tools are providing good and reliable data, we don't need to work on this topic (it is usually the case of the volumes estimated by the national forest inventories).
At the end, an indicator that is relevant at national level or at management unit level, but not at the pilot zone or at the regional level was dismissed.

b) The result

As a result we get the list displayed in the second part. We can identify a few tendencies in the work plan as designed by the expert groups:

- First of all when an indicator is already well documented, and reliable, it is not taken into consideration (Wood volumes provided by national forest inventories, protected area, …)
- Some of the indicators selected will just be assessed to compare the national estimations with international standards like IPCC, FAO… So a part of the work that will be done is mainly comparison of results according to different definitions.
- An other aspect is to try to give a more complete estimation that the data actually provided by the official statistics, it will be for example done for forest employment or carbon stocks.
- There are also some indicators that will be evaluated in a very different way than they are at the moment, to compare the results and validate or invalidate the actual methods.
- Sometimes some of the indicators are considered as bad, and FORSEE project will have to do the demonstration by evaluating **verifiers** that are data collected in a costly way (so they cannot be consider as an indicator) showing that there is no correlation between the estimated indicator and the real status of the system.
- At the end, some indicators have been put in the list because at the moment there is no reliable data and we will generate a reference value (dead wood, damages, non wood products, …)

4. FORSEE specific studies definition (done)

The regional specific study concept: when applying for the project we clearly identified that the background in many fields was missing for the estimation of some of the indicators in some of the regions, so in an ideal way we planned to do some scientific work in each region for each criteria that could be used then in the estimation of the indicators of all the pilot zones. The initial repartition done in 2003 of the specific study based on regional priorities and research capacities was as follow:

Region	*Related criteria*
Ireland	*C1 : Carbon storage*
Aquitaine	*C4 : Biodiversity*
Cantabria	-
Euskadi	*C5 : Soil protection*
Navarra	*C1 : Carbon storage*
Castille y Leon	*C2 : Forest health*
Galicia	*C1 : Carbon storage*
North Portugal	*C6 : Socioeconomics*
Centre Portugal	*C1 : Carbon storage*

Table 1 : Scientific regional studies of FORSEE Project

The only criteria for which no specific study was raised up is the number 3 “Maintenance and Encouragement of Productive Functions of Forests (Wood and Non-Wood)”.
These specific studies are described in the expert’s group’s reports of each criterion below.

The perspective of a fast Carbon Market establishment incited the participant to work more on criteria one, producing allometric functions required for the tests, or volume weight ratio required for C assessment in the understorey.

The specific study on biodiversity in Aquitaine will mainly try to identify the key parameters at landscape and stand level that are required to estimate a global (all taxa) diversity of a forest system.
Specific study in Basque country on soils will mainly provide methods to assess forest soils sustainability in mountainous areas and update new pedo transfer functions.
The specific study on C2 done in poplars of Castille y Leon will mainly validate the forest health indicators protocols.

5. *Protocols definition (almost done)*

As a result of the expert groups work, we expected to get the list of indicators and the protocols for the estimation.
But an intermediate step has been necessary, some of the groups having eliminated interesting indicators, considering that it would not be feasible in the context of the project, by ignoring the plan of the other expert groups (dead wood, non wood products...).
So, a technical committee and inter group meetings have been organised to define the protocols of the three main tasks:

1. Mapping: A common list of basic maps and spatial analyses to apply on them has been defined.
2. Field work: In each pilot zone about 100 plots will be sampled according a harmonized field protocol, collecting data for all the criteria.
3. Survey to forest owners and official statistic analyses will be done in each pilot zone or regions taking into account local specificities but using a same framework.

All this harmonization work has been supervised by IEFC and will be published at the end of the data acquisition phase incorporating regional adaptations.

6. *FORSEE specific studies execution (in progress)*

a) *The specific studies for Criteria 1*

- In Eire: The field work has been achieved and the first total biomass equations are available for young trees not counted in NFI, so that C stock can be estimated taking into account all the young plantations.
- In Navarra: Field work to establish regional Fagus tree allometric equations has been data. Data are under process.
- In Galicia: The field work to estimate the Carbon stock in fast growing plantation on agricultural land has started. The update of growth models and C soil pools under this site conditions will be done therefore.
- In Portugal centre: the data to establish allometric equations for above and below ground plant components and carbon stock in understorey are collected. The implementation in existing models will start.

b) *The specific studies for Criteria 2*

In Castilla y Leon, more than 30 poplar stands have been selected to compare the real health status with the indicator estimated in FORSEE. At the moment tramps for insects are disseminated in many plots and leaves will be collected for fungi identifications. A software for numerical picture analysis will be done to estimate accuracy of defoliation estimations.

c) *The specific studies for Criteria 4*

Conducted by INRA in Aquitaine is trying to identify landscape and stand parameters correlated to multitaxa biodiversity.
The status of this task is as follow:

- Field work : inventories
  - Done : Stand characteristics
  - Done on 20 stands : vascular plants, carbides, spiders, birds
  - Done on 80 stands : butterfly, vascular plants
  - Done on 220 stands : Carabid birds
  - In progress on 50 stands : Dead wood saproxylic beetles
- Landscape analysis :
  - Done : Landscape maps based on EUNIS habitats classification
  - To be achieved : multi variable analysis for biodiversity estimation

d) The specific studies for Criteria 5

- Field work: The soils perturbations under standard forest management regimes have been collected.
- Maps: this data will be used to estimate the appropriate coefficients for the USLE equation in forested areas.

e) The specific studies for Criteria 6

The update of the Portuguese total economy value of the forest sector relies on the other indicators estimated. So this update will be done at the end of the indicator assessment.

7. Data collection for the indicator assessment (In progress)

All the data required for the indicators rely on three kind of activities: mapping, field work and statistical collection. Most of the time is a contracted team dedicated to the project that will be in charge of the data collection. In some of the regions like in Aquitaine and Euskadi, different organisations are responsible of different criteria, and collect the data separately.

a) Maps (Task 2.1)

Many indicators require maps. According to the protocols set up, it is about 25 maps that are required to estimate the whole list of indicators based on this 17:

- Map of the forest surface
- Map of current wood volume with bark (main biomass)
- Map of wood volume with bark (main biomass) in 1990
- Growth rate in volume of the last 10 years
- Map of the specific composition of the stand
- Map of the stand structure
- Map with the position of the FORSEE inventory points
- Map with the position of the NFI inventory points on the pilot zone
- Map of the surface with forest treatments
- Map of the forest property status
- Road maps
- Slops' maps, or FDM (field digital model)
- Max Rain data
- Map of the soil permeability
- Textural map and Soil structure
- EUNIS
- Hydrological Map

Most of this map can be found in public institutions. Some of them will need a specific work of aerial photo interpretation.

b) Stand data to be collected on the field (Task 2.2)

(1) Device

The selected indicators list implies the collection of traditional forest inventory data, such as tree diameters and heights, as well as additional data that are not usually available from current forest inventories: damages, dead wood (snags and logs), soil carbon, shrub biomass, biodiversity. The harmonised field protocols include following guidelines:
Field measurements occur in plots systematically spread over the pilot zones: in some areas sampling intensity is based on data available from previous forest inventory (when those data are not available it has been based on common sense). A grid of 1 km X 1 km is one of the most common sampling intensities. The number of devices sampled in each pilot zone is between 30 and 130 according to the size and the financial resources of the region.
On each sampling location, previously marked on photo-interpreted orto-photomaps, the following cluster of 4 plots, apart 50 m from each other and with a cross design, and 2 transects will be implemented:
NFI plot – following the protocol established by the NFI of each country for tree and stand characterization; soil and understorey carbon is also evaluated in this plot.
ICP[2] spirals – following the ICP European Forest protocol (ICP, 2004) and sampling the 20 trees closest to plot centre
Snag plot – in one of the ICP plots, all snags within a fixed radius (defined according to the NFI plot) is sampled
Deadwood and soil perturbation transects – linking the centres of the plots where dead wood in logs will be sampled as well as soil perturbations.

This sampling unit (the inventory device), should be installed in the position that maximizes its coincidence inside the subject strata (the one that coincides with the NFI plot centre) and that will be more convenient for the study (for example searching for ecotones or following slopes).

(2) Data collected in the NFI plot includes:

Characterisation of the site: GPS position; azimuth; slope; topography; recent forest management activities; piled wood; recent stumps; soil description; soil disturbances; fire scars; signs of erosion and compaction; signs of game or grazing; silvicultural system
Tree variables: species; diameter at breast height; height; height to the base of live crown; social class, polar coordinates relative to plot centre; age in even-aged stands
Under storey survey: under storey use; number of species; vertical and horizontal structure; species in the shrubs strata; phytovolume (area covered by shrubs x mean height of shrubs); regeneration
Soil characterisation: litter floor sampling (fresh, partially decomposed, decomposed); soils samples for the 0-30 cm and 30-60 cm depths (figure 3)
Inventory of snags: as in the snags plot
Forest health and vitality: as in the ICP plots

(3) Data collected in the snags satellite includes:

identification and characterisation of all snags inside the plot (tree variables, decomposition status, fauna signs).In the ICP plots the 20 trees closest to the plot centre (search will be done according to a spiral) will be analysed for symptoms/signs, affected part, agents, tree variables)

[2] International Co-operative Programme on Assessment and monitoring of Air Pollution Effects on Forests www.icp-forests.org

In the deadwood transects all the laying logs (length >1 m, diameter > 7.5 cm) intersecting the transect will be identified, diameter on the intersection point will be measured and decomposition status registered. The soils samples collected in the NFI plot will be mixed, by soil depth, in a composite sample for the determination of main physical and chemical characteristics.

c) Statistics for socioeconomic indicators (Task 2.3)

Detailed inventory of data for socio-economic indicators related to the pilot zones has confirmed the heterogeneity of data coming from the official statistics and the lack of data for evaluation of some socio-economic quantitative indicators from criteria 3 and 6.They are also large differences between regions and countries in defining the forest-based cluster and the boundaries of the system. The next steps of the approach include:
A SWOT analysis of the regional data available currently performed to improve the accuracy and comparability of the data, and sharing the experience of all the regions.
When data are missing (ex: services or non-wood goods), a first reference value will be provided through a harmonized survey currently conducted with the forest owners

8. Cost assessment (to be achieved)

The cost assessment will be done at the end of the estimation process. We will just estimate the execution cost, considering that the methodology assessment is a part of the project, so we mainly consider: time by category of personal, km, consumables, specific tools.
Then to get a more relevant cost assessment, we will need an estimation of resources required but not totally affected to the estimation of an indicator.
We will also try to build a tree of cost to show what is common to many indicators and what is specific to an other one because many times to estimate two indicators it is not the double cost of estimating one.
We will also try to generate comparable data between the regions providing cost by basic units like hectares, km…

9. Dissemination (In progress)

There are two level of communication:
The international level is covered by IEFC and USSE, and relies on the following actions:

- Brochures,
- Website (www.iefc.net)
- Presentations in conferences
- Organisation of an international conference in 2006

At the regional level as in most of the region, regional forest owners associations are associated to the project; they can edit a few papers for the regional professional newspapers, and support scientific activities when forest owner knowledge is needed.

II. SELECTED SET OF INDICATOR FOR TEST AND IMPROVEMENT

A. List of indicators by tasks

FORSEE Indicator Code	***Criteria***	***Short description***	***Origin***			***Type of work requested***		
			Process	ID in process	Type	Map (T2,1)	Field (T2,2)	Enquiry (T2,3)
C1.1	*1*	*Forest area – Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area*	*MCPFE Vienna*	*1.1*	*Indicator*	*X*		
C1.2	*1*	*Growing stock – growing stock on forest and other wooded land, classified by forest type and by availability for wood supply*	*MCPFE Vienna*	*1.2*	*Indicator*	*X*		
C1.4	*1*	*Carbon stock (EXPANSION FACTORS)*	*MCPFE Vienna*	*1.4*	*Indicator*	*X*		
C1.4.1	*1*	*Carbon stock in the woody biomass (above and below ground)*	*MCPFE Vienna*	*1.4.1*	*Indicator*	*X*	*X*	*X*
C1.4.2	*1*	*Carbon stock in the soils*	*MCPFE Vienna*	*1.4.2*	*Indicator*		*X*	
C1.4.3	*1*	*Carbon in the dead wood stock*	*IPCC*	*1.4.3*	*Indicator*		*X*	
C1.4.4	*1*	*Carbon in the litter stock*	*IPCC*	*1.4.4*	*Indicator*		*X*	
C1.4.5	*1*	*Carbon in the understorey*	*IPCC*	*1.4.5*	*Indicator*	*X*	*X*	
C2.4	*2*	*Damages*	*MCPFE Vienna*	*2.4*	*Indicator*		*X*	
C2.4.a	*2*	*Key factors for damages*	*Expert group*		*Verifiers*		*X*	
C3.1	*3*	*Increment and fellings*	*MCPFE Vienna*	*3,1*	*Indicator*	*X*		
C3.2	*3*	*Roundwood harvested (Value and volume)*	*MCPFE Vienna*	*3,2*	*Indicator*		*X*	*X*
C3.3	*3*	*Non Wood Products*	*MCPFE Vienna*	*4,2*	*Indicator*			*X*
C3.5	*3*	*Forest under management plans*	*MCPFE Vienna*	*3,5*	*Indicator*	*X*		*X*
C3.6	*3*	*Accessibility*	*MCPFE Lisbon*	*3,6*	*Indicator*	*X*		*X*
C3.7	*3*	*Harvestability*	*MCPFE Lisbon*	*3,6*	*Indicator*	*X*		
C4.1	*4*	*Tree species composition*	*MCPFE Vienna*	*4.1*	*Indicator*	*X*		
C4.10a	*4*	*Vascular plant diversity*	*Expert group*		*Verifiers*		*S*	
C4.10b	*4*	*Carabid diversity*	*Expert group*		*Verifiers*		*S*	
C4.10c	*4*	*Birds diversity*	*Expert group*		*Verifiers*		*S*	
C4.11	*4*	*Habitat parameters*	*Expert group*		*Verifiers*		*X*	
C4.2	*4*	*Regeneration*	*MCPFE Vienna*	*4.2*	*Indicator*	*X*		
C4.3	*4*	*Naturalness*	*MCPFE Vienna*	*4,3*	*Indicator*	*X*		
C4.4	*4*	*Introduced tree species*	*MCPFE Vienna*	*4,4*	*Indicator*	*X*		
C4.5	*4*	*Deadwood*	*MCPFE Vienna*	*4,5*	*Indicator*		*X*	
C4.7	*4*	*Landscape pattern*	*MCPFE Vienna*	*4,7*	*Indicator*	*X*		
C5.1.1	*5*	*% and length of stream length with appropriate riparian buffer*	*Expert group*		*Indicator*	*X*		
C5.1.2	*5*	*Potential erosion risk*	*Expert group*		*Indicator*	*X*		

C5.1.3	*5*	*Road/Trail density in the riparian areas*	*Expert group*		*Indicator*	*X*		
C5.3.1	*5*	*Carbon soil stock and Water Holding Capacity*	*MCPFE Vienna*	*1.4.2r*	*Indicator*		*X*	
C5.3.2	*5*	*Nutritive Status / total depth- water table depth*	*MCPFE Vienna*	*2.2*	*Indicator*		*X*	
C5.3.3	*5*	*Total nutrient stocks & nutrient Balance*	*Expert group*		*Indicator*		*X*	
C5.3.4	*5*	*Fast visual assessment of soil disturbance*	*Expert group*		*Indicator*		*X*	
C5.4.1	*5*	*Soil disturbance related to standard forest management activities*	*Expert group*		*Indicator*		*S*	
C5.4.2	*5*	*Physical characterisation of soil disturbance categories*	*Expert group*		*Verifiers*		*S*	
C6.01	*6*	*Forest holdings*	*MCPFE Vienna*	*6,1*	*Indicator*			*X*
C6.03	*6*	*Net revenue*	*MCPFE Vienna*	*6,3*	*Indicator*			*X*
C6.04	*6*	*Expenditure for services*	*MCPFE Vienna*	*6,4*	*Indicator*			*X*
C6.05	*6*	*Forest sector workforce*	*MCPFE Vienna*	*6,5*	*Indicator*			*X*
C6.06	*6*	*Occupational safety and health*	*MCPFE Vienna*	*6,6*	*Indicator*			*X*
C6.10	*6*	*Accessibility for recreation*	*MCPFE Vienna*	*6,10*	*Indicator*			*X*
C6.12	*6*	*Total economic value of forest production*	*Expert group*		*Indicator*			*X*

Table 2: List of Indicators tested in FORSEE project

S: Special field activity not using always the same plots as the others indicators as detailed in appendices of the technical guidelines

B. List of indicators by priorities in the regions

Each region is free to estimate an indicator on its pilot zone according to its subsidies and its regional context.
In the following tables, priorities are given to all the indicators according to this code:
1: This indicator will be evaluated on the pilot zone
2: We will try to evaluate this indicator on the pilot zone
3: We probably won't try to evaluate this indicator on the pilot zone

FORSEE Indicator Code	***Criteria***	***Short description***	***Priority for evaluation on the pilot zone***								
			e	i	a	v	a	a	s	t	k	a	a	b	a	i	a	b	g
C1.1	*1*	*Forest area – Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C1.2	*1*	*Growing stock – growing stock on forest and other wooded land, classified by forest type and by availability for wood supply*	*2*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C1.4	*1*	*Carbon stock (EXPANSION FACTORS)*	*1*	*1*	*1*	*1*		*2*	*1*	*1*	*1*
C1.4.1	*1*	*Carbon stock in the woody biomass (above and below ground)*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C1.4.2	*1*	*Carbon stock in the soils*	*1*	*1*	*3*	*1*		*2*	*1*	*1*	*1*
C1.4.3	*1*	*Carbon in the dead wood stock*	*2*	*1*	*3*	*1*		*2*	*2*	*1*	*1*
C1.4.4	*1*	*Carbon in the litter stock*	*2*	*1*	*3*	*1*		*2*	*2*	*1*	*1*
C1.4.5	*1*	*Carbon in the understorey*	*1*	*1*	*3*	*1*		*2*	*2*	*1*	*1*
C2.4	*2*	*Damages*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C2.4.a	*2*	*Key factors for damages*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C3.1	*3*	*Increment and fellings*	*2*	*1*	*1*	*2*		*1*	*1*	*1*	*1*
C3.2	*3*	*Roundwood harvested (Value and volume)*	*2*	*1*	*2*	*2*		*1*	*1*	*1*	*1*
C3.3	*3*	*Non Wood Products*	*2*	*2*	*2*	*1*		*2*	*2*	*1*	*2*
C3.5	*3*	*Forest under management plans*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C3.6	*3*	*Accessibility*	*1*	*2*	*3*	*1*		*1*	*1*	*1*	*2*
C3.7	*3*	*Harvestability*	*1*	*2*	*3*	*1*		*2*	*1*	*1*	*2*
C4.1	*4*	*Tree species composition*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C4.10a	*4*	*Vascular plant diversity*	*3*	*1*	*3*	*1*		*2*	*2*	*2*	*2*
C4.10b	*4*	*Carabid diversity*	*3*	*1*	*3*	*3*		*2*	*3*	*3*	*1*
C4.10c	*4*	*Birds diversity*	*3*	*1*	*3*	*3*		*3*	*3*	*3*	*1*
C4.11	*4*	*Habitat parameters*	*3*	*1*	*3*	*2*		*1*	*2*	*3*	*1*
C4.2	*4*	*Regeneration*	*1*	*1*	*2*	*1*		*2*	*2*	*1*	*1*
C4.3	*4*	*Naturalness*	*1*	*1*	*2*	*1*		*2*	*1*	*2*	*1*
C4.4	*4*	*Introduced tree species*	*1*	*1*	*2*	*1*		*1*	*1*	*2*	*1*
C4.5	*4*	*Deadwood*	*2*	*1*	*2*	*1*		*2*	*2*	*2*	*1*
C4.7	*4*	*Landscape pattern*	*2*	*1*	*3*	*1*		*1*	*1*	*3*	*1*
C5.1.1	*5*	*% and length of stream length with appropriate riparian buffer*	*1*	*1*	*1*	*1*		*1*	*1*	*3*	*1*
C5.1.2	*5*	*Potential erosion risk*	*2*	*1*	*1*	*1*		*1*	*1*	*3*	*1*
C5.1.3	*5*	*Road/Trail density in the riparian areas*			*1*						
C5.3.1	*5*	*Carbon soil stock and Water Holding Capacity*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*

C5.3.2	*5*	*Nutritive Status / total depth- water table depth*	*3*	*1*	*2*	*1*		*1*	*1*	*1*	*1*
C5.3.3	*5*	*Total nutrient stocks & nutrient Balance*			*3*						
C5.3.4	*5*	*Fast visual assessment of soil disturbance*	*3*	*2*	*1*	*1*		*2*	*1*	*3*	*1*
C5.4.1	*5*	*Soil disturbance related to standard forest management activities*	*2*	*2*	*3*	*1*		*1*	*1*	*3*	*2*
C5.4.2	*5*	*Physical characterisation of soil disturbance categories*			*3*						
C6.01	*6*	*Forest holdings*	*1*	*1*	*1*	*1*		*1*	*1*	*1*	*1*
C6.03	*6*	*Net revenue*	*1*	*2*	*2*	*2*		*2*	*2*	*1*	*1*
C6.04	*6*	*Expenditure for services*	*1*	*2*	*3*	*2*		*2*	*2*	*1*	*1*
C6.05	*6*	*Forest sector workforce*	*1*	*1*	*2*	*2*		*2*	*1*	*1*	*1*
C6.06	*6*	*Occupational safety and health*	*2*	*2*	*2*	*2*		*2*	*2*	*1*	*1*
C6.10	*6*	*Accessibility for recreation*	*2*	*2*	*2*	*1*		*1*	*2*	*1*	*1*
C6.12	*6*	*Total economic value of forest production*	*2*	*2*	*3*	*2*		*2*	*2*	*1*	*1*

Table 3: List of Indicator priorities by Pilot Zones

III.Report of the Expert Group of Criterion 1: FOREST RESOURCES AND CARBON (by M. Tomé and A. Colin)

A. Functioning of C1 group

1. Objectives

The objectives of Criterion 1 working group meetings were (1) to propose improved methodologies to inform the indicators dealing with forest resources and carbon stocks at the regional or sub-regional level, and (2) to share methods and experiences on forest inventories and carbon stock calculation.

2. Participants

- Margarida Tomé (ISA Lisboa - C1 expert group coordinator)
- Paula Soares (ISA Lisboa)
- Rémi Teissier du Cros (IFN Bordeaux)
- Antoine Colin (IFN Bordeaux)
- Gustavo Saiz (UCD Dublin)
- Carmen Traver (GAVR Navarra)
- Fernando Puertas Tricas (GAVR Navarra)
- Juan Gabriel Alvarez (USC Lugo)
- Pedro Alvarez Alvarez (USC Lugo)
- Marta Camps (NEIKER Bilbao)
- Felipe Bravo (Universidad Palencia)
- Christophe Orazio (IEFC)
- Americo Mendes (UCP Porto)
- Raul Salas Gonzales (ESAC)

3. Criterion 1 expert group meetings

a) Bilbao NEIKER – 27 February 2004

8 people have attended the meeting
OBJ1: To explore relevant scales and methodologies to assess C1 indicators.
OBJ2: To discuss the specific studies that would be conducted in Navarra and Aquitaine.
OBJ3: To analyse the issue of the estimation of C stocks in biomass, understorey, soils.
OBJ4: To approve a list of documents to inform on regional forest inventories and C stocks calculation coefficients at the regional level.

b) Lisbon ISA – 19 May 2004

10 people have attended the meeting
OBJ1: To validate the list of indicators to be assessed at the regional level.
OBJ2: To propose improved methodologies at the regional level.
OBJ3: To validate the specific studies conducted in Navarra, Ireland and Centre Portugal.
OBJ4: To prepare the C1 expert group document for TC meeting on 25 June 2004.

4. Comments

In addition to the specific analysis of C1 indicators assessment and the proposal of improved methodologies at the regional level, C1 expert group meetings were organised a bit like a forum for the participants to exchange on their respective experiences.
C1 networking has conduced to the elaboration of a synthetic document (annex) on forest inventories and C sequestration accounting methods and thresholds at the national and regional levels.

Each time there was a C1 meeting, at least 1 representative of the C5 expert group on soils has come to participate to the discussions on the methodology for accounting soil C.

B. List of indicators checked by the expert group:

1. Lists used as references

C1 expert group has checked the criterion 1 indicators as listed in the "**improved pan European indicators for sustainable forest management**" validated at the Ministerial Conference for the Protection of Forests in Europe MCPFE held in Vienna in 2003.
We have based our decision considering the general agreement among the forest experts on the MCPFE indicators; making them reliable for the assessment of sustainable management of forests in Europe. Moreover, the regional sustainable forest management certification processes (PEFC) are all based on the MCPFE list of indicators.

Forest, forest area, forest types, etc. definitions may vary from one country to another. Every 5 years, the FAO publishes a report on the world forest resources (FRA) compiling data extracted at the national levels. Because of the multiple sources and in order to make the results comparable, an expert FAO committee has validated the common definitions and thresholds that are required for the preparation of the FRA 2005.
C1 expert group has used the "FRA 2005 terms and definitions" as a basis for the discussion on improved methodologies at the regional level.

2. List of indicators checked by the group

Criteria	***Short description***	***Process***	***ID***	***Approved for FORSEE test***
1	*Forest area – Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area*	*MCPFE Vienna*	*1.1*	*Yes*
1	*Growing stock – growing stock on forest and other wooded land, classified by forest type and by availability for wood supply*	*MCPFE Vienna*	*1.2*	*Yes*
1	*Age structure and / or diameter distribution – age structure and / or diameter distribution of forest and other wooded land, classified by forest type and by availability for wood supply*	*MCPFE Vienna*	*1.3*	*No*
1	*Carbon stock*	*MCPFE Vienna*	*1.4*	*Yes*
1	*Carbon stock in the woody biomass (above and below ground)*	*MCPFE Vienna*	*1.4.1*	*Yes*
1	*Carbon stock in the soils*	*MCPFE Vienna*	*1.4.2*	*Yes*
1	*Carbon in the dead wood stock*	*IPCC*	*1.4.3*	*Yes*
1	*Carbon in the litter stock*	*IPCC*	*1.4.4*	*Yes*
1	*Carbon in the understorey*	*IPCC*	*1.4.5*	*Yes*

C. List of indicators not selected by C1 expert group

Criteria	***1***	***Process***	***MCPFE Vienna***	***ID***	***1.3***
Short description		*Indicator 1.3 aims to inform on age and/or diameter distribution of trees within the forest areas, classified by forest types and availability for wood supply.*			
Reason for non		☒ *Already well documented*		☐ *Too easy from existing data*	

selection	☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*
Rationale	*The understanding of age or diameter distribution of trees within a forest area is essential for the elaboration of forest policies as well as for the development and investment of the forest related industries in a region. Forest inventories main objective is to provide quantitative information on the forest resources. Consequently, we assume that the existing data on age or diameter distribution of trees are already well documented and that no major methodological improvements can be achieved on that issue through the FORSEE project duration.*

D. List of approved indicators for C1

1. Considerations on the terms "Forest types" and "availability for wood supply"

According to the subtitle of the indicators, the results on forest areas (indicator 1.1) and growing stocks (indicator 1.2) should be distinguished by **forest types** and by **availability for wood supply**.

Nevertheless, it does not seem to be relevant to make too many efforts on that point within the FORSEE project. Actually, the definitions and the methodologies developed by the forest inventory services are based on the national / regional contexts (e.g. forest types defined at the subregional level in France). Anyway within the FORSEE project, it is possible for the regions to inform on basic forest types like the proportion of coniferous and broadleaved forests etc...

Considering the term "availability for wood supply", the qualitative criteria used for the identification of the productive forests are rather different from one region to another and they also rely on the local contexts. Consequently, FAO does not help much. To inform the FRA 2005 reports, the countries are provided with a large flexibility since the FAO definition is: "forests designated for production and extraction of forest goods, including both wood and non-wood forest products".

At least, at the regional level, every region should inform the indicators using its own forest type's definitions and criterion for the availability of wood supply.

2. Forested area indicators

a) Main Issue

Criteria	***1***	***Process***	***MCPFE Vienna***	***ID***	***1.1***
Short description		*Extent of forest area and other wooded land (ha) classified by forest type and by availability for wood supply.* *The information on the extent of forest and other wooded land is necessary for assessing state and change in forest resources.*			
Rationale in favour of this indicator		*Many forest inventories do inform the indicator on forest area but the definitions and thresholds vary from one country to another (e.g. forest cover in the definition of forests, minimal surface and minimal width in the definition of forest areas).* *The task on indicator 1.1 will be to compare the surface calculated according (1) to the national definitions and (2) to the FAO definitions.* *The FAO definitions of forest and other wooded land are in annex 1.* *The national and FAO definitions would be tested at different geographic scales, from the pilot zone level to the whole region level depending on the data available.* *The results could be displayed by forest types (coniferous / broad-leaved species or more detailed forest types).*		

b) Regional adaptations

Region concerned		***AQUITAINE***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : -*	
Equipment	Software	*Excel, Access, Arc View 8 and 3.3*	
	Field material	-	
Personal	Qualification/ Time	*Engineer*	
Data	To buy	-	
	To compile	*from the IFN database*	
	To investigate	-	
	To acquire	-	
	Bibliography	*- Terms and definitions – FRA 2005* *- Guidelines for country reporting to FRA 2005 - FAO* *- But et méthodes de l'Inventaire Forestier National – Edition 2003 - IFN* *- Inventaire forestier départemental – Landes – 4^{ième} inventaire - IFN*	
Detailed protocols		*The French national forest inventory provides data on the forest area at the regional and at the "département" level.* *According to the French definitions, forests have a minimal surface of 0.05 ha, a minimal width of 25 m, forest tree species are able to reach 7 m and the forest cover have to be over 10%.* *We will analyse the changes occurred in the forest area because of the use of the FAO minimal forest surface definition (0.5 ha) in Aquitaine. The French IFN identify areas called "bosquets" with a surface >= 0.05 ha and <0.5 ha. As a result, the surface included within the FAO category "other wooded land" will also be calculated.* *But the use of the minimal FAO width thresholds (20 m) will not be assessed because that would imply to conduct some new plot analysis from the aerial photographs and it has no sense for the French IFN. It will neither be feasible to analyse the impact on the forest area of taking into account trees able to reach 5 m instead of 7 m.* *The study will be conducted at the (1) regional, (2) PEFC, (3) IFN forest region and (4) pilot zone level for the year 1990, 2000 and 2005.*	
Comments for Aquitaine		*The results will be classified according to the forest types defined at the "département" level and according to the criteria "availability for wood supply" (for the definitions in France, go to annex n°IX.A).*	

Region concerned		***IRELAND***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access (Office 2000) ArcView 8*	
	Field material		
Personal	Qualification/ Time	*Engineer* *2.5 man months*	
Data	To buy		
	To compile	*EFISCEN database, National Forest Inventory System, Grant Aid applications, Coillte Forest Inventory records, coop members map.*	
	To investigate		
	To acquire		

	Bibliography	*- Terms and definitions – FRA 2005* *- Guidelines for country reporting to FRA 2005 - FAO* *- Coillte Definitions* *- Forest Inventory and Planning System*
Detailed protocols		*Currently Ireland has 3 variations of a forest definition. Previously officially reported is the Coillte (The Irish Forestry Board) definition and that reported to the FAO. Additionally a new forest definition has been developed for the planned National Forest Inventory to be conducted by the Forest Service. It is suggested that this may be the definition adopted for reporting to the UNFCCC/KP in the future.* *The significant definitional differences are between reported area and crown cover. Area ranges from 0.1 to 0.5ha and crown cover from 10% to 20%.* *We will consider the impact of the minimum area and crown cover thresholds on the growing stock in 1990 and 2004, based on available data and will be conducted at the regional and pilot zone level.*

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access, Arc View, ERDAS*	
	Field material		
Personal	Qualification/ Time	*Forest Engineer*	
Data	To buy	*Cartography maps*	
	To compile	*NFI data, 1990 Aerial photograph 1:15 000, 1995 Aerial photograph 1:40 000*	
	To investigate		
	To acquire		
	Bibliography	*Inventário Florestal Nacional – 3ª Revisão- 1995/1998 - DGF*	
Detailed protocols		*The Portuguese national forest inventory provides thresholds for forest area according to FAO, a minimum surface of 0.5 ha, a minimal width of 20 m and a forest cover over 10%.* *The general classification definitions are not similar and the definition of "availability for wood supply" is not included in the Portuguese NFI classification, therefore these differences can be the focus analyze.* *It is proposed under the specific study to analyze the land use evolution at the pilot zone Lousã according to FAO definitions, in the following steps:* *Land-use 1990 : Aerial photograph 1:15 000, not ortorectified, no photo-interpretation available - photo-interpretation to be undertaken using the current IFN stand classification* *Land-use 1995 : Aerial photograph 1:40 000, ortorectified, simplified photo-interpretation available - photo-interpretation to be improved according to the current IFN stand classification* *Land-use 2004/2005 : New aerial photograph is planned for 2004/2005 – photo-interpretation will be undertaken with the current IFN stand classification* *The objective is to identify the new forest areas and the reforested areas taking into account the area that will be consider to the Kyoto protocol for carbon stock change estimation. Another objective is to predict future carbon stocks under alternative land use and management by the construction of different scenarios.* *The study will be conducted at the pilot zone level. For the year 1990, 1995, 2005.*	

General comments	*The results will be presented according to the forest types defined at the Portugal IFN.*

Region concerned		***NAVARRA***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other:*	
Equipment	Software	*Excel, Access, Spans (GIS) o Arc View 8.3*	
	Field material	-	
Personal	Qualification/ Time	*Engineer*	
Data	To buy	*Dates for Navarra from the IFN database-Navarra*	
	To compile	-	
	To investigate	-	
	To acquire	-	
	Bibliography	*Terms and definitions – FRA 2005* *- Guidelines for country reporting to FRA 2005 – FAO* *- Inventario Forestal Nacional – Edition 2003 - IFN –Navarra (IFN 3)* *- Map of crops and uses (Mapa de cultivos y aprovechamientos). Gobierno de Navarra, 2001.- Navarra (MCA 99)*	
Detailed protocols		*In Navarra is used the data provided by both, the MCA (1:25.000) and the IFN (1:50.000) Between the two sources exist changes in the areas, which are compatible in the majority of cases. The IFN definitions are established at a national level and edited at Provincial level.* *The national forest inventory provides data on the forest area at the "Provincial" level. It is also possible to obtain data at regional, watershed and municipality, level* *According to the Spanish definitions, forests have a minimal surface of 0,25 ha, a minimal width of 25 m and the forest cover have to be over 5%.(see annexe IX.A) .* *We can analyse the changes produced in the forest area respect to the percentage of forest cover defined by the FAO (> 10%), including the areas with forest cover from 5 to 10 % in to "other wooded land"* *However this is not considered as feasible in the event of " bosquetes" smaller than 0,25 ha. It will neither be feasible to use the minimal FAO width thresholds (20 m)* *The study can be considered at "comarca" and municipality level in the case of the Pilot Zone.*	
General comments		*The results will be classified according to the forest types defined at the "comarca" level and according to the criteria "availability for wood supply" (for the definitions in Spain go to annex n°IX.A.1.*	

Region concerned		***CASTILLA Y LEÓN***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : -*	
Equipment	Software	*Excel, Access, Arc View 8 and 3.3, BASIFOR*	
	Field material	-	
Personal	Qualification/ Time	*Engineer*	
Data	To buy	-	
	To compile	*from the IFN database and Spanish Forest Map*	
	To investigate	-	
	To acquire	-	
	Bibliography	*Terms and definitions – FRA 2005* *Guidelines for country reporting to FRA 2005 – FAO* *Ley de Montes. 2004* *El Inventario Forestal Naciona. Elemento clave para la gestión forestal sostenible. Ed. 2002* *Mapa Forestal deEspaña (Scale 1: 50 000)* *Instrucciones para el apeo de las parcelas de campo del IFN3. Ed. 1997* *Segundo IFN. Explicaciones y métodos 1986-1995. Ed. 1990* *Inventario Forestal Nacional – Palencia – 2º y 3º inventario - IFN*	
Detailed protocols		*The Spanish national forest inventory and Forest Map provide data on the forest area at different levels: national, regional, province. Software BASIFOR allows us to delimitate different areas (from NFI), as the pilot zones, to analyze it.* *The study will be conducted at the pilot zone level for the year 1991 and 2000.*	
Comments for Castilla and León		*The results will be classified according to the forest types defined at the pilot zone and according to the criteria "availability for wood supply".*	

Region concerned		***GALICIA***	***Indicator 1.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access, Arc View 8 and 3.3*	
	Field material	-	
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*3 IFN database*	
	To investigate		
	To acquire		
	Bibliography	*- Terms and definitions – FRA 2005* *- Guidelines for country reporting to FRA 2005 - FAO* *- 2nd IFN (1990)* *- 3rd IFN (2002)*	
Detailed protocols		*The 3rd Spanish IFN (1998) provides data on the forest areas at regional and provincial level.* *Two different forest areas are defined:* *1. Monte arbolado: minimum surface of 0.25 ha; canopy closure of more than 20% and width threshold (buffer) of at least 25 m.* *2. Monte desarbolado: canopy closure ranged from 10 to 20%.*	

	The FAO category "Other Wooded Land" could be calculated using the following Spanish IFN definitions: *1. Monte arbolado disperso: canopy closure ranged from 5 to 10%.* *2. Monte desarbolado: canopy closure of less than 5%* *3. Árboles fuera del monte: forest lands of less than 0.25 ha and width threshold of less than 25 m.* *The use of the minimum FAO tree height (7 m) will not be considered because it would imply to conduct some new plot analysis.* *The study will be conducted at regional and target zone level for the years 1990, 1998 and 2005 using the optimum information to achieve the minimum requirements (satellite images or aerial photographs).*

3. *Wood volume indicators*

a) Main issue

Criteria	***1***	***Process***	***MCPFE Vienna***	***ID***	***1.2***
Short description		*Indicator 1.2 regards the wood volume in the living stems (m^3) classified by forest types and by availability for wood supply.* *The information on growing stock is essential to understand the dynamics and productive capacity of forests in order to develop national policies and strategies for a sustainable use of the forest resources*			
Rationale in favour of this indicator		*The definition of the growing stock differs from one country to another. Sometimes, the stumps, the coarse branches and the bark are, or are not, included in the volume calculation. Top end stem diameter, minimal basal level for tree height measurement and minimal DBH diameter are also variable.* *In its FRA 2005 guidebook, the FAO provides a minimal definition for the growing stock; it concerns the volume over bark of living trees. FAO also requires information on the national thresholds and the part of the trees that are included in the volume. The countries must also indicate whether the reported figures refer to volume above ground or above stump.* *The commercial growing stock refers to the growing stock in the forests available for wood supply.* *The FAO definitions for growing stock and commercial growing stock are in annex 1.* *In some regions it is proposed to evaluate both growing stock and commercial growing stock including or not the stump or the bark. In the whole regions, it is proposed to inform the national thresholds for volume calculation and to estimate indicator 1.2 at least for one year included in the project duration.* *The geographic scale could be from the pilot zone level to the regional level according to the data available.* *The results could be displayed by forest types and by availability for wood supply.*		

b) Regional adaptations

Region concerned		***AQUITAINE***	***Indicator 1.2***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*Access, Excel, Arc View 8 and 3.3*	
	Field material		

Personal	Qualification/ Time	*Engineer*
Data	To buy	
	To compile	*IFN database*
	To investigate	
	To acquire	
	Bibliography	*- FAO – Guidelines for country reporting to FRA 2005* *- FAO – Specification of national reporting tables for FRA 2005* *- IFN – Nomenclature* *- IFN - But et méthodes*
Detailed protocols		*Both growing stock and commercial growing stock will be estimated (1) at the pilot zone level, (2) at the PEFC level and (3) at the regional level for the year 1990, 2000 and 2005. The regional volume thresholds and definitions will be reported.* *Commercial growing stock will be obtained from the volume over bark in the forest areas available for wood supply, namely the "formations boisées de production" of IFN and detailed by forest types at the "département" level.*

Region concerned		***IRELAND***	***Indicator 1.2***
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access (Office 2000) ArcView 8*	
	Field material		
Personal	Qualification/ Time	*Engineer* *5.5 man months*	
Data	To buy		
	To compile	*FIPs data and Coillte inventory.*	
	To investigate		
	To acquire	*Forest inventory to be undertaken in chronosequence. 3 plots per stand. Number of stands yet to be determined.*	
	Bibliography		
Detailed protocols		*Commercial growing stock will be estimated at the pilot zone level for 2004. These estimates will be obtained from the volume over bark in the commercial forest areas based on volume and yield tables, existing information from Coillte inventory data and the pilot zone forest inventory proposed (see detail under Section V)*	

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.2***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access, Arc View*	
	Field material	*Tree and plot measurement equipment, digital recording equipment, GPS*	
Personal	Qualification/ Time	*Forest Engineer, Forest inventory field crew*	
Data	To buy	*Cartography maps*	
	To compile	*NFI data for the Lousã pilot zone*	
	To investigate	*height*	
	To acquire	*Monitoring data at Lousã pilot zone to complete and intensity data collected for the NFI in 2005*	
	Bibliography		

Detailed protocols	*The Portuguese National Forest Inventory definitions of growing stock and commercial growing stock differ in some aspects from the FAO definitions. Therefore, the growing stock and commercial growing stock will be calculated according to the Portuguese NFI definitions and also with FAO definitions for comparisons purposes.* *Both growing stock and commercial growing stock will be estimated at the pilot zone level.* *For the specific study we will use data provided by the NFI for forest stands in Lousã, the Maritime pine and Eucalyptus growth models available for the whole country can be improve.*
Comments	*Although, the proposal consider only two species, if it is relevant other important species can be consider.* *The collection of new data will only be undertaken if the existing data reveals not to be enough.*

Region concerned		***NAVARRA***	***Indicator 1.2***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*Access, Excel, Spans, Arc View 8.3*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*IFN database*	
	To investigate		
	To acquire		
	Bibliography	*- FAO – Guidelines for country reporting to FRA 2005* *- FAO – Specification of national reporting tables for FRA 2005* *- IFN – Definiciones y metodos* *- Pliegos Generales de Condiciones Técnicas de los Proyectos de Ordenación (Management Plans) y Planes Técnicos de Gestión. Gobierno de Navarra. (include definitions and policies)*	
Detailed protocols		*Both growing stock and commercial growing stock will be estimated at the pilot zone level, and for the year 1990, 2000 and 2005. The regional volume thresholds and definitions will be reported.* *Commercial growing stock will be estimated at the Comarca level from the data provided by the IFN, and at the pilot zone level, through the FORSEE program. It will be obtained from the volume over bark in the forest areas available for wood supply detailed by forest types.*	

The evaluation of this indicator require		***CASTILLA Y LEÓN***	***Indicator 1.2***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*Access, Excel, Arc View 8 and 3., BASIFOR*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*IFN database*	
	To investigate		
	To acquire		
	Bibliography	*Terms and definitions – FRA 2005*	

		Guidelines for country reporting to FRA 2005 – FAO *Ley de Montes. 2004* *El Inventario Forestal Nacional. Elemento clave para la gestión forestal sostenible. Ed. 2002* *Mapa Forestal deEspaña (Scale 1: 50 000)* *Instrucciones para el apeo de las parcelas de campo del IFN3. Ed. 1997* *Segundo IFN. Explicaciones y métodos 1986-1995. Ed. 1990* *Inventario Forestal Nacional – Palencia – 2º y 3º inventario – IFN*
Detailed protocols		*Both growing stock and commercial growing stock will be estimated at the pilot zone level for the years 1991 and 2001.* *Commercial growing stock will be obtained from the IFN equations of volume over bark and detailed by forest types at the pilot zone level.*
Comments		*Tables are filed with regional forest types and compiled, by dominant species, in coniferous and broad-leaved.*

Region concerned		***GALICIA***	***Indicator 1.2***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Access, Excel, Arc View 8 and 3.3*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*2nd IFN and 3rd IFN databases*	
	To investigate		
	To acquire		
	Bibliography	*- 2nd IFN (1990)* *- 3rd IFN (2002)* *- BARRIO ANTA, M. (2003). Crecimiento y producción de masas naturales de Quercus robur L. en Galicia. Tésis doctoral. Escuela Politécnica Superior de Lugo. Universidad de Santiago de Compostela. 252pág.* *- BRAVO, F.; DEL RÍO, M. Y DEL PESO, C (2002).: El inventario Forestal Nacional. Elemento clave para la Gestión Forestal Sostenible. Universidad de Valladolid.* *- CASTEDO DORADO, F. (2003). Modelo dinámico de crecimiento para las masas de Pinus radiata D. Don en Galicia. Simulacion de alternativas selvícolas con inclusión del riesgo de incendio. Tésis doctoral. Escuela Politécnica Superior de Lugo. Universidad de Santiago de Compostela. 297pág.* *- DIEGUEZ, U. (2004). Modelo dinámmico de creciiento para masas de Pinus sylvestris L. procededentes de plantación en Galicia. Tésis Doctoral. Escuela Politécnica Superior de Lugo. Universidad de Santiago de Compostela. 191 pág.* *- FAO – Guidelines for country reporting to FRA 2005* *- FAO – Specification of national reporting tables for FRA 2005* *- GRANDAS ARIAS, J. A. (20002). Desarrollo de un modelo de crecimiento para la Gestión Sostenible de las masas de abedul en Galicia. Trabajo Fin de curso en el "I Master internacional en Gestión del Desarrollo Rural. Lugo.* *- RODRÍGUEZ, R. (1995). Crecimiento y producción de masas forestales regulares de Pinus pinaster Ait. En Galicia. Alternativas selvícolas posibles. Tésis doctoral. Escuela Técnica Superior de Ingenieros de Montes. Universidad Politécnica de Madrid. 297 pág.*	

		- SÁNCHEZ, F. (2001). Estudio de la calidad de estación, crecimiento, producción y selvicultura de Pinus radiata D. Don en Galicia. Tésis doctoral. Escuela Politécnica Superior de Lugo. Universidad de Santiago de Compostela. 347 pág.
Detailed protocols		*The growing stock will be directly calculated at the target zone level for the year 1998 using the sample plots of the 3rd Spanish IFN. The same estimates for the years 1990 and 2005 will be obtained using species-specific growth models to project the stand status backward and forward from 1998, respectively.* *The current annual increment obtained comparing the 2nd and 3rd Spanish IFN will be used to estimate the growing stock at regional level for 1990.* *According to the Spanish IFN sampling methodology, all the growing stock will be calculated using a minimum dbh of 7.5 cm and a thin-end diameter of 7 cm, without including the stump.*
Comments		*The main forest species present at the target zone will be evaluated: Pinus pinaster, Pinus radiata, Pinus sylvestris, Quercus robur, Betula alba and Eucalyptus globulus.*

4. C stock indicators

a) Main issue

IPCC identify 5 carbon pools in the forest ecosystem (above ground biomass, belowground biomass, dead wood, litter and soils) instead of 1.4 MCPFE indicator which only deals with the C stock in the woody biomass (above and below ground) and in the soils.

For research on ecosystem functioning or productivity purposes, it is relevant to assess the amount of carbon in the whole forest ecosystem. For that reason we have split indicator 1.4 in 5 sub-indicators, each one dealing with a specific carbon pool.

Criteria	***1***	***Process***	***MCPFE Vienna***	***ID***	***1.4.***
Short description		*Calculation of the carbon stock in the whole forest ecosystem. This information is directly linked to the international processes reporting on GHG emissions and climate change.*			
Rationale in favour of this indicator		*Since the impacts of land use change and forestry on C stocks has been included into the national greenhouse gas emissions reports to satisfy the Kyoto commitments of each country, C stock accounting in the forest ecosystems has become an important issue.* *In a forest ecosystem, five carbon pools are identified by IPCC (1) the C pool in the aboveground biomass, (2) in the belowground biomass, (3) in the dead wood, (4) in the litter and (5) in the soils.* *In order to harmonise with ongoing international processes, the categories and definitions used in FRA 2005 correspond to those established by the IPCC. The definitions are given in annex 1.* *At the national level, C stocks sequestered in the tree biomass have been estimated through the use of aggregated inventory data and biomass expansion factors.* *Within FORSEE, the proposal is to compare the 2 methodologies presented by IPCC for the calculation of the C stocks in the woody biomass at the regional level. The first one based on the use of biomass expansion factors at stand level, and the second one based on the use of allometric relationships established at tree or stand level. For each one of the 2 methods, the cumulative errors should be estimated.* *Belowground biomass calculation relies on difficult and expensive field measurements and until now, not all the tree species count with their own data at the regional level, and the reliability is not so good for instance on fine roots biomass.*			

	Most of the time the root-shoot ratios or biomass root expansion factors implemented at the regional level is extracted from the international bibliography. However, in the regions where the specific study will be carried on C1, a special effort will be done to generate regional biomass root expansion factors. In the other regions, no specific protocols are planned because of the weight in time and people to realise those studies. *Soil C account for almost 50% of the total C stored in the forest ecosystems. Nevertheless few systematically soil C survey networks are developed in Europe and even if some data are available at the plot level in some regions, up scaling processes are complex and these operations should be conducted together with a soil C expert. On that point, the discussions are engaged with the FORSEE expert group on soils C5.* *IPCC assumes as a default that changes in C stocks in dead organic matter pool (dead wood and litter) are not significant and be assumed zero i.e. that inputs balance losses so that net dead organic matter C stock changes are zero. However, IPCC also highlights that dead organic C matter should be considered in future work on inventory methods because the quantity of C in dead organic matter is a significant reservoir in many of the world's forests.* *In some regions where fire risk analyses are conducted, protocols will be designed to convert phytovolumes into biomass and C stocks in the shrubs to complete the exiting equation list.*

b) Regional adaptations

Region concerned		***AQUITAINE***	***Indicator 1.4***
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*ACCESS, EXCEL*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*IFN database*	
	To investigate		
	To acquire		
	Bibliography	*- IFN – Nomenclature* *- IFN – Buts et methods* *- FAO – Guidelines for country reporting to FRA 2005,* *- FAO – Specification of national reporting tables for FRA 2005* *- IPCC good practice guidance for LULUCF 2004* *- Chantal – Estimation du stock de C dans la biomasse de Pin maritime2001* *- Pignard, Dupouey and Dhôte – Allometric relationships and W expansion factors for the french forests (CARBOFOR project not yet published)* *- Porté – Relations allométriques pour pin maritime en Lande humide – Compte rendu de travail de l'INRA 2003*	
Detailed protocols		*The comparison of the 2 methodologies to estimate C stock will be conducted at the IFN forest region level in Aquitaine.* *Method 1: Above ground biomass expansion factors* *C stock estimated from the growing stock at the IFN forest region level (100.000 ha) for the year 1990. Estimated in 2000 for the maritime pine forest. Forest inventory data actualization is required.* *Use of national biomass expansion factors for coniferous and broadleaved species, and regional biomass expansion factors for maritime pine.* *Method 2: Allometric relationships at tree level* *Development of a calculation procedure to estimate the biomass from the forest plots to the whole IFN forest region*	

	C stock calculated from the last inventory data available (updated after 1999 storm) on the maritime pine forest *Use of 9 above ground biomass allometric relationships for all the tree species.* *Error analysis propagation?*
Comments for Aquitaine	*Protocols to estimate C stocks in belowground biomass, understorey and shrub will be studied compensing the lack of data at the regional level in cooperation with INRA.* *Regarding C stocks in soils, discussions are engaged with the representatives of C5 in Aquitaine.* *We will also develop a methodology to assess a new indicator aiming at the evaluation of the changes in the C balance of the regional forestry-wood chain between the years 1990, 1999 and 2001.The study will be performed at the maritime pine forest level. We will take into account the C stocks in the forest, in the wood products, the life span of the wood products and the fossil fuel consumption from the forest production to manufactured wood-products.*

Region concerned		***IRELAND***	***Indicator 1.4***
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*Excel, Access (Office 2000) ArcView 8*	
	Field material		
Personal	Qualification/ Time	*Engineer* *10 man months*	
Data	To buy		
	To compile	*National Forest Inventory System, Grant Aid applications, Coillte Forest Inventory records.*	
	To investigate		
	To acquire		
	Bibliography	*- Coillte Inventory Processes* *- FAO – Guidelines for country reporting to FRA 2005,* *- FAO – Specification of national reporting tables for FRA 2005* *- IPCC good practice guidance for LULUCF 2004* *- Green, 2004 Allometric Equations for Sitka spruce (yet to be published)* *-*	
Detailed protocols		*Aboveground Biomass* *Method 1: Above ground biomass expansion factors* *C stock estimated from the growing stock at the regional level for the year 1990 using Coillte inventory data. A forest inventory will be carried out during 2004/2005 to estimate C stock. Regional biomass expansion factors for lodgepole pine will be developed and applied.* *Method 2: Allometric relationships at tree level* *Due to the nature of the historical inventory data, the ability to apply allometric relationships will need to be considered. Tree measurements will be collected within the project timeframe and compared with the application of BEFs for 2004. Estimates of uncertainty will be carried out as part of the comparison of techniques.* *Belowground Biomass* *National estimates of belowground biomass stock will be applied at the regional level where available. Alternatively literature values will be considered.* *Soil* *Peat depths, bulk density measurements and C analysis will be undertaken to develop C stock estimates in Lodgepole pine at the pilot zone level.*	

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.4.1***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access, Arc View*	
	Field material	*Tree and plot measurement equipment, digital recording equipment, GPS*	
Personal	Qualification/ Time	*Forest Engineer, Forest inventory field crew*	
Data	To buy		
	To compile	*ESAC database, ISA database, UTAD database*	
	To investigate		
	To acquire	*Destructive sampling will be made under the specific study*	
	Bibliography		
Detailed protocols		*For the general study the following tasks are:* *Comparison of carbon stocks estimated with BEF versus allometric equations (tree and/or stand level)* *Study of the effect of using aggregated data (published NFI results) versus the use of raw IFN data (dbh and height) and allometric equations in the estimation of carbon stocks* *One of the objectives of the specific study is the development or improvement of tree biomass equations. Therefore, biomass data for the species, Maritime pine (Pinus pinaster) and Eucalyptus (Eucalyptus globulus) compilation will consist in collecting existing data or acquire new data of tree biomass per components from destructive sampling.* *After the achievement of compatible systems equations for estimation the tree biomass per components, it will be the integrated on growth models that can be use on a simulator into a decision support system to select the scenarios that optimize wood and/or carbon fluxes.* *The study will be conducted at the pilot zone level.*	
Comments		*Although, the proposal consider only two species, if it is relevant other important species can be consider.* *The collection of new data will only be undertaken if the existing data reveals not to be enough.*	

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.4.2***
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile		
	To investigate		
	To acquire	*carbon soil analyses*	
	Bibliography		
Detailed protocols		*At the specific study will be proposed a methodology for the carbon soil estimation. First it will be made a methodology review to select the most adequate and probably the collection carbon soil analyses will be necessary. The study will be conducted at the pilot zone level.*	
Comments		*Regarding C stocks in soils, discussions are engaged with the representatives of C5 in Aquitaine.* *Also, the study will be related with the litterfall study.*	

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.4.4***
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel, Access*	
	Field material		
Personal	Qualification/ Time		
Data	To buy		
	To compile		
	To investigate	*Models for litterfall and decomposition rates*	
	To acquire		
	Bibliography		
Detailed protocols		*The litterfall and decomposition rates for different components, for each Maritime pine (Pinus pinaster) and Eucalyptus (Eucalyptus globulus) stands existing in Lousã, will be one of the objectives of the specific study.* *Results will be used to estimate carbon in litter in the pilot zone.*	
Comments		*This study will be related with the carbon soil study.* *Although, the proposal consider only two species, if it is relevant other important species can be considered.*	

Region concerned		***PORTUGAL-CENTRE***	***Indicator 1.4.5***
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other : (specify)(tick using right button)*	
Equipment	Software	*Excel*	
	Field material		
Personal	Qualification/ Time	*Forest Engineer, Forest inventory field crew*	
Data	To buy		
	To compile	*satellite image*	
	To investigate		
	To acquire	*phytovolume data*	
	Bibliography		
Detailed protocols		*At the specific study, two approaches for the carbon stock estimation will be consider: one regarding the understory for the Maritime pine (Pinus pinaster) and Eucalyptus (Eucalyptus globulus) stands, the other regarding uncultivated areas occupied with shrubs.* *For the first approach it will be estimate carbon stock with a selected methodology with data collected from the national forest inventory.* *For the second approach it will be developed a methodology to monitor carbon stocks in uncultivated areas, most probably based on satellite imagery.* *The study will be conducted at the pilot zone level.*	
Comments		*Although, the proposal consider only two species, if it is relevant other important species can be consider.*	

Region concerned	***NAVARRA***	***Indicator 1.4***
The evaluation of this indicator require	☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☒ *Field measurements*	

		☐ *Other :*
Equipment	Software	*ACCESS, EXCEL; SPSS 11; SAS (2001)*
	Field material	*Beechwood of the Burguete forest*
Personal	Qualification/ Time	*Engineer (specialised in statistics)*
Data	To buy	
	To compile	*IFN database; IF Burguete*
	To investigate	
	To acquire	
	Bibliography	*- FAO – Guidelines for country reporting to FRA 2005,* *- FAO – Specification of national reporting tables for FRA 2005* *- IPCC good practice guidance for LULUCF 2004* *- IFN – Nomenclatura* *- Gracia, Vayreda, Sabatery Ibañez. Biomass expansion factors in 37 tree species in Catalonia*
Detailed protocols		*The comparison of the 2 methodologies to estimate C stock will be conducted at the IFN forest region level in Navarra and only for the aboveground biomass.* *Method 1: Above ground biomass expansion factors* *C stock estimated from the growing stock at the IF forest Burguete level for the year 1990. Estimated in 2000 for the beech forest. The actualisation of forest inventory data is required.* *Use of national biomass expansion factors for coniferous and broadleaved species (IFN), and regional (Cataluña) biomass expansion factors for beech.* *Method 2: Combination of half tree and allometric method (methodology CIFOR-INIA)* *Development of a calculation procedure to estimate the modular values of biomass for the whole forest of Burguete and Provincia* *C stock calculated from the last inventory data available (2004) on beech forest* *Error analysis*
Comments for Navarra		*Protocols CIFOR-INIA to estimate C stocks in aboveground and belowground biomass (including the stump)* *Protocols to estimate C stocks in shrub won't be studied because of the lack of data at the regional level.*

Region concerned	***CASTILLA Y LEÓN***	***Indicator 1.4***
The evaluation of this indicator require	☐ *GIS processing* ☒ *Data processing* ☐ ☒ *Field survey* ☒ *Field measurements* ☐ *Other :*	
Equipment — Software	*Access, Excel, BASIFOR, SAS*	
Equipment — Field material	*Core borer, PDA, calliper, VERTEX, laboratory for dendrochronological analyses including WinDendro, Binocular and sanding machine*	
Personal — Qualification/ Time	*Engineer*	
Data — To buy		
Data — To compile	*IFN database*	
Data — To investigate	*C stocks in belowground biomass, dead wood and shrub*	
Data — To acquire	*Data from ground, understorey and shrub biomass*	
Data — Bibliography	*- IPCC good practice guidance for LULUCF 2004* *-Montero et al. Ecuaciones de biomasa y contenido en carbono. 2004* *Terms and definitions – FRA 2005* *Guidelines for country reporting to FRA 2005 – FAO* *Ley de Montes. 2004* *El Inventario Forestal Nacional. Elemento clave para la gestión forestal sostenible. Ed. 2002* *Mapa Forestal deEspaña (Scale 1: 50 000)*	

		Instrucciones para el apeo de las parcelas de campo del IFN3. Ed. 1997 *Segundo IFN. Explicaciones y métodos 1986-1995. Ed. 1990* *Inventario Forestal Nacional – Palencia – 2º y 3º inventario – IFN*
Detailed protocols		*Allometric relationships at tree level and expansion factors:* *C stock estimated from the growing stock at the IFN pilot zone level for the year 1991 and 2001* *Use of national biomass equations from different species (Montero et al, 2004)* *Develop specific equations for the pilot zone for shrubs species*
Comments for Castilla and León		*Protocols to estimate C stocks in belowground biomass, dead wood and shrub will be studied in order to develop a new methodology to assess the Carbon stock in these compartments.*

Region concerned		***GALICIA***	***Indicator 1.4***
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*	
Equipment	Software	*Access, Excel*	
	Field material		
Personal	Qualification/ Time	*Engineer*	
Data	To buy		
	To compile	*2nd and 3rd IFN*	
	To investigate		
	To acquire		
	Bibliography	*- 2nd IFN (1990)* *- 3rd IFN (2002)* *- BALBOA, M.; ÁLVAREZ, J.G.; RODRÍGUEZ-SOALLEIRO, R.; MERINO, A. (2003). Aprovechamiento de la biomasa forestal producida por la Cadena Monte-Industria. Cuantificación e implicaciones ambientales. CIS-Madera, Revista del Centro de Innovación y Servicios Tecnológicos de la madera de Galicia, nº 10, 1er semestre 2003.* *- FAO – Guidelines for country reporting to FRA 2005,* *- FAO – Specification of national reporting tables for FRA 2005* *- Brañas, J.; González Río, F.; Rodríguez Soalleiro, R.; Merino, A. (2000). Biomasa maderable y no maderable en plantaciones de eucalipto. Cuantificación y estimación. CIS-Madera, 4. Pág 72-75.* *- Merino, A.; rey, C.; Brañas, J.; Rodríguez-Soalleiro, R. (2003). Biomasa arbórea y acumulación de nutrientes en plantaciones de Pinus radiata D. Don en Galicia. Invest. Agrar.: Sist. Recur. For.12 (2). Pág 85-98.* *- Merino, A.; Rodríguez López, A.; Brañas, J.; Rodríguez-Soalleiro, R. (2003). Nutrition and growth in newly established plantations of Eucalyptus globulus in Northwest Spain. Annals of Forest Sciences, 60. Pág 509-517.* *- Rey, C; Brañas, J.; Rodríguez-Soalleiro, R.; Merino, A. (2001). Biomasa y acumulación de nutrientes en plantaciones de Pinus radiata D. Don del norte de España. Actas del III Congreso Forestal Español. Granada. Tomo I. Pág 500-504.*	
Detailed protocols		*The comparison of the two methodologies to estimate C stock will be conducted at the IFN forest region level in Galicia.* *Method 1: above ground biomass expansion factors (regional and target zone level)* *Method 2: allometric relationships at tree level (target zone level)*	

E. Specific studies

1. IRELAND

a) Introduction

As a partner to the FORSEE project, Ireland proposes to undertake a detailed study of C1. This detailed study of carbon stocks will be undertaken in the region of Co. Mayo on the west coast of Ireland and our proposal is outline over the following sections.

(1) Selected Region

The Irish region selected for the detailed study is within the County of Mayo on the West Coast of Ireland. Co. Mayo experiences an average annual temperature of 9.6°C and 1142.7 mm of rainfall over 249 rain days per year. With 9% forest cover, Co. Mayo is one of the most afforested counties in Ireland. Spruce and Pine represent almost 60% of counties forest resource. Blanket peat and peaty gley are the main soil types in the county. The detailed study of the region will be confined to Lodgepole pine plantations on peat soils.

(2) Forest Area

Forest boundaries are recorded in the Forest Inventory and Planning System (FIPS). This tool will be use to identify forested lands and assess the implications of the selection of a forest definition. Currently Irelands definition of forest varies between FAO reporting, Coillte (The Irish Forestry Board) and the newly developed National Forest Inventory (Table 4).

	Defining Criteria	***Coillte Inventory***	***National Forest Inventory***	***FOA***	***UNFCCC***
FOREST	*Area*	*0.5ha*	*>0.1ha*	*>0.5ha*	*Not defined*
	Crown Cover	*20%*	*20% of the total area occupied or 50% of c onventional stocking*	*>10%*	*Not defined*
	Height	*Not Defined*	*5m*	*5m*	*Not defined*
	Width	*Not Defined*	*20m*	*20m*	*Not defined*
OTHER WOODED LAND	*Area*	*>0.2ha*		*Not defined*	*Not defined*
	Crown Cover	*<20%*		*5-10%*	*Not defined*
	Height	*<Yield Class 4*		*<5m*	*Not defined*
	Width	*Not Defined*		*Not defined*	*Not defined*

Table 4: Summary of National and International reporting forest definitions

Analysis of the implications on C stock estimates caused by these definitional differences will be considered in this study.

As a means of verification, planting permits and grant aid applications will be checked against the database.

(3) Growing stock

A forest inventory of the selected area of Lodgepole pine stands on peat will be designed and undertaken based on the information provided by the FIPS database. The inventory will be designed by UCD and jointly conducted with the Western Forestry Co-op. It is intended to design the forest inventory in accordance with the soon to be implemented NFI and consider current Coillte[3] inventory processes ensuring, as much as possible, data compatibility.

[3] Coillte is the Irish Forestry Company which manages all state owned forests. This organisation undertakes a periodic forest inventory, based on non permanent plots, in this estate.

b) FOREST INVENTORY DESIGN

Plots will be located in a false chronosequence of Lodgepole pine forests on peat. Three plots, 12m in diameter will be permanently marked in each age class. Measurements of DBH and height will be recorded for each tree in the plot, enabling volume estimates from models to be generated.

(1) Carbon Stock of woody biomass and soils

Estimation of the identified carbon pools in stands of Lodgepole pine on peat will be undertaken as follows.

(2) Aboveground biomass

In this region we propose to develop allometric relationships for 1 significant tree species, i.e. lodgepole pine, with a focus on trees with small DBH (i.e. young trees). Using destructive techniques, approximately 60 trees will be selected to develop relationships for aboveground biomass based on inventory measurements (DBH, or height for young trees). Additionally national estimates of volume and BEFs for Lodgepole pine will be established through this work.

c) STUDY DESIGN

Trees will be selected across a DBH range of 4 – 30cm with more weight on small diameter trees.

Each tree will be felled at ground level. The stem length will be recorded and diameter measurements taken every 0.5m.

For small trees, volume will be measured using displacement by immersing entire tree in water. Larger trees branches will be removed from the stem and random branches selected for displacement measurement.

Entire trees will be weighed (fresh weight) in the field and samples selected to determine dry weight in the laboratory. IPCC default values for carbon content will be applied.

Trees (approx. 10) from outside the pilot zone will be selected to verify the developed equations.

(1) Belowground biomass

No direct measurement of the belowground biomass is proposed. A literature review on national root studies will be undertaken and advice sort from the IPCC Good Practice Guidance default approach to estimating this pool.

(2) Soil

The detailed study will focus on peat soils, on which the large majority of Lodgepole forests are planted in the selected region. To estimate carbon stock for the project inventory period, peat depth and bulk density measurements will be taken and some carbon determinations carried out. Literature will be reviewed in the attempt to determine a stock for the 1990 inventory, however measuring a carbon stock change with an acceptable level of uncertainty on this soil type in the absence of historical measurements is seen to be a difficulty at this point. Providing a baseline study of carbon stock will however be a useful contribution to Ireland's ability to make future carbon stock change estimates of this pool. Therefore mapping of the measurement locations will be a priority.

(3) STUDY DESIGN

Within the located forest plots peat depth will be measured and a sample taken at the ordinal points. Samples will be bulked for carbon analysis. A sample for bulk density will be taken at the plot centre. Estimates of carbon stock will be made on the plot basis and up scaled up to generate $tCha^{-1}$.

2. NAVARRA

"METHODOLOGY for the QUANTIFICATION OF THE MID AND LONG-TERM CARBON CAPTATION ABILITY FOR *Fagus sylvatica* "
Pilot Station: Montes de Burguete - Spain
M.C. Traver (GAVRN - Spain)

a) Introduction

The methodology presented here was developed and used by the CIFOR-INIA team to estimate the carbon retained in the main tree species in Spanish forests. It has been applied so far to the following: *Pinus sylvestris, Pinus nigra, Pinus pinaster, Pinus halepensis, Pinus pinea, Quercus ilex, Quercus suber, Quercus pyrenaica, Quercus canariensis, Olea europea ssp. sylvestris* and *Eucalyptus globulus*. During 2004 it has also been applied to *Fagus sylvatica.*
The methodology has been specifically designed to be able to apply the results obtained to the information provided by the National Forest Inventory (IFN) or Forest Inventories (IF) of each species directly. This decision determined the sampling method for biomass estimation (felling, individual tree measuring and weighting) and the adoption of the same diametrical class intervals as those used by the IFN.
The method is based on the calculation of carbon retained from aerial and radical biomass estimation, setting an input-output balance through the equivalent carbon dioxide calculation. The biomass estimation is made by combining the half-tree method with the adimensional and allometric method. Modular values for each biomass fraction and diametrical class are also obtained.
During this study this methodology will be validated with data obtained at the pilot zone. It will be also compared with data obtained by using the expansion factor to calculate the biomass. The errors of the application will be calculated in both cases.

b) Material and Methods

(1) Field work (in the natural environment)

Designation of sampling points and selection of sample trees. The sample will contain at least three trees for each diametrical class. Fourteen classes are considered at 5-cm intervals, from 10 cm to 75 cm.

Collection of physiographic data corresponding to the natural environment where the samples are taken: Altitudes, position, slope.

Obtaining data from the standing sample trees: diameter at breast height (dbh), diameter at 4 m, total height (H_t) and living crown height.

Processing of samples and collecting data from felled trees.

(a) Aerial Biomass

- Division of the aerial biomass fractions:
  Stemwood
  Branches > 7 cm diameter
  Branches 2- 7 cm diameter
  Branches < 2 cm diameter and leaves
- Obtaining the green weight of each fraction (weighting)
- Calculation of green stemwood volume by log (V outside bark)
- Preparation of a table containing the green aerial biomass data: volume outside bark of stemwood (m^3) and green weight (Kg)

(b) Belowground Biomass

- Extraction, cleaning and weighing of a stump by diametric class
- Division of the belowground biomass fractions:
  Roots with diameter > 7 cm
  Roots with diameter < 7 cm
  Stump
- Obtaining the green weight of each fraction. The weight of the different fractions
- Preparation of a table containing the green belowground biomass data: green weight (kg)

Obtaining sub-samples of each biomass fraction (aerial and belowground biomass). Three sub-samples of each fraction will be obtained (5 kg each one) and two disks of the stemwood of one tree will be cut at different heights. One sub-sample of thirty leaves will be collected to determinate the humidity percentage in leaves. These samples will be sent to the laboratory to analyse the humidity percentage and basic wood density.

(2) Laboratory work

Estimation of the humidity percentage for each fraction and the wood basic density
The sub-samples of each fraction will be dried in a heater and the dry weight of each fraction obtained. The humidity percentage and the wood basic density will be calculated from these data.

Determination of nutrients (optional)

(3) Office work

Preparation of a table containing the dry matter by fraction, calculated by applying the humidity percentage to each biomass fraction. The volume over bark of the stemwood will be converted into dry weight by using the values of wood basic density (= kg of dry matter/m^3 of green volume).

Obtaining modular values of dry matter from the sample and making tables corresponding to aerial and root parts. A single table will be created with the data corresponding to the dry matter of each fraction and tree. This table will be used to work on the development of the regression function and its later application.

Statistical processing of the data. Obtaining new modular values of dry matter from the equation.
The values of the samples of each biomass fraction will be analysed using different models from functions that relate the dependent variable and the dry matter (kg) with the independent variable (dbh, dbh^2, Ht…). The function that presents the best setting will be selected in each case.

The analysis will be carried out using SPSS and/or a SAS program. One equation will be obtained for each fraction (stemwood, branches with diameter bigger than 7 cm, branches with diameter between 2 and 7 cm, branches with diameter smaller than 2 cm and roots) and for the whole tree. The independent variable could be the same for all the fractions or not, depending on the accuracy of the setting and the way the error is corrected, which will be exposed later.
New modular values, called "modular values from equation", will be obtained from the equations made.

Correction of values
The functions applied to calculate the modular values of the biomass fractions are erroneous and, therefore, the addition of the modular values of the fractions differs from the result

obtained when using the function for the whole tree. In the methodology used by the INIA the error (difference) correction is made by calculating the appropriate percentage of each fraction with respect to the total tree. New modular values are achieved by multiplying these percentages by the total biomass obtained from the formula, and these will be the definitive values. These modular values can be applied to any beech wood located in similar conditions as those in the forest where the sampling is carried out. In our case they will be applied to the pilot zone, which includes the municipal terms of Aria, Aribe, Burguete, Garralda, Orbaiceta, Orbara, Roncesvalles and Villanueva de Aezkoa.
NOTE: If belowground biomass fractions come under the heading of total radicular weight as a complete root, this corresponds to the extracted part (stump, part of the main roots and a small proportion of the rest of the roots), so the belowground biomass is estimated by default.

Determination of thennual increment (current annual growth) for each fraction and preparation of tables containing modular values of the annual increment of dry biomass. The dry biomass difference between two consecutive years will indicate the annual weight increment of each biomass fraction by diametrical class. If we apply the same equations as those used to calculate the biomass we will make the same error, which will be corrected in the same way.

Preparation of information, determination of organic carbon and its equivalent as carbon dioxide, fixed in each biomass fraction and by diametrical class. Preparation of a table containing the carbon modular values by fraction and diametrical class. The total carbon contained in the different tree compartments is present in the dry biomass, so we will consider the carbon as a fraction of the dry biomass weight. Kollman (1959) stated that "Wood composition is identical for different woody species, and also within the same tree in terms of its different parts, stemwood and branches". It is generally admitted that all woods contain approximately 50% carbon, this value is recommended by IPCC if there is no available specific data.
Equivalent CO_2 will be obtained through the proportion between CO_2 molecular weight and C atomic weight (m.w. CO_2 /a.w. C = 3,67 K). CO_2 modular values will be obtained by multiplying the biomass modular values by the C content and by 3.67. The modular values will be calculated and classified by fraction and diametrical class.

Application of modular values to Forest Inventory data (IF, IFN) and to the annual increment. The application of the function to Forest stocks provides the modular values, which supply the total biomass (Mg), the total sequestered carbon and the sequestered CO_2 for each fraction and diametrical class. We will do the same for the biomass and CO_2 annual increments, classified by fraction and diametrical class.

Annual harvest determination and preparation of tables. The average annual harvest values correspond to the green stemwood volume obtained in the forest. Dry biomass weight (kg) corresponding to green volume is calculated by using the basic wood density:

Tm year stemwood = Medium Annual Harvest (m3/year) x Basic density (kg. ms/m3)/1000.
The calculation of the harvests corresponding to the rest of biomass fractions is obtained by establishing the proportion between stemwood extractions and total stemwood stocks, multiplied by the stocks of each biomass fraction:
(Stemwood extrac./ Stemwood stocks) x Fraction stocks = Fraction extrac. (Tm)
This relationship is also valid to calculate the total biomass, carbon and carbon dioxide extractions, because the values of carbon and CO_2 are proportional to dry biomass values, as has been demonstrated throughout the proposed methodology.

Net annual balance of emission-fixation

Knowing the total CO_2 fixed by beech (TF) by the forest during the year $\mathbf{t_1}$, that accumulated each year (AF) and the CO_2 extracted due to annual felling (E), the net annual CO_2 fixation is then determined by the AF-E difference. The total CO_2 fixed during the year $\mathbf{t_2}$ (n years later) will be:

$$TF + n \times FA - n \times E$$

One part of total fixed CO_2 does not return to the atmosphere immediately, but it will be fixed into wood, beams and other products for a certain period depending on its half-life. Another part of the extractions will be left in the forest and they will rot, so the CO_2 will return to the atmosphere in a fairly brief period of time.

c) Comparison with other methods used in biomass estimation

Certain studies have carried out biomass calculations on the basis of the so-called "expansion factors". These are applied to commercial wood in order to obtain the total biomass. However, some articles highlight a lack of consistency throughout the methodology.
In this study expansion factors will be applied to calculate both, aerial and root biomass of the beech wood in the pilot zone. C and CO_2 evaluation, as well as C, CO_2 and biomass annual increments, will be carried out as described throughout the methodology.

d) Conclusion

The methodology presented here is specially designed for application to Forest Inventories or to the National Forest Inventory (IFN), because both provide figures on stocks, annual increments and woodland variations by forest species and diametrical class.
The method makes the determination of fixed carbon and the net fixation for a determined period possible, taking into account annual biomass growth and harvests. The fixation estimate can be calculated for any year, present or future, and for a certain mass. Balance variations that depend on different forestry hypotheses can be also estimated.

3. PORTUGAL CENTRE

a) Introduction

The specific study will be carried out in the "Pinhal Interior Norte" region, which includes the Lousã pilot zone. This region, with a total area of 261 774 ha, is a NUT level III region and, simultaneously, a designated PROF region, subject to a Regional forest plan. It includes 14 counties, one of which being the Lousã pilot zone, with a total area of 13 927 ha.

b) Main objective

To propose an improved methodology to monitor carbon stocks at regional level, namely to fulfil data needs for the Kyoto protocol, in the principal forest types present in the mentioned regions:

- Eucalypt
- Maritime pine
- Mixed stands
- Understorey (Uncultivated areas)

The indicators focused on the specific study are:
(Indicator 1.4.1) – Carbon stock in woody biomass above and belowground
(Indicator 1.4.2) – Carbon stock in soils
(Indicator 1.4.4) – Carbon stock in litter
(Indicator 1.4.5) – Carbon stock in understorey (Uncultivated areas)

Working Package	***Indicator***	***Task***	***Sub tasks***
WP1 –Development or improvement of carbon stocks in forests for the main	*1.4.1*	*1. Biomass equations*	*5*

forest types in Lousã	*1.4.5*	*2. Carbon stock in understorey*	*3*
WP2 – Methodology to monitor carbon stocks in litter and soil	*1.4.2*	*1. Litterfall and decomposition*	*5*
	1.4.4	*2. Soil carbon stock*	*3*
WP3 – Methodology to monitor carbon stocks in uncultivated areas	*1.4.5*	*1. Literature review*	
	1.4.5	*2. Description of the chosen methodology*	
	1.4.5	*3. Test of the chosen methodology*	
WP4 –KYOTO Protocol's	*1.1*	*1. Land use evolution at Lousã*	*5*
	1.2	*2. Growth models*	*4*
	1.4	*3. Prediction of future carbon stocks under alternative scenarios of management*	*3*

c) Working packages:

(1) WP1. Tasks for development/improvement of carbon stocks in forests for the main forest types in Lousã

(a) Biomass equations – *indicator 1.4.1*

Sub-tasks to be undertaken for each species:
Maritime pine (Pinus pinaster)
Eucalyptus (*Eucalyptus globulus)*
Other important species
Compilation of data from destructive sampling, including root biomass

- Identification for the needs of new data and preparation of a field protocol
- New data gathering from destructive biomass
- Database construction
- Development of compatible systems of equations for estimation of tree biomass per components

(b) Carbon stock in understory – *indicator 1.4.5*

Sub-tasks to be undertaken for each specie:
Maritime pine (Pinus pinaster)
Eucalyptus (*Eucalyptus globulus)*
Other important species
Literature review

- Definition of a methodology
- Data gathering from the national forest inventory

(2) WP2. Tasks for development/improvement of carbon stocks in litter and soil

(a) Litterfall and decomposition – indicator 1.4.4

Sub-tasks to be undertaken for each specie:
Maritime pine (Pinus pinaster)
Eucalyptus (*Eucalyptus globulus)*
Other important species
Compilation of existing data in Portugal

- Literature review
- Identification for the needs of new data and preparation of a field protocol
- New data gathering
- Modelling decomposition rates for different litterfall components

(b) Soil carbon stock – indicator 1.4.2

Sub-tasks to be undertaken:
Literature review

- Carbon soil analyses
- Methodology selection and estimation

(3) WP3. Tasks to be undertaken for the development of a methodology to monitor carbon stocks in uncultivated areas – indicator 1.4.5 :

Literature review

- Description of the chosen methodology
- Test of the chosen methodology will be taken in Lousã

(4) WP4. Tasks under the KYOTO Protocol's range

(a) Land use evolution at Lousã – *indicator 1.1.*

Sub-tasks to be undertaken:

- Land-use 1990: Aerial photograph 1:15 000, partially ortorectified, photo-interpretation to be undertaken using the current IFN stand classification
- Land-use 1995 Aerial photograph 1: 40 000, ortorectified, simplified photo-interpretation available - photo-interpretation to be improved according to the current IFN stand classification
- Identification of changes in the land use of forest areas between 1990 and 1995, namely of afforestation, deforestation and reforestation
- Land-use 2004/2005: New aerial photograph is planned for 2004/2005 – photo-interpretation will be undertaken with the current IFN stand classification
- Identification of changes in the land use of forest areas between 1995 and 2005, namely of afforestation, deforestation and reforestation

(b) Growth models – indicator *1.2*

Sub-tasks to be undertaken for each specie:
Maritime pine (Pinus pinaster)
Eucalyptus (*Eucalyptus globulus)*
Other important species
Compilation of existing models for Portugal

- Selection of models/sub-models for each forest stand identified in the NFI
- Compilation of data available to improve the existing growth models
- Selection and improvement of existing growth models

(c) 3. Prediction of future carbon stocks under alternative scenarios of management

Sub-tasks to be undertaken:

- Simulation of alternative land use and management scenarios (construction of scenarios) – *indicator 1.1*
- Prediction of carbon stocks for first commitment period (2008-2012) – *indicator 1.4.x*
- Integration of the simulator into a decision support system to select the scenarios that optimize wood and/or carbon fluxes – *indicator 1.4.1*

F. Work plan outline

1. VI.1 List of indicators or tasks to be achieved for the criteria

a) AQUITAINE

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
Indicator or task 1.1	*0.5*	*0.5*			
Indicator or task 1.2	*0.5*	*0.5*			
Indicator or task 1.4		*6*			

b) IRELAND

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*

Indicator or task 1.1	*1*	*1*			*0.5*
Indicator or task 1.2	*1*	*1*	*3*		*0.5*
Indicator or task 1.4		*6*		*3*	*1*

c) NAVARRA

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
Indicator or task 1.1	*0.7*	*0.6*			
Indicator or task 1.2	*0.7*	*0.6*			
Indicator or task 1.4		*6*	*?*	*0,5*	

d) CASTILLA Y LEON

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
Indicator or task 1.1	*0.5*	*0.5*			
Indicator or task 1.2	*0.5*	*0.5*			
Indicator or task 1.4		*6*	*0.5*	*2*	*1*

e) GALICIA

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
Indicator or task 1.1	*2*	*1*			
Indicator or task 1.2	*1*	*0,5*			
Indicator or task 1.4	*0,5*	*0,5*			

2. VI.2 Regional organisation:

Partners or subcontractors responsible for developing/applying the protocols *(Thank you for fulfilling this table as much as possible, putting (?) when you don't know)*

Criterion 1	***Portugal Centre***	***Portugal North***	***Galicia***	***Castilla y Leon***	***Euskadi***	***Navarra***	***Aquitaine***	***Eire***
Indicator 1.1	*IFN*		*IFN*	*IFN and regional forest services*		*GAVRN*	*IFN*	*UCD*
Indicator 1.2	*IFN CELPA*		*IFN*	*IFN and regional forest services*		*GAVRN*	*IFN*	*UCD*
Indicator 1.4	*Monitoring data*		*IFN*	*IFN and regional forest services*		*GAVRN-INIA*	*IFN*	*UCD*

3. Expert group time chart

C1 expert group plans to visit the pilot zones where specific studies are conducted. Visits could be planned together with the management or technical meetings of the project.

IV. Report of the Expert Group of Criterion 2 - FOREST HEALTH (by Julio Diez Casero)

A. Functioning of the group

1. Participants

First meeting, Bilbao, February 28th 2004

- Francisco Fdez de ANA MAGÁN, Galicia, CIFL
- Julio DIEZ CASERO, Castilla y León, Univ. Valladolid
- Hervé JACTEL, Aquitaine, INRA
- Dominique PIOU, Aquitaine, INRA
- Fernando PUERTAS, Navarra, GAVRN
- Carmen TRAVER, Navarra, GAVRN

Second meeting, Lisbon, May 21st 2004

- Christophe ORAZIO, Atlantic Europe ,IEFC
- Dominique PIOU, Aquitaine, INRA
- Gustavo, Irlande.
- Hervé JACTEL, Aquitaine, INRA
- Joserra DIEZ, Euskadi, IKT
- Julio DIEZ,Castilla y León,Univ. Valladolid
- Manuela BRANCO, Portugal Centre, GAVRN
- Substitute, Galicia, CIFL

Coordinator: Julio Javier Díez Casero (University of Valladolid, Castilla y León)

2. Comments

We have established some baselines level for the methodology, however each region must decide:
Number forests tree species (we advise 1 tree species)
Number of site qualities.
Number of ages.
Number of replicates, we advise 8.

Each region must assess his possibilities, in terms of his staff and time that they can devote to the criteria 2.

B. List of indicators checked by the expert group:

1. Lists used as references

We use the updated list of forest health indicators proposed by the MCPFE, Vienna 2003 and a new indicator propose for expert group.

2. List of indicators checked in the group

Indicator	***Short description***	***Process***	***ID***	***Approved for FORSEE test***
Deposition of air pollutants	*Deposition of air pollutants on forest and other wooded land, classified by N, S and base cations*	*MCPFE Vienna*	*2.1*	*No*
Soil condition	*Chemical soil properties (pH, CEC, C/N, organic C, base saturation) on forest and other wooded land related to soil acidity and eutrophication, classified by main soil types*	*MCPFE Vienna*	*2.2*	*No*
Defoliation	*Defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes "moderate", "severe" and "dead"*	*MCPFE Vienna*	*2.3*	*No*
Forest damage	*Forest and other wooded land with damage, classified by primary damaging agent (abiotic, biotic) and by forest type*	*MCPFE Vienna*	*2.4*	*Yes*
Key factors for damage	*Tree/forest variables that are known to be correlated with this damage*	*Expert group proposal*	*2.5*	*Yes*

C. List of indicators not selected by the expert group :

Criteria	***2***	***Process***	***MCPFE Vienna***	***Deposition of air pollutants***	***2.1***
Short description		*Deposition of air pollutants on forest and other wooded land, classified by N, S and base cations*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Deposition of air pollutants is not relevant for South Western European forests. It only affects to forests near to industrialised areas, which are not representatives of this region.*			

Criteria	***2***	***Process***	***MCPFE Vienna***	***Soil condition***	***2.2***
Short description		*Chemical soil properties (pH, CEC, C/N, organic C, base saturation) on forest and other wooded land related to soil acidity and eutrophication, classified by main soil types*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic*			

	☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*
Rationale	*This group has not select Soil condition, because should be addressed by the C1 or C5 expert groups.*

Criteria	***2***	***Process***	***MCPFE Vienna***	***Defoliation***	***2.3***
Short description		*Defoliation of one or more main tree species on forest and other wooded land in each of the defoliation classes "moderate", "severe" and "dead"*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Defoliation is not selected because it is included in the C.2.4 (Forest damage).*			

D. List of approved indicators

This list must contain as many details as possible, so that any-one can evaluate an indicator reading the table.

Criteria	***2***	***Process***	***MCPFE Vienna***	***Forest Damage***	***2.4***
Short description		*Forest and other wooded land with damage, classified by primary damaging agent (abiotic, biotic) and by forest type*			
Rationale in favour of this indicator		*It can include defoliation estimate.* *This indicator is informative for forest managers.* *It is quiet easy to evaluate for the different forests species present in each FORSEE Regions.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other :*			
Equipment	Computers Software	*Excel, Access and 3. Statistica* *GIS software like ArcView 3.3*			
	Field material	*Binocular, Computer, bags and scissors.*			
Data	To buy	*Digital (aerial) orto-photos* *Forest maps*			
	To compile	*From the IFN database and Spanish Forest Map*			
	To investigate				
	To acquire	*Number and surface of stands from each forest type*			
	Bibliography				
Detailed protocols		*This indicator will measure the variables: defoliation, discoloration, % dead crown, cankers, dieback, miners, cracks, direct action of men, etc (Table 1).* *Select a sample of stands from all types of forest cover (three site qualities and two ages), 8 replicates per forest type, as a whole 48 stands.* *In each stand, establish two fixed area plots (20 m radius) 100 m apart.* *In each plot we will choose 9 trees (see figure 1).* *Besides we will select other tree more that may act as reference, which must to present upper (high) growth and the absence of forest damage. We will use this tree as a model. After, we must to correlate the damage observed on the Tree Model and the decreasing in the growth in relation with the other 18 trees. To achieve Statistical Significance is very important to have the correct number of stands replicates; we propose 8 replicates.* *Sample all trees (19 in each stand), we must fill in the form (table 1) for each tree. This assessment will carry out very easily and quickly.* *Establish a linear transect of 100 m between the two plots. Record all forests damage that you will observe during the transect.*			

	Finally we will develop a Crown Damage Index (CDI), which must be relatively quick and easy to apply.
General comments	*These protocols are defined searching an harmonisation with the protocols established in C4 (biodiversity). Since we will probably carry out the specifics studies C2 and C4.* *Defoliation and discolouration are subjective variables, for that reason our group propose that before that each region begin the field measurement, all regions would meet for harmonized sampling.*

** example:*
The Poplar plantation forest of Carrion basin (Pilot Zone of Castilla y León)

Tree species	***Clone***	***Site quality***	***Age (years)***	***Forest types***
Populus x euroamericana	*I-214*	*1*	*5*	*1*
Populus x euroamericana	*I-214*	*2*	*5*	*2*
Populus x euroamericana	*I-214*	*3*	*5*	*3*
Populus x euroamericana	*I-214*	*1*	*10*	*4*
Populus x euroamericana	*I-214*	*2*	*10*	*5*
Populus x euroamericana	*I-214*	*3*	*10*	*6*

E. Specific study of Castilla Y Leon

In the specific studies we will assess the agents causing the different damages biotic and abiotic, after we will try correlate the symptoms (degree defoliation or discolouration) with type of damage. So in the future an easy monitoring can show the forest health and we can assess the environmental management systems and forest certification schemes.

Experimental process:

1. Monitoring abundance of fungal inoculums in the air using spore traps. Allow sample abundance at scale of forest stand.
2. Monitoring typical symptoms caused by each pathogen in each tree. Allow sample abundance on a tree-specific basis.
    a. In leaves:
        i. Spots and necrosis caused by *Mycosphaerella populi*.
        ii. Anthracnose caused by *Venturia populina*.
        iii. Spots and necrosis caused by *Drepanopeziza punctiformis*.
        iv. Spots and necrosis caused by *Taphrina populina*.
        v. Spots and clorosis caused by *Melampsora populnea*.
    b. In branches and trunk:
        i. Necrosis and canker caused by *Crytodiaporthe populea*
        ii. Necrosis and canker caused by *Valsa sordida*.

3. Monitoring typical signs caused by each pathogen in each tree, to confirm diagnosis. Allow sample abundance on a tree-specific basis:
    a. In leaves:
        i. Picnidia of *Septoria populi*, and peritecia of *Mycosphaerella populi*.
        ii. Mycelium and conidia of *Pollacia elegans*, and peritecia of *Venturia populina*.
        iii. Acervula of *Marssonina brunnea*, and apotecia of *Dedranopeziza punctiformis*.

iv. Ascus of *Taphrina populina*.
v. Uredia and telia of *Melampsora populnea*.

b. In branches and trunk:
i. Picnidia of *Dothichiza populea*, and peritecia of *Crytodiaporthe populea*.
ii. Picnidia of *Cytospora chrysosperma*, and peritecia of *Valsa sordida*.

4. We will carry out field measurements two times each year, the first in winter-spring and the second in summer-autumn. So we will record all possible damages.

5. We will try to find correlations between inoculums, symptoms and sings of different pathogens with tree defoliation, tree size, stand density, age, stand sylviculture, tree growth and site quality.

6. Thus, we could to propose a series of directions for the forest management, which in principle will give rise to suitable forest health.

F. Workplan outline

1. VI.1 List of indicators or tasks to be achieved for the criteria

	Men month estimation for					
Indicator or task for the criteria 2	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Laboratory Identification*	***Total***
Indicator 2.4	*1*	*2*	*1*	*6*		*10*
Indicator 2.5						
TOTAL						
Specific study	*1*	*2,5*	*0.5*	*5*	*6*	*15*

V. Report of the Expert Group of Criterion 3: FOREST PRODUCTS (By Roque Solleiro)

A. Functioning of C3 group

1. Objectives

The objectives of the Criterion 3 working group are to define the list of common indicators to be evaluated in the pilot areas, as well as to propose improved methodologies to evaluate the indicators dealing with forest productivity at the pilot area and regional level.

2. Participants

- Roque Rodríguez (USC Lugo – C3 expert group coordinator)
- Christophe Orazio (IEFC)
- Pedro Ochoa (ISA Lisbon)
- José G. Borges (ISA Lisboa)
- Helena Martins (ISA Lisbon)
- Joao Bento (UTAD Vilareal, Portugal)
- Américo Mendes (UCP Porto)
- Manuel Marey (USC Lugo)
- Ray Gallaguer (Western Forest Cooperatives, Ireland)
- Carmen Traver (GAVR Navarra)
- Fernando Puertas Tricas (GAVR Navarra)
- Olga Moro Coco (CESEFOR)
- Marcos Martín Larrañaga (CESEFOR)
- Pedro Álvarez Álvarez (USC Lugo)
- Fernando Solla-Gullón (USC Lugo)
- Alejandro Cantero (IKT Vitoria)
- Guillaume Chantres (AFOCEL)

3. Criterion 3 expert group meetings

a) Bilbao NEIKER – 26 February 2004

13 people have attended the meeting
OBJ1: To analyze a complete list of indicators for forest productivity.
OBJ2: To define the list of common indicators to be evaluated in all the regions and those will be interesting only in some regions.
OBJ3: To compare the levels of detail of the information available in each region.

b) Palencia ETSIA – 24 June 2004

6 people from the C3 plus 2 more from C6 have attended the meeting
OBJ1: To discuss the drafts of protocols to monitor the 4 common indicators.
OBJ2: To prepare the C3 expert group document for TC meeting on 25 June 2004.

4. Comments

In the C3 meeting the differences between regions in relation to the scales for the work and the availability of information to monitor the indicators were pointed out. For these regions, the protocols could not be exactly the same for any region, and for some indicators the proposal is that each region should develop the monitoring at the better scale available. Each time there was a C3 meeting, at least 1 representative of the C6 expert group on socio-economics has come to participate to the discussions on the methodology.

B. List of indicators checked by the expert group:

1. Lists used as references

1. Improved pan European indicators for sustainable forest management, validated at the Ministerial Conference for the Protection of Forests in Europe MCPFE held in Vienna in 2003.
2. Pan European criteria and indicators of Lisbon, 1998
3. Estudio de recopilación bibliográfica y documental de indicadores de gestión forestal sostenible. Foresna-Zurgaia, Asociación forestal de Navarra.
4. Indicators of the LIFE Project developed in France about Sustainable Management of Forest.
5. Catalogue d'indicateurs pour l'état des lieux préalable a la certification forestière. Association Française de certification forestière.
6. Estimation d'indicateurs de gestion durable des forêts : étude de faisabilité a l'échelle d'une petite région forestière.

As well as the C1 expert group, C3 has used the "FRA 2005 terms and definitions" as a basis for the discussion on improved methodologies at the regional level.

2. List of indicators checked by the group

Criteria	***Short description***	***Process***	***ID***	***Approved for FORSEE test***
3	*1. Increment and fellings*	*MCPFE Vienna*	*3.1*	*Yes*
3	*2. Roundwood*	*MCPFE Vienna*	*3.2*	*Yes*
3	*3. Non-wood goods*	*MCPFE Vienna*	*3.3*	*Yes*
3	*4. Services*	*MCPFE Vienna*	*3.4.*	*No*
3	*5. Forest under management plans*	*MCPFE Vienna*	*3.5*	*Yes*
3	*6. Accesibility*	*Lisbon*	*3.6*	*Yes*
3	*7. Economic profitability*	*Lisbon*	*3.7*	*No*
3	*8. Use the genetically improved stock for plantations*	*Ministerio de Agricultura de Portugal*	*3.8*	*No*
3	*9. Area of afforestation with grants*	*Samalens*	*3.9*	*No*
3	*10. Area of plantations of unsutitable-to-site species*	*LIFE*	*3.10*	*No*
3	*11. Owner´s grouping for private-forest management*	*Samalens*	*3.11*	*No*
3	*12. Timber price*	*Samalens*	*3.12*	*No*
3	*13, Products for energy*	*Samalens*	*3.13*	*No*
3	*14. Timber transformed in site*			*No*
3	*15. Clasification of the total volume in timber grades and products*	*LIFE*	*3.14*	*No*
3	*16. Area of forest under active management*	*Proposed*	*3.15*	*No*

C. List of indicators not selected by C3 expert group

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	***3.4***
Short description		*Indicator 3.4. Services*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			

Rationale		*The Marketed services of the forest can contribute directly or indirectly to increase the income of the forest owners. To gather information about this indicator is necessary to obtain a large amount of data that in many occasions is not available. This indicator should be addressed by C6 expert group*			
Criteria	3	*Process*	*Lisbon*	*ID*	*3.7*
Short description		*Indicator 3.7 Economic profitability*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator is too complicated to test*			
Criteria	3	*Process*	*Ministerio de Agricultura de Portugal*	*ID*	*3.8*
Short description		*Indicator 3.8. Use the genetically improved stock for plantations*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator is only interesting for regions which their pilot zones have forest plantations.*			
Criteria	3	*Process*	*Samalens*	*ID*	*3.9*
Short description		*Indicator 3.9. Area of afforestation with grants*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator is only interesting for regions which their pilot zones have forest plantations.*			
Criteria	3	*Process*	*LIFE*	*ID*	*3.10*
Short description		*Indicator 3.10. Area of plantations of unsuitable-to-site species*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator is only interesting for regions which their pilot zones have forest plantations.*			
Criteria	3	*Process*	*Samalens*	*ID*	*3.11*
Short description		*Indicator 3.11. Owner's grouping for private-forest management*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Only relevant for some regions*			
Criteria	3	*Process*	*Samalens*	*ID*	*3.12*
Short description		*Indicator 3.12. Timber price*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*To be used for other indicators already selected*			
Criteria	3	*Process*	*Samalens*	*ID*	*3.13*

Short description		*Indicator 3.13. Products for energy*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale					
Criteria	3	*Process*	*Samalens*	*ID*	*3.14*
Short description		*Indicator 3.14. Timber transformed in site*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Only relevant for some regions*			
Criteria	3	*Process*	*LIFE*	*ID*	*3.15*
Short description		*Indicator 3.15. Classification of the total volume in timber grades and products*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale					
Criteria	3	*Process*	*LIFE*	*ID*	*3.16*
Short description		*Indicator 3.16. Area of forest under active management*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Only relevant for some regions*			

D. List of approved indicators for C3

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	***3.1***
Short description		*The net annual increment is defined as the average annual volume over the given reference period of gross increment less than of natural losses on all trees to a minimum diameter of 0 cm. Fellings refers in this case to the volumes of all trees, living or dead, measured over bark and to a minimum diameter of 10 cm, that are felled during a given period, whether or not they are removed from forests.*			
Rationale in favour of this indicator		*This indicator is needed to evaluate the balance between annual increment wood and fellings. So these parameters will indicate whether the management is sustainable.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : -*			
Equipment	Software	*Excel, Access, Arc View 8 and 3.3*			
	Field material	-			
Personal	Qualification/ Time	*Engineer*			
Data	To buy	-			
	To compile	*IFN database and auctions registers of the Forest Administration*			
	To investigate	-			
	To acquire	-			
	Bibliography	*- FAO (1998). FRA 2000 .Terms And Definitions. Food and Agriculture*			

		Organization of the United Nations. Forestry Departament. Rome. *- FAO (2004). Global Forest Resoucers Assessment update 2005. Specification of National Reportig Tables for FRA 2005. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- ICONA (1986-1996). Segundo Inventario Forestal Nacional. Madrid* *- MINISTERIO DE MEDIO AMBIENTE (2003). Tercer Inventario Forestal Nacional. Madrid*
Detailed protocols		***Net annual increment:*** *The reference period established in most of the drafts of protocols is 1990-2000-(2005), so this is the period we propose to calculate increments. Many problems arise from the fact that national surveys were done at different dates, so that species specific growth models should be used to project the stand status backward and forward. In those cases where no growth models were available to do so, we propose to consider the period between inventories, so that this could allow for comparisons between the annual results.* *These plot-Ievel data should be applied to a forest area which is derived directly from data of the national surveys. Since 1990 is the reference year for C stock determination, a complete study with satellite images or aerial photographs should be undertaken for the target zone.* *The calculations of the growing stock (which are also necessary for others indictors) would permit the direct comparison and the calculation of the net difference of volumes. By adding the annual fellings to that value, a prediction of the net increment could be obtained. These increments are generally referred to a minimum dbh of 7.5 cm (France and Spain), and a thin-end diameter of 7 cm, without including the stump (all cases). Although the data is not referred to a minimum diameter of 0 cm, we consider that the proposed methodology could provide a good estimation, since the increment is obtained from a difference between inventories.* *In our opinion, there is not need of a plot densification in the cases of national surveys with sampling intensity of 1 plot per 100 ha or more (Spain and France)* ***Fellings:*** *Fellings refers in this case to the volumes of all trees, living or dead, measured over bark and to a minimum diameter of 10 cm that are felled during a given period, whether or not they are removed from the forests. A complete gathering of information seems to be necessary in this case, in a way very related to the protocol to evaluate roundwood. The wood auctions registers of the Forest Administration and the data of volumes recorded in the cutting permit forms that the forest owners should apply for before the Forest Administration, for a period of ten years (1990-2000), will be studied. If possible, the fellings done without a further marketing of the wood would be identified, in order to do not consider those as removals for the roundwood indicator.* *If possible, data for each species should be recorded to study the possible over harvesting in some of them.* ***Regional specification*** *Two cases:* *1.- Regions that will use only the information of the inventory (the most of the cases, P.e. Aquitanie and Ireland).* *2.- Regions where it will be possible to gather information about auctions and cutting licences (Galicia and Euskadi). In these regions, the inventory information will be improved with these data.* *In summary:* *1.- Select IFN plot that belong to the pilot zone* *2.- Gather information to this plots* *3.- Cartographic study to assign the surfaces*

	4.- Office work
General comments	*After FRA2000, the definition of forest area available for wood supply considers those forests where any legal, economic, or specific environmental restrictions do not have a significant impact on the supply of wood. Then, the following areas should not be taken into account:* *1. Wooded areas covered with shrubs which have been not planted recently. 2. Forest with legal or political restrictions, which totally exclude or severely limit wood supply for reasons of environmental or biological diversity conservation. 3. Forest where physical productivity or wood quality is too low or harvesting and transport costs are too high to warrant wood harvesting*

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	***3.2***
Short description		*After the improved Pan-European indicators for sustainable forest management (Vienna, 2002), the indicator Marketed roundwood should include all wood removed from the forest with or without bark, including wood removed in its round form, or split, roughly squared or in other form and sold by the forest owner. Value added processing steps are not included. Marketed roundwood is a direct contribution to the income of the forest owner.*			
Rationale in favour of this indicator		*In this case, the definitions of FAO (FRA 2005) should be considered. The value of wood removal is considered by FAO as the economic contribution from forest and woodlands, so it deals with the market value of the wood removed. The definition refers to both industrial wood and woodfuel removed, as is indicated in the following table. Since the Vienna definition of the indicator clearly refers to an income of the forest owner, we propose do not take into account the timber harvested by the owner for his own use, which is not marketed*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*			
Equipment	Software	*Access, Excel, Arc View 8 and 3.3*			
	Field material				
Personal	Qualification/ Time	*Engineer*			
Data	To buy				
	To compile	*IFN database, auctions registers of the Forest Administration and cutting licences*			
	To investigate				
	To acquire				
	Bibliography	*- FAO (1998). FRA 2000 .Terms And Definitions. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- FAO (2004). Global Forest Resoucers Assessment update 2005. Specification of National Reportig Tables for FRA 2005. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- MCPFE (2002). Improved Pan-European indicators for sustainable forest management. Vienna* *MCPEE (2003). Background information for improved Pan-European indicators for sustainable forest management. Vienna* *- ICONA (1986-1996). Segundo Inventario Forestal Nacional. Madrid* *- MINISTERIO DE MEDIO AMBIENTE (2003). Terver Inventario Forestal Nacional. Madrid*			
Detailed protocols		*Data collection should be done in this case from wood auctions registers of the Forest Administration, which includes the final selling prices, referred to standing-timber prices. These prices should also be used for the removals applied in the forest managed by the owners. The data of volumes and number of trees are generally recorded in the cutting permit forms that the*			

	owners should apply for before the Forest Administration (selling prices are not recorded in this case). A complete gathering of these records should be done, and a complete database including species, volume, number of trees, year or ownership must be elaborated for the period considered. *For all the timber marketed for which no price data were available, we propose to use a regional table of reference standing-prices for different species and diameter classes* ***Period of study*** *Since the draft of protocol for evaluating the indicator 1.1. states that the study will be conducted at the pilot zone level for the year 1990, 2000 and 2005, and also the evaluation of the 1.4 (carbon stock refers to these years, we propose to make and annual evaluation of the removals in all this period, with two levels of detail:* *1. The pilot zone level, in which the complete gathering defined before should be done* *2. A regional level, using data of removals from the Basic Statistics of the Forest Administrations* *The evaluation of the removals could largely change from one year to another, so that a long series of data should be used in this case.* *The incomes of the different years will be discounted to the year of reference, considering discount rates defined specially for timber. The possibility to take into consideration the different rotation lengths of the different species should still be discussed.* *To evaluate this indicator as a ratio, the total amount of incomes for the period of study should be divided by the forest area, defined as the forest and wooded land, as has been (FRA2005)* ***Regional specification*** *Gather the information of harvests done by the Forest Administration (by public auctions) and the removals done by forest owners. These last ones should be evaluated from the cutting licences, which give information about volumes and number of trees removed. If possible, data by diameter classes would be use. Cases of Galicia and Euskadi, where a significant amount of removals come from little forest parcels. Navarra would apply this method but with some changes.* *Use the information from the management plans (available for parcels of a different minimum size depending on the region) and the age-distribution of the plantations in the case of owners not having a FMP. Consider in this case the owners do standard silvicultural practices. Case of Aquitaine or Ireland.* *North and Centre Portugal should determine their appropriate methods.* *The way to obtain the index price is common to all methodologies. This can be studied in function of the normal diameter classes or average tree volume, depending of the way of the logging data (data classified for diameter classes or average tree volume).*

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	
Short description		*Non wood goods are physical merchandises that get out forest, generating or not a direct income to the owner. So it has to distinguish from services to society and from net value.*			
Rationale in favour of this indicator		*Non-wood goods can imply a very important source of economical profits, even, in some cases, can be greater than wood production. Generally, this indicator is very relevant for this criterion although there is not a solid market and it is very difficult to make an inventory as well as other products. This indicator should be addressed in most of the FORSEE pilot zones..*			

The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : -Grey literature review*
Equipment	Software	*Computer*
	Field material	
Personal	Qualification/ Time	*Quantitative sociology expert*
Data	To buy	-
	To compile	
	To investigate	*Forest owner survey*
	To acquire	-
	Bibliography	*"Estudio de la productividad de los bosques de Navarra en cuanto a hongos forestales comestibles, propuestas de ordenación y repercusiones sobre el empleo y la actividad económica de Navarra".Work ordered to GAVRN by regional forest serviceof Navarra,(1997-1998). Unpublished.*
Detailed protocols		*At the moment this indicator is very poorly and partially documented. The work that will be done in FORSEE will cross to information providers :* *1/ Grey literature and case study can be extrapolated to estimate the importance of non wood market at the pilot zone or at the regional level.* *2/ A forest owner survey planned for the criteria 6, can also provide data about non wood product sold or not provided by the forests.* *Deliverable will be estimation at the pilot zone level of the annual harvest of each kind of non wood product collected on the pilot zone.*
General comments		*The work already done by certification process or national estimation of indicators can give us an idea of the list of this product. The main challenge will be to estimate quantities: bark, berries, foliage, flowers, honey, mushrooms, …*

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	***3.5***
Short description		*The indicator quantifies the forest area, for which a planning process has been carried out and documented in written form. The management document can be operational (management plant) or less specific (equivalent). It is registered or approved by public authorities, but this is not precondition (MCPFE, 2002)*			
Rationale in favour of this indicator		*The existence of a forest management plan or equivalent indicates approaches of forest management towards pre-set goals, and has the intention to archive these goals. The plan in general contributes to sustainable forest management, but can not guarantee it. On the other hand, sustainable management can be carried out without a written management plan*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other : -*			
Equipment	Software	*Excel, Access, Arc View 8 and 3.3*			
	Field material	-			
Personal	Qualification/ Time	*Engineer*			
Data	To buy	-			
	To compile	*- Auctions registers of the Forest Administration and private owner*			
	To investigate	-			
	To acquire	-			
	Bibliography	*- FAO (1998). FRA 2000 .Terms And Definitions. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- FAO (2004). Global Forest Resoucers Assessment update 2005. Specification of National Reportig Tables for FRA 2005. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- MCPFE (2002). Improved Pan-European indicators for sustainable forest management. Vienna*			

		MCPEE (2003). Background information for improved Pan-European indicators for sustainable forest management. Vienna *- Ministère des Ressources naturelles, de la Fauna et des Parcs Service aux citoyens (2003). 2005 Evaluation of Timber Supply and Forest Management Agreement Holders.*
Detailed protocols		*The plans will usually include goals and objectives, stand age and type maps, aerial photographs, an inventory, and a list of management recommendations for practices such as controlled burning, timber stand improvement, timber sales, site preparation, and regeneration through natural means or through tree planting. The minimum information that we believe as necessary are: clear goals, stand inventory, plan of investments, recording of costs, plan of silvicultural practices, recommendations for practices and a map.* *It is necessary to point out that the management plan could be oriented to conservation, seed production or other objectives.* *The indicator could be defined as the percentage of the total forest and other wooded land which is managed under management plans, so that the units should be in %. In those regions where the management area could be estimated for species, data for each of them could be considered.*
General comments		*The Forest Administration has usually a registry of management plans, which includes not only documents for forest managed by the Forest Service, but often also those plans which have received public grants for redaction or application. Those private management plans which have been not approved by public authorities are not recorded by the public registries, so that it would be necessary to gather them by a field check. In our opinion, all the landowners of a forest larger than 3-5 ha (frequently in different parcels) in the pilot area should be asked for the existence of such a document, and, with the goal of gather more information about the application of an active management, whether the owner keep records of activities and costs.* *Perhaps is possible to take advantage of the field work in the C4 group to enquire the owners to get information about the application of an active management or existence of a FMP not registered*

Criteria	***3***	***Process***	***MCPFE Vienna***	***ID***	***3.6***
Short description		*The net of roads (or similar) that let the access to forest lands (the unit of measurement is meter of roads per hectare).*			
Rationale in favour of this indicator		*There is not possible to manage any forest without good conditions of accessibility, so this indicator gives us much information about this parameter.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other :*			
Equipment	Software	*Access, Excel, Arc View 8 and 3.3*			
	Field material				
Personal	Qualification/ Time	*Engineer*			
Data	To buy	-			
	To compile	-			
	To investigate	-			
	To acquire	-			
	Bibliography	*- FAO (1998). FRA 2000 .Terms And Definitions. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- FAO (2004). Global Forest Resoucers Assessment update 2005. Specification of National Reportig Tables for FRA 2005. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- Sedlak, O., 1984. Principios generales sobre la planificación de redes de carreteras forestales. En: La explotción maderera de bosques de montaña, FAO, 27-48.* *- Sundberg, U. y Silversides, C.R., 1988. Operational efficiency in forestry.*			

		Kluwer Academic Publishers, vol 2. *- Vignote, S., et al, 2001. Manual de gestión forestal sostenible de las primeras claras sobre repoblaciones de coníferas. AITIM, Madrid, 29pp.* *- USDA, 2000. Forestry best management practices for Illinois. Illinois Department of Forestry.*
Detailed protocols		*This cartography should be used in a digital format if possible, and the topographic maps 1:5000 would be also used. We propose each region would use the better scale available, but in most of the cases the comparison could be possible at least in the 1:5000 scale.* *The main types of the roads are:* ***Temporary roads**. The most common type of roads, designed and constructed for a short term and used during a specific project, specially a timber harvesting. They are only used when the ground is firm. When the project is finished, the road is closed, all stream crossing were removed and the road is naturally revegetated or replanted.* *It is very important in this case the knowledge of the system of symbols considered in the cartography, since the temporary roads are often represented in the more detailed maps. The symbols are sometimes wrong, especially when the representation is derived exclusively from photo interpretation. A field checking is thus necessary. The characteristic vehicle for this kind of ways is the tractor, instead of the lorry (Vignote et al, 2001), the maximum grade is 20%, the levelling width is commonly 3 to 3,5 m and, in most cases, no drainage system is constructed. Temporary roads should not be included in the calculation of the road density, although it could be difficult to precise whether a road must be considered as permanent or temporary.* *Skid trails, which are temporary travel-ways for logging equipment to transport trees or logs to a landing and which receive no ground preparation at all, will not be considered for road density calculation.* ***Permanent roads.** These are the roads that make a permanent contribution to the forest accessibility, so that they should be keep in consideration. The permanent roads are classified in different ways after the scholars. They could be seasonal roads or permanent all-season roads, these usually having gravel surfaces which allow the traffic on any ground state.* *Other classification focussed in the location and planning of the road system, and thus, Sedlak (1984) consider the access roads, principal roads and secondary roads. The two first have a permanent use and a complete drainage system, with maximum longitudinal grade of 12%. Occasionally they have asphalt surfacing, especially in the case of access roads, which connect the forest land to the public roads. There is no doubt that this type of roads should be considered for road density calculations.* *The secondary forest roads have usually a seasonal use, because the surface is constructed using gravel or crushed rock. The characteristic vehicle is still the lorry, although the traffic is restricted in wet seasons. The minimum width of the levelling is 3m, and the maxim grade is 15%. The drainage structures can include roadside ditches and pipe culverts for cross drains, but often these roads have no drainage system (Vignote et al, 2001). There are many roads which have been constructed for fire fighting that could be included in this category. Our proposal is to consider these roads for calculation in the case when they could be classified as permanent structures.* *In many cases, roads which have been constructed as permanent structures become inactive, and the lack of maintenance give the possibility of erosion or natural revegetation, these being especially quick processes in high rainfall regions. Such degradated roads that do not allow traffic and do not have signs to be near reparation activities should not be considered for monitoring forest accessibility.* ***Public roads.** It is generally stated that forest roads connect the forest land to existing public roads, but in some southatlantic European regions the net of public roads often cross small polygons of forest lands, giving to these parcels directly an access service and even the possibility of locate the landings beside*

	the public road. These roads are classified usually after their administrative dependence into: country roads, secondary or B-roads, major or A-roads and divided highways. As the category of the road increase, such roads acquire a higher value for timber transportation purposes, but a lower interest for being used as ways for harvesting operations. We propose to take into account those roads which do not have restrictions to the direct incorporation to the traffic of lorries or forest tractors. This excludes obviously the divided highways and those highways not having lateral service tracks for tractors. *Special cases* ***Tracks or trails.*** *They are referring to paths or rough roads which are made of earth rather than having a specific designed and constructed surface. They are employed mainly in the countryside and for traditional agricultural uses, allowing parcels to have a service. They are usually narrow and thus used by jeeps or all-purposes vehicles, also by farm tractors, so that they can not provide good accessibility for forest tractors. They are usually represented in the cartography, being particularly in plenty near the villages. Our general proposal is do not take them in consideration, except in the cases when they were wide enough (<3m) to allow the traffic of logging tractors such as forwarders or skidders. It is thus necessary a field check to evaluate this situation.* ***Fuel break.*** *Although their design and construction are not orientated to improve the forest accessibility for harvesting, they often are used for such purposes, and even they are used as secondary roads. Our proposal is to take them into account for the length of ways calculation, under the following conditions: maximum grade of the fuel break of 15%, free of obstacles for circulation, signs that apparently the fuel break is currently being used as a road for vehicles and lorries, subjected to frequent operations of maintenance.* ***General Details*** *It is necessary to know the surface that the net of roads provide services, using cartography and taking into account the width of buffer on both sides of the roads. This parameter is depending of the slope and should be studied in detail. Give values classified by slope classes (0-12%, 12-20%, 20-35%, 35-60%, >60%)* *It is necessary to define the width of the harvestable area depending on the slope, and based on the net of permanent roads (see harvestability indictor that has been selected in a second step).*
General comments	***Type of lands to consider are****:* ***Forest****: Land spanning more than 0,5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.* *This class of land is dedicated to forest activity, and includes forest land, burned areas of forest stands, clear-cut areas and other forest.* ***Wooded land :*** *Land not classified as "Forest", spanning more than 0,5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.*

Criteria	***3***	***Process***	***MCPFE Lisbon***	***ID***	
Short description		*Harvestability. Percentage of forest area where timber can be harvested without the need to constructing new forest roads*			

Rationale in favour of this indicator		*This indicator takes into account the accessibility of the site for a lorry, as well as the slope and the distance needed for using harvest machinery. There is uneconomic to harvest in remote or very rough areas, and forests in these areas have no productive goals.*
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other :*
Equipment	Software	*Access, Excel, Arc View 8 and 3.3*
	Field material	
Personal	Qualification/ Time	*Engineer*
Data	To buy	-
	To compile	-
	To investigate	-
	To acquire	-
	Bibliography	*- FAO (1998). FRA 2000 .Terms And Definitions. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- FAO (2004). Global Forest Resoucers Assessment update 2005. Specification of National Reportig Tables for FRA 2005. Food and Agriculture Organization of the United Nations. Forestry Departament. Rome.* *- Sedlak, O., 1984. Principios generales sobre la planificación de redes de carreteras forestales. En: La explotción maderera de bosques de montaña, FAO, 27-48.* *- Sundberg, U. y Silversides, C.R., 1988. Operational efficiency in forestry. Kluwer Academic Publishers, vol 2.* *- French National Forest Inventory.* *- USDA, 2000. Forestry best management practices for Illinois. Illinois Department of Forestry.*
Detailed protocols		*The cartography should be used in a digital format if possible, and the topographic maps 1:5000 would be also used. We propose each region would use the better scale available, but in most of the cases the comparison could be possible at least in the 1:5000 scale.* *The main types of the roads are:* *This indicator should evaluate the possibility to harvest trees in an area, i.e., to do the following operations: felling and processing, gathering of the logs, extraction of the logs by skidder, forwarder or other machinery to a landing. The total harvesting distance could be defined as the total amount of distance that the logs should cover to reach a road accessible for a lorry or where a landing could be established.* *We could consider the roads accessible for lorries as the permanent roads defined for the indicator Accessibility (3.6). These are the roads that make a permanent contribution to the forest accessibility, so that they should be keep in consideration. They could be seasonal roads or permanent all-season roads, these usually having gravel surfaces which allow the traffic on any ground state. The secondary forest roads have usually a seasonal use, because the surface is constructed using gravel or crushed rock. The characteristic vehicle is still the lorry, although the traffic is restricted in wet seasons. The minimum width of the levelling is 3m, and the maximum grade is 15%. A further analysis of the length of the radius of the curves should be done to identify the curves large enough to allow a log truck to negotiate the turn. A reference minimum length for the radius could be 25 m, although this value depends on the type of lorry and the pr4esence of overwidth in the curves. This definition is less restrictive than those used in the National French Forest Inventory (minimum width of 4 m, maximum grade of 10%).* *The field work necessary for the indicator Accessibility would provide, at least for some areas of the pilot zone, the classification of al the existing roads, and so the roads accessible for lorries. We propose a simplified calculation of the harvesting distances as the distance in a straight line, from the compartment to be felled to the next permanent road, using GIS. It can be pointed out that the need to open temporary roads would not be considered in this case.*

	To calculate the surface of harvestable forest, these points should be considered: *Any area closer than 200 m from a permanent road is harvestable using winches.* *Areas separated 200-1000 m would be considered as harvestable if there is not areas with slope higher than 60% in the way to the closer permanent road.* *Areas separated 1000-2000 m would be considered as harvestable if there is not areas with slope higher than 35% in the way to the closer permanent road.* *Areas separated more than 2000 m would not be considered as harvestable.* *The value of the indicator can be expressed as the percentage of forest land which appears as harvestable.*
General comments	***Type of lands to consider are**:* ***Forest**: Land spanning more than 0,5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.* *This class of land is dedicated to forest activity, and includes forest land, burned areas of forest stands, clear-cut areas and other forest.* ***Wooded land :** Land not classified as "Forest", spanning more than 0,5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.*

E. Specific studies

No specific study will be done on this criterion.

F. Work plan outline

1. VI.1 List of indicators or tasks to be achieved for the criteria

	Men month estimation for				
Indicator or task for the criteria 1	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
Indicator or task 3.1	*0,25*	*1*			
Indicator or task 3.2	*0,5*	*0,5*			
Indicator or task 3.5	*0,5*	*0,5*		*0,5*	
Indicator or task 3.6	*1*	*0,5*		*1*	
Indicator Harvestability	*0,5*	*0,5*	*0,5*		

G. Conclusion

The task has been done in a correct way, although some regions didn't make a selection of the methodologies that they are using for each indicator yet (*in November 2004*).

VI. Report of the Expert Group of Criterion 4 – Biodiversity (By Herve Jactel)

A. Functioning of the group

1. Participants

First meeting, Bilbao, February 28th 2004

- Hervé JACTEL, Aquitaine, INRA
- Dominique PIOU, Aquitaine, INRA
- Julio DIEZ CASERO, Castilla y Leon, Univ. Valladolid
- Ibone AMEZAGA, Pais Vasco,Univ. Pais Basco
- Mikel SAN SEBASTIAN, Pais Vasco, Univ. Pais Basco
- Joserra DIEZ, Pais Vasco - Cantabria, IKT
- Carmen TRAVER, Navarra,
- Fernando PUERTAS, Navarra,

Second meeting, Lisbon, May 21st 2004

- Hervé JACTEL, Aquitaine, INRA
- Dominique PIOU, Aquitaine, INRA
- Christophe ORAZIO, Aquitaine, IEFC
- Rémi Tessier du Cros, Aquitaine, IFN
- Julio DIEZ CASERO, Castilla y Leon, Univ. Valladolid
- Miren Onaindia,Pais Vasco,Univ. Pais Basco
- Joserra DIEZ, Cantabria, IKT
- Pedro Álvarez Álvarez, Galicia, Univ. Lugo
- Susana Dias, Portugal, ISA
- Fransisco Rego, Portugal, ISA
- Raoul Salas Gonzalez, Portugal ,ESAC
- Gustavo Saiz, Ireland, Univ. Dublin

Coordinator: Hervé Jactel (INRA, Aquitaine)

2. Meeting

The two meetings were well organised and quite fruitful thanks to the Basque and Portuguese colleagues

3. Comments

The list of experts varied from the first to the second meeting and it is not yet stabilised. This results from the fluctuant availability of the colleagues but also from the uncertainty concerning the involvement of some of the regions in the test of biodiversity indicators. This should be discussed by the regional FORSEE coordinators.

B. List of indicators checked by the expert group :

1. Lists used as references

We use the updated list of biodiversity indicators proposed by the MCPFE, Vienna 2003

2. List of indicators checked in the group

Indicator	***Short description***	***Process***	***ID***	***Approved for FORSEE test***
Tree species composition	*Area of forest and other wooded land, classified by number of tree species occurring and by forest type*	*MCPFE Vienna*	*4.1*	*Yes*
Regeneration	*Area of regeneration within even-aged stands and unevenaged stands, classified by regeneration type*	*MCPFE Vienna*	*4.2*	*Yes*
Naturalness	*Area of forest and other wooded land, classified by "undisturbed by man", by "semi-natural" or by "plantations", each by forest type*	*MCPFE Vienna*	*4.3*	*Yes*
Introduced tree species	*Area of forest and other wooded land dominated by introduced tree species*	*MCPFE Vienna*	*4.4*	*Yes*
Deadwood	*Volume of standing deadwood and of lying dead-wood on forest and other wooded land classified by forest type*	*MCPFE Vienna*	*4.5*	*Yes*
Genetic resources	*Area managed for conservation and utilisation of forest tree genetic resources (in situ and ex situ gene conservation) and area managed for seed production*	*MCPFE Vienna*	*4.6*	*No*
Landscape pattern	*Landscape-level spatial pattern of forest cover*	*MCPFE Vienna*	*4.7*	*Yes*
Threatened forest species	*Number of threatened forest species, classified according to IUCN Red List categories in relation to total number of forest species*	*MCPFE Vienna*	*4.8*	*No*
Protected forests	*Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural elements*	*MCPFE Vienna*	*4.9*	*No*

C. List of indicators not selected by the expert group :

Criteria	***4***	***Process***	***MCPFE Vienna***	***Genetic resources***	***4.6***
Short description	*Area managed for conservation and utilisation of forest tree genetic resources (in situ and ex situ gene conservation) and area managed for seed production*				
Reason for non selection	☒ *Already well documented* ☒ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*				
Rationale	*Forest genetic resources for the main tree species from South Atlantic Europe have been thoroughly studied, particularly within the frame of the EUFORGEN research program. Areas managed for conservation, utilisation and production of tree genetic resources are well known (classified stands/populations and seed orchards). This indicator is therefore easy to document*				

Criteria	***4***	***Process***	***MCPFE Vienna***	***Threatened forest species***	***4.8***
Short description	*Number of threatened forest species, classified according to IUCN Red List categories in relation to total number of forest species*				
Reason for non selection	☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic*				

	☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*
Rationale	*According to experts the Red list is not reliable (lots of missing species, some rare species are indeed abundant…). By definition most rare species are characterized by a poor abundance and are consequently hard to sample…*

Criteria	***4***	***Process***	***MCPFE Vienna***	***Protected forests***	***4.9***
Short description	*Area of forest and other wooded land protected to conserve biodiversity, landscapes and specific natural elements*				
Reason for non selection	☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*				
Rationale	*The total area of forest protected to conserve biodiversity is really small in Atlantic Europe and almost null in the Pilot Zones*				

D. List of approved indicators

This list must contain as many details as possible, so that any-one can evaluate an indicator reading the table.

Criteria	***4***	***Process***	***MCPFE Vienna***	***Tree species composition***	***4.1***
Short description	*Area of forest and other wooded land, classified by number of tree species occurring and by forest type*				
Rationale in favour of this indicator	*The relevance of tree species to global forest biodiversity is largely acknowledged. For example a good deal of species are known to be tree-species specific (different assemblages in conifers vs. broadleaved) and species richness tends to increase with the number of tree species per stand.*				
The evaluation of this indicator require	☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : aerial photos*				

Criteria	***4***	***Process***	***MCPFE Vienna***	***Regeneration***	***4.2***
Short description	*Area of regeneration within even-aged stands and unevenaged stands, classified by regeneration type*				
Rationale in favour of this indicator	*The type of tree regeneration (artificial vs. natural) is the key factor that determines the stand structural complexity (even aged vs. uneven aged) which is known to greatly influence the biodiversity. The structural component of the tree stand determines the biodiversity by providing species with different niches*				
The evaluation of this indicator require	☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : aerial photos*				

Criteria	***4***	***Process***	***MCPFE Vienna***	***Naturalness***	***4.3***
Short description	*Area of forest and other wooded land, classified by "undisturbed by man", by "semi-natural" or by "plantations", each by forest type*				

Rationale in favour of this indicator	*Sylviculture practices, aiming at increasing wood production, change both processes, structure and composition of the original forest and consequently the prerequisite for the native species. Numerous studies indicate the effect of rotation time, understorey management, thinning, harvesting etc. do influence biodiversity.*
The evaluation of this indicator require	☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : aerial photos*

Criteria	***4***	***Process***	***MCPFE Vienna***	***Introduced tree species***	***4.4***
Short description		*Area of forest and other wooded land dominated by introduced tree species*			
Rationale in favour of this indicator		*Alien tree species influence the biodiversity of a forest stand as such but also indirectly by influencing the species composition of the associated flora (understorey) and fauna (herbivores). It can also affect the frequency and intensity of disturbance that may in turn affect biodiversity*			
The evaluation of this indicator require		☒ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : aerial photos*			

For the former 4 stand-level indicators (4.1 to 4.4) we propose the same protocols, materials and methods:

Equipment	Computers Software	*Computer* *GIS software like ArcView 3.3 (875€)*
	Field material	
Personal	Qualification/ Time	*Engineer* *1 man-month (for 5000 ha)*
Data	To buy	*Digital (aerial) ortho-photos (700€ for 5000 ha)* *Forest maps*
	To compile	
	To investigate	*Presence of exotic tree species, type of stand management*
	To acquire	*Number and surface of stands from each forest type*
	Bibliography	
Detailed protocols		*Define the limits of the study area (all or part of the Pilot Zone)* *Import digital orto-photos of the study area in Arcview* *Map the limit of the polygons* *Define a land cover typology (land use types) for the forest stands using a combination of the four stand-level Vienna Indicators (4.1 to 4.4)** *Use the EUNIS land cover typology for the other stands (e.g. meadows, grasslands, crop lands etc.)* *Attribute a land-use to each of the polygons in the study area* *Correct the land-use attribute according to a field survey (presence of exotic trees, type of stand management…)* *Calculate the mean area of forest per category of tree composition, stand regeneration, naturalness and dominance of exotic species.*
General comments		*An harmonisation of the forest mapping procedures across all involved regions would be of great interest. This could be achieved by using the same software (Arcview) and by organising training course if requested*

* Example:
The maritime pine plantation forest of south-western France (Pilot Zone of Aquitaine)

Tree species composition	***Regeneration***	***Naturalness***	***Origin***	***Land-use TYPES***
Pure pines	*even-aged*	*plantation*	*native*	*V1*
Mixed oaks and pines	*uneven-aged*	*semi-natural*	*native*	*V2*
Mixed broadleaves	*uneven-aged*	*semi-natural*	*native*	*V3*
Mixed broadleaves	*even-aged*	*plantation*	*Native & acclimated*	*V4*

Criteria	***4***	***Process***	***MCPFE Vienna***	***Deadwood***	***4.5***
Short description		*Volume of standing deadwood and of lying dead-wood on forest and other wooded land classified by forest type*			
Rationale in favour of this indicator		*A large proportion of forest species (saproxylic beetles, lichens , fungi but also birds and rodents) depend on the presence of dead wood which can supply them with food or shelter. It is not only the total volume of dead wood but also the variability of its quality that is beneficial to biodiversity.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other*			
Equipment	Computers Software				
	Field material	*Metric tapes, compass, permanent spray paint, hammer*			
	Qualification/ Time	*Technician* *3 man-month (for 50 stands = 100 plots + 50 line transects)*			
Data	To buy				
	To compile				
	To investigate				
	To acquire	*Volume and diversity of dead wood*			
	Bibliography				
Detailed protocols		*Select a sample of stands from all types of forest cover (typology based on the 4 stand-level Vienna Indicators), 10 replicates per forest type or more, up to 50 stands* *In each stand, sample all snags (standing dead trees) in two fixed area plots (20m radius) 100m apart: record species, dbh, height and class of decay for each snag* *Establish a linear transect of 100m between the two plots. Measure all the logs (or dead and downed) intercepted by the line transect. The minimum dimensions these woody detritus are 10 cm diameter at the large end and 1 m in length. For all logs, record species, dbh, length, and class of decay.* *Calculate the volume per type of coarse woody debris*			
General comments		*Many methods exist to evaluate the volume of dead wood, more discussion are probably needed to refine the proposed protocol. An harmonisation with the methodology proposed by the C1 Expert Group for evaluating the carbon stock in dead wood would be also of interest.*			

Criteria	***4***	***Process***	***MCPFE Vienna***	***Landscape pattern***	***4.7***
Short description		*Landscape-level spatial pattern of forest cover*			
Rationale in favour of this indicator		*Forest cover continuity (in time) is of great importance for biodiversity, particularly for long living species and species dependent on old growth trees. Landscape fragmentation (discontinuity in space) influence the biodiversity by reduction of habitat size and increased isolation of habitat*			

		patches, increasing the risk of extinction of isolated populations among species with small dispersal abilities (metapopulation dynamics). By contrast, forest connectivity, the degree to which isolation is prevented by landscape elements allowing organisms to move among patches, can maintain biodiversity. Landscape heterogeneity can increase biodiversity by providing a diversity of habitats beneficial to different species.
The evaluation of this indicator require		☒ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other*
Equipment	Computers Software	*Spatial analyst for ArcView (875€)* *Fragstat (freeware)*
	Field material	
	Qualification/ Time	*Engineer* *1 man-month (for 5000 ha)*
Data	To buy	
	To compile	
	To investigate	*Presence of exotic tree species, type of stand management*
	To acquire	*Values of landscape metrics (Fragstat)*
	Bibliography	
Detailed protocols		*Use the same sample of stands from all types of forest cover (typology based on the 4 stand-level Vienna Indicators), 10 replicates per forest type or more, up to 50 stands* *Define a buffer zone of 500m radius around each sample stand (avoid the overlapping of buffer zones from two adjacent stands). This buffer zone will intercept a part of the study area (Pilot Zone) where all polygons are characterized by a land-use cover, based on the EUNIS typology for non forest polygons and based on the four stand-level Vienna Indicators for the forest polygons.* *Use Spatial Analyst program (ArcView) to import the land-use information from each buffer zone in Fragstat* *Calculate in Fragstat the landscape metrics for each buffer zone. Three types of metrics are needed to define the landscape pattern: fragmentation (e.g. number of patches=polygons, mean patch size, edge density, area weighted mean shape index), heterogeneity (Shannon's diversity index, Shannon's evenness, percentage of each forest type), connectivity (mean nearest neighbour distance between two patches of the same forest type).*
General comments		*The list of potential forest landscape metrics is endless. It will be refined by the expert groups based on available knowledge or based on a PCA (selection of non correlated landscape variables accounting for the maximum variance of observed data). Likewise the radius of the buffer zone might be adjusted to the size of the study area.*

E. Specific studies

Two specific studies are proposed in order to test for the relevance of the biodiversity indicators proposed by the MFCPE (Vienna 2003). They will be conducted in Aquitaine, but also partially in Basque country, Castilla y Leon and Portugal.

1. Comparison of the "Vienna Indicators" values with species richness and abundance at the stand level

- In each of the 50 sample stands, species from three taxonomic groups will be sampled: vascular plants, carabids (ground beetles) and birds
- Ground-dwelling carabids will be sampled with the pitfall trap method (Spence and Niemelä 1994). In each stand 5 pitfall traps will located at least 10 m apart in a cross design and in the centre of the stand in order to avoid edge effects. Each trap will have a volume of > 500 ml and will be filled with ethylene-glycol or

formaline or a solution of quaternary ammonium diluted at 25 %. Each trap will be covered to be protected from rainfalls, debris and small mammal disturbances. Trapping period will go continuously from late April to mid-October (with a possible break during summer) and traps will be collected every 3 weeks (or 2 weeks if the captures are abundant). Facilities/taxonomic knowledge permitting, spiders will be sampled with the same method.

- Breeding birds will be sampled by the point-count method (Blondel et al. 1981). The observer will located in the centre of the stand and noted all birds heard or seen, with unlimited distance but within the stand, during 20 minutes in a 5 hours period after sunrise, in non rainy days. Two 20 min-counts will be performed, the first visit was made during the early breeding season (mid-April to mid-May) and the second during the late-breeding season (mid-May to mid-June). Each singing male heard or breeding pair seen will be noted 1 and each non-singing bird heard or seen was noted 0.5. The abundance index used was a semi-quantitative index ranging from 0 to 5. Bird species abundance in the analyses will be the best abundance index noted for each species among the two 20 min-counts. Non-confirmed breeders and breeding species occurring in less than 3 stands will be excluded from further analyses.
- Vascular plants will be sampled by the Braun-Blanquet abundance-dominance coefficient method in 25 m² quadrats randomly located within the stand (Bullock 1996).
- An ANOVA procedure will be used to test the effect of the stand-level Vienna indicators (class variables) on biodiversity direct estimates (species richness and abundance)
- A multiple stepwise regression procedure will be used to test the correlation between the landscape-level indicators values (indices of fragmentation, heterogeneity and connectivity) and the biodiversity direct estimates (species richness and abundance).

2. Comparison between the relevance of the "Vienna Indicators" and the "Habitat Indicators" for biodiversity evaluation in forest

- Considering that forest stands are habitat patches for forest species, we propose to use compositional and structural variables to characterize their quality (key factor approach, Larsson 2001). We further suggest keeping the variables that are easily documented from forest maps or aerial photos in order to provide forest-users friendly indicators.
- Based on experts' knowledge and literature, we will refine a list of key habitat types for plant, carabid and bird forest species at the regional level. Each of them will be defined by a combination of compositional variables (using the EUNIS typology) and structural variable including for example stand age or canopy height, tree density or canopy cover, stand size and shape.
- The list of key habitat types will provide a new land-use typology for forest stands. This typology will be applied to the same sample of 50 stands and their buffer zones. Landscape metrics will be recalculated using this new land-use cover.
- Both ANOVA and correlation procedures will be used to test the effect of stand level and landscape level attributes on biodiversity estimates (species richness and abundance).

F. Workplan outline

1. VI.1 List of indicators or tasks to be achieved for the criteria

	Men month estimation for				
Indicator or task for the criteria 4	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	***Total***
Indicator 4.1 + 4.2 + 4.3 + 4.4	*0.75*		*0.25*		*1.0*
Indicator 4.5		*0.25*		*2.75*	*3.0*
Indicator 4.7	*1.0*				*1.0*
TOTAL	*1.75*	*0.25*	*0.25*	*2.75*	***5.0***
Specific study 1 (validation of Vienna indicators by comparison with plant, carabids and bird species richness)		*0.25*		*4.75*	***5.0***
Specific study 2 (validation of Vienna indicators by comparison with Habitat indicators))	*1.0*			*1.0*	***2.0***

2. VI.2 Regional organisation:

Partners or subcontractors responsible for developing/applying the protocols *(Thank you for fulfilling this table as much as possible putting ? when you don't know)*

Criterion 4	***Portugal Centre***	***Portugal North***	***Galicia***	***Castille y Leon***	***Cantabria***	***Euskadi***	***Aquitaine***
Indicator 4.1 4.2 4.3 4.4 4.5 4.7	*ISA* *Fransisco Rego Susana Dias*	*ESAC* *Raoul Salas Gonzalez*	*Univ. Lugo* *Pedro Álvarez Álvarez*	*Univ. Valladolid* *Julio Diez Casero*	*IKT* *Joserra DIEZ*	*Univ. Pais Basco* *Ibone Amezaga Miren Onaindia*	*INRA* *Hervé Jactel, Inge Van Halder*
Specific study 1	*X*	*?*	*?*	*X*	*?*	*X*	*X*
Specific study 2	*?*			*X*		*?*	*X*

3. Expert group time chart

1. The calculation of the Vienna biodiversity indicators will be rather straightforward if the proposed GIS processing is used. Technical problems may be solved using email exchanges. The refinement of the protocol for dead wood sampling will be also achieved through discussion within the C4 group and with the C1 group.

2. Depending on the decision of the Managing Committee and the Regional Coordinators, specific studies may be set up in some regions. A third C4 group meeting with the experts from the regions involved in the specific studies will be organised by the end of 2004 to refine the protocols for plant, bird and carabids sampling and to refine the list of additional compositional or structural to document in the sample stands.

3. If requested a technical support and a first evaluation of the work done will be provided by the expert group to the people in charge of the biodiversity indicators during the course of 2005.

G. Conclusion

An important work has been done by the expert group to work out the list of indicators and corresponding verifiers for what remains one of the most complicate SFM criteria, biodiversity. A great joint effort has been made to propose a general methodology to implement the Vienna indicators and thanks to relevant inputs from all experts, the protocols are now available.

However, two points need to be made.
First, a significant improvement of the protocols and a great reduction of the implementation cost for several indicators could be obtained from a better dialogue among the different expert groups. We would therefore advocate the organisation of a joint meeting with the expert group leaders in order to identify the data that can be shared, the common measurements that can be done and try to set up common sampling schemes at the regional level.

Secondly, several (most?) C4 experts have felt a frustration concerning the possibility to test the relevance of the Vienna Indicators for biodiversity. Beside the cost evaluation and the feasibility of the implementation of the indicators, a critical analysis of their quality as correlates or surrogates for forest species diversity would be worthwhile. This is the reason why specific studies have been proposed. The expert group now seek an in-depth discussion with the technical and managing committees to sort out the regions that would be interested in participating in these specific studies and to evaluate the funding that could be allocated to forest species sampling.

VII. Report of the Expert Group of Criterion 5 (By Inazio Martinez)

A. Functioning of the group

1. Participants

Coordinator: Inazio Martinez de Arano
Participants: Laurent Augusto, Mark Bakker, Jean-Michel Carnus, Antoine Colin, Ted Farrell, Ander Gonzalez, Manuel Madeira, Agustin Merino, Christophe Orazio, Etienne Saur, Pierre Trichet, Françoise Vernier, Henri Beuffe, Francisco Lario Leza.

2. Meetings

- Lisbon 2003
- Derio (Bilbao) 27 February 2004
- Palencia June 2004

3. Comments

At the Derio meeting our group concluded that the indicator needs for group 5 could be best be divided into the following three separate indicator lists:

1. Long term indicators for soil quality change (ID numbering from C5LT01 on)
2. Short term indicators, related to forestry practices: "Visual guide" (ID C5ST01 etc.)
3. Indicators related to Forests/Forestry contribution to water quality (ID C5WQ01 etc.)

At the meeting held in Palencia on 25th June 2004 the indicators proposed by Laurent Augusto and Mark Bakker where revised the following suggestions were proposed for the long term indicator list:

- Since long term risks to soil sustainability may be different from one region to another, it is probably no practical to test the same set of indicators in all regions.
- Thus, we should make the effort to systematically identify the risks that threaten sustainability in every region as well as the main driving forces behind them. This means for example: Mean risks could be, for different regions i) Organic matter loss and to physical deterioration of soils, ii) perturbation on peat mineralization dynamics after afforestation, iii) long term nutrient imbalance iv) ...
- Bearing these facts in mind, it was proposed that for long term sustainability assessment:
    - 1) a common list of indicators is proposed
    - 2) each region has to identify mean risks to soil sustainability
    - 3) Each region will choose and test a minimum subset of indicators, that better address identified risks in a cost-effective way. It is suggested that, at least a set of one chemical; one physical and one biological indicator should be measured at each region.

As a result of a discussion of the above proposal it was decided to develop a set of packages of indicators that could respond to main sustainability risks in different regions. As such Laurent Augusto and the Aquitaine team proposed the following packages.

- Common Packs
    - Sampling Pack for Soil Carbon and Water Holding capacity.
    - Sampling Pack for Top Soil nutritive status
    - Sampling pack for Soil disturbances (visual estimation)
- Optional Packs

- Sampling pack for **Nutrient Stocks**. To be applied when main concern is in long term nutrient unbalance of forest operations
- Sampling pack for **Soil Physics** : To be Applied when main concern is in mechanical alteration of soils
- Sampling pack for **Organic Mater dynamics** (Biological properties) to be applied when main concern is on ecosystem functional shifts that may pass undetected by the above packages.

For each of these packages, a sampling procedure and analytical methods are proposed, as described in this report.

B. Part II List of indicators checked by the expert group

1. 2.1 Lists used as references

In order to establish a list of indicators sensitive to evaluate changes in the longer term related to sustainability of forest management, several lists were combined. For each list the criterion for selection was based on the soundness of the descriptions, the completeness and the expected relevancy according to our own expert judgement.

Among the documents directly related to international processes and made available to all members of the FORSEE project, the MCPFE list provided a good starting point with a small set of potential indicators. To this we added documents issue of the French national survey programme (RENECOFOR) and two scientific articles reviewing lists of indicators (Doran and Jones 1996; Schoenholtz *et al.* 2000). From these four sources we compiled one indicator list which was used for examination (see below). For a part of these indicators, we feel that they are more appropriate for the Short-term Indicator list or the Water Quality Related Indicator lists (this is indicated in our list).

List of individual sources (lists) used for compilation:

1) Doran, J. W. and A.J. Jones. 1996. Methods for Assessing Soil Quality. Spec. Publ. # 49, SSSA, Madison, WI.
2) Burger, JA and Kelting, Daniel 1998. Soil Quality monitoring for Assessing Sustainable Forest Management. *In* The Contribution of soil science to the development of and implementation of Criteria and Indicators of sustainable Forest Management. Spec. Publ. Nº 53. SSSA, Madison, WI.
3) MCPFE AG Draft recommendations for the Improvement of the Pan-European Indicators for Sustainable Forest Management. Working document of the Fourth MCPFE Workshop on the Improvement of Pan-European Indicators for Sustainable Forest Management, 5-7 May 2002, Camigliatello Silano (Cosenza) Italy. Liason Unit Vienna, 11 April 2002
4) Schoenholtz SH, H van Miegroet & JA Burger (2000) A review of chemical and physical properties as indicators of forest soil quality: challenges and opportunities. For. Ecol. Manage. 138: 335-356.
5) RENECOFORa: Brêthes A & E Ulrich (coordinateurs) (1997) RENECOFOR - Caractéristiques pédologiques des 102 peuplements du réseau. Office National des Forêts, 573 pp.
6) Soil Conservation Surveys Guidebook and published by the British Columbia Ministry of Forests (2001)

It has to be noted that the source may refer to the parameter to be measured and not necessarily to the measuring protocols or to the evaluation schemas proposed.

2. 2.2 List of indicators checked in the group

a) 2.2.1. Long Term Indicators

Criteria	***Short description***	***Source***	***ID***	***Approved for FORSEE test***
	Soil physical parameters			
	Static indicators			
5	*Parent material (bedrock)*	*RENECOFOR 1997*	*C5LT_01*	*Y (*)*
5	*Total soil depth*	*Doran & Jones 1996, Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_02*	*Y*
5	*Rooting depth*	*Doran & Jones 1996*	*C5LT_03*	*N*
5	*A horizon depth*	*Doran & Jones 1996*	*C5LT_04*	*N*
5	*Topsoil depth*	*Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_05*	*Y*
5	*Soil texture*	*Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_06*	*Y(*)*
5	*Fine earth proportion*	*Doran & Jones 1996*	*C5LT_07*	*N*
5	*Aggregate shape and size distribution*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_08*	*N*
5	*Aggregate stability*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_09*	*N*
5	*Soil bulk density*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_10*	*Y*
5	*Total porosity*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_11*	*N*
5	*Pore size distribution*	*Doran & Jones 1996*	*C5LT_12*	*N*
5	*Penetrability*	*Doran & Jones 1996*	*C5LT_13*	*N*
5	*Water holding capacity*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_14*	*Y*
5	*Hydraulic conductivity*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_15*	*N*
5	*Soil roughness*	*Schoenholtz et al 2000*	*C5LT_16*	*N*
5	*Soil loss*	*Schoenholtz et al 2000*	*C5LT_17*	*N*
5	*Soil strength*	*Schoenholtz et al 2000*	*C5LT_18*	*N*
5	*Soil tilth*	*Schoenholtz et al 2000*	*C5LT_19*	*N*
5	***Dynamic indicators***			
5	*Least limiting water range*	*Schoenholtz et al 2000*	*C5LT_20*	*N*
5	*Trafficability*	*Schoenholtz et al 2000*	*C5LT_21*	*N*
5	*Leaching potential*	*Schoenholtz et al 2000*	*C5LT_22*	*N*
5	*Erosion Risk*	*Schoenholtz et al 2000*	*C5LT_23*	*Y*
	Soil Chemical parameters			
5	*Major element litter composition*	*RENECOFOR 1997*	*C5LT_24*	*N*
5	*Litter amount (mass or thickness)*	*RENECOFOR 1997*	*C5LT_25*	*Y*
5	*Organic Matter content*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_26*	*N*
5	*Total C*	*RENECOFOR 1997*	*C5LT_27*	*Y*
5	*Organic C*	*MCPFE 2002, Schoenholtz et al 2000*	*C5LT_28*	*N*
5	*Total Nitrogen*	*Doran & Jones 1996, MCPFE 2002, Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_29*	*Y*
5	*Organic N*	*Schoenholtz et al 2000*	*C5LT_30*	*N*
5	*Mineral N*	*Schoenholtz et al 2000*	*C5LT_31*	*N*

5	*Extractable NH4*	*Schoenholtz et al 2000*	*C5LT_32*	*N?*
5	*NO3*	*Schoenholtz et al 2000*	*C5LT_33*	*N*
5	*C/N ratio*	*Doran & Jones 1996, MCPFE 2002, RENECOFOR 1997*	*C5LT_34*	*Y*
5	*Available P*	*Doran & Jones 1996*	*C5LT_35*	*Y*
5	*Total P*	*Schoenholtz et al 2000*	*C5LT_36*	*Y*[α]
5	*Mineral P*	*Schoenholtz et al 2000*	*C5LT_37*	*N*
5	*Extractable P*	*Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_38*	*Y*
5	*P sorption*	*Schoenholtz et al 2000*	*C5LT_39*	*N*
5	*Total CEC*	*Doran & Jones 1996, MCPFE 2002, Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_40*	*Y*
5	*CEC base saturation*	*Doran & Jones 1996, MCPFE 2002, Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_41*	*Y*
5	*Total K, Ca, Mg*	*Schoenholtz et al 2000*	*C5LT_42*	*Y*[α]
5	*Exchangeable K*	*Schoenholtz et al 2000*	*C5LT_43*	*N*
5	*Extractable K, Ca, Mg*	*Schoenholtz et al 2000*	*C5LT_44*	*N*
5	*Exchangeable K, Ca, Mg, NH4*	*RENECOFOR 1997*	*C5LT_45*	*Y*
5	*Exchangeable H, Al, Mn*	*RENECOFOR 1997*	*C5LT_46*	*Y*
5	*Cation ratios*	*Doran & Jones 1996*	*C5LT_47*	*N*
5	*CaCO3 %*	*RENECOFOR 1997*	*C5LT_48*	*N*
5	*Al oxides*	*RENECOFOR 1997*	*C5LT_49*	*N*
5	*Fe oxides*	*RENECOFOR 1997*	*C5LT_50*	*N*
5	*Active Aluminium fractions*	*Doran & Jones 1996*	*C5LT_51*	*N*
5	*Aluminium and basic cations ratio*	*Doran & Jones 1996*	*C5LT_52*	*N*
5	*Electric conductivity*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_53*	*N*
5	*pH-H2O*	*Doran & Jones 1996, MCPFE 2002, Schoenholtz et al 2000, RENECOFOR 1997*	*C5LT_54*	*Y*
5	*pH-KCl ou CaCl2*	*RENECOFOR 1997*	*C5LT_55*	*N*
5	*Total organic contaminants in soils*	*Doran & Jones 1996*	*C5LT_56*	*N*
5	*Total Heavy metals in soils*	*Doran & Jones 1996*	*C5LT_57*	*N*
	Soil Biological properties			
5	*Potential respiration*	*Doran & Jones 1996*	*C5LT_58*	*N*
5	*Microbial C biomass*	*Doran & Jones 1996*	*C5LT_59*	*N*
5	*Potential N mineralization*	*Doran & Jones 1996, Schoenholtz et al 2000*	*C5LT_60*	*Y*[β]
5	*Net N mineralization*	*Schoenholtz et al 2000*	*C5LT_61*	*N*
5	*Functional Groups of soil invertebrates*	*Doran & Jones 1996*	*C5LT_62*	*N*
5	*Soil micro-organism community structure*	*Doran & Jones 1996*	*C5LT_63*	*N*
5	*Pathogen infection risk*	*Doran & Jones 1996*	*C5LT_64*	*N*
	Plant physiological Status			
5	*Foliar nutrient contents*	*Doran & Jones 1996*	*C5LT_65*	*N*
5	*Plasmatic resistance of leaf tissue*	*Doran & Jones 1996*	*C5LT_66*	*N*
5	*Fluorescense response of leaves*	*Doran & Jones 1996*	*C5LT_67*	*N*
5	*Active mycorrhization of root tips*	*Doran & Jones 1996*	*C5LT_68*	*N*
	Ecosystem balances			

[α] In an optional pack on total nutrient stocks..

[β] Included in the optional pack on soil biological properties

5	*Stand nutrient balance over the rotation*	*Doran & Jones 1996*	*C5LT_69*	*N*[ϕ]
5	*Runoff and lixiviation water quality*	*Doran & Jones 1996*	*C5LT_70*	*N*
5	*Potentially lixiviation index*	*Doran & Jones 1996*	*C5LT_71*	*N*
5	*Total element loads*	*Doran & Jones 1996*	*C5LT_72*	*N*

b) 2.2.3 Water Quality indicators

Criteria	***Short description***	***ID***	***Approved for FORSEE test***
	LAND USE		
5	*Crop area/ watershed area*	*C5WQ01*	*N*
5	*Forested area/watershed area*	*C5WQ02*	*N*[γ]
5	*Forestry area / watershed area*	*C5WQ03*	*N*
5	*Clear cuttings area/watershed area*	*C5WQ04*	*N*
	AGRICULTURAL and FORESTRY practices		
5	*Fertilization (organic and mineral nitrogen, phosphorus) amount/culture/hectare*	*C5WQ05*	*N*
5	*Fertilization (organic and mineral nitrogen, phosphorus)amount /culture/ watershed hectare*	*C5WQ06*	*N*[γ]
5	*Breeding (type, stock, N equivalent)*	*C5WQ07*	*N*
5	*Pesticides (number of treatments/culture, amount/ha)*	*C5WQ08*	*N*
5	*Intercropping period /cropping rotation*	*C5WQ09*	*N*[η]
5	*Clear cuttings duration*	*C5WQ10*	
5	*Revolution period*	*C5WQ11*	
5	*Bare soils area/watershed area*	*C5WQ12*	***N***
5	*% Stream length with Riparian Buffer*	*C5WP-01*	*Y*
5	*Road density and type*	*C5WP-03*	*Y*[ι]
	Erosion		
5	*Drainage density / watershed area*	*C5WQ13*	*N*
5	*Ditches density / watershed area*	*C5WQ14*	***N***
5	*Erosion Risk (USLE Approach)*	*C5WP_02*	*Y*
	Water quality		
5	*pH*	*C5WQ15*	*N*
5	*Dissolved Carbon, Total Organic Carbon (concentration)*	*C5WQ16*	*N*
5	*Suspended matter (concentration)*	*C5WQ17*	*N*
5	*Total phosphorus*	*C5WQ18*	*N*
5	*Total nitrogen (nitrates, nitrites, mineral and organic nitrogen)*	*C5WQ19*	*N*
5	*Pesticides (some representative molecules)*	*C5WQ20*	*N*
5	*Heavy metals*	*C5WQ21*	*N*
5	*River flow*	*C5WQ22*	*N*
5	*Water treatment plants (number, location)*	*C5WQ23*	*N*
5	*Factories (number, location)*	*C5WQ24*	*N*

[ϕ] Although could be calculated from the optional « total nutrient stocks » and indicators in c1/c2
[γ] Some of this parameters are needed as a general description of the pilot zones, but will not be used as indicators
[η] This parameters are included in the Indicator « Erosion Risk »
[ι] This parameter will be measured by other groups

C. Part III List of indicators not selected by the expert group

1. Long Term Indicators

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_03***
Short description		*Rooting depth*			
Reason for non selection LT		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Total soil depth (C5LT_02) is thought to provide a correct approximation for rooting depth in case this would be needed.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_04***
Short description		*A Horizon depth*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We have preferred Topsoil depth (C5LT_05) to this indicator.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_07***
Short description		*Fine earth proportion*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Soil texture (C5LT_06) gives more information and should be preferred to this indicator Fertility better than sustainability (while texture is related to soil vulnerability does not change with management, but is related to soil vulnerability (palencia).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_08***
Short description		*Aggregate shape and size distribution*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator seems not that relevant, but above all is too complicated to guarantee a correct implementation by all participants and should give rise to problems of interpretation. It is relevant, but it is difficult to measure, and to standardise*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_09***
Short description		*Aggregate stability*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Far too complicated. Expert group in Palencia:* ***It is difficult to measure, and to standardise.***			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_11***
Short description		*Total porosity*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator will be taken into consideration in the short-term indicator list. Furthermore, soil texture and total carbon may enable to assess soil porosity by pedotransfer functions.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_12***
Short description		*Pore size distribution*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*As for indicator C5LT_11, this indicator will be taken into consideration in the short-term indicator list*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_13***
Short description		*Penetrability*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*As for indicator C5LT_11, this indicator will be taken into consideration in the short-term indicator list.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_15***
Short description		*Hydraulic conductivity*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator is related to C5LT_11, C5LT_12 and C5LT_13 and will be considered in the short-term indicator list.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_16***
Short description		*Soil roughness*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale					

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_17***
Short description		*Soil loss*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)*			

	☒*Other : (specify)(tick using right button)*
Rationale	*This indicator is too complicated to assess in a detailed way. Wind erosion would not be a relevant term in this matter, whereas soil loss by runoff might occur in case of forest exploitation (considered in the short term list as well as the water quality related indicator list).* *Difficult to measure. Potential Erosion with a risk. Sylviculture; species…. See C5WP_02)*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_18***
Short description		*Soil strength*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*This indicator may be considered for the short term indicator list (assessing direct effects of forest harvesting).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_19***
Short description		*Soil tilth*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*The result of tillage practices are expected to be assessed already by other indicators that have been selected (such as total carbon).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_20***
Short description		*Least limiting water range*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐*Other : (specify)(tick using right button)*			
Rationale		*Although water availability is most important to ecosystem functioning, this indicator would need measurements throughout many seasons and therefore is far too cost and time expensive.* *Expert group in Palencia:* ***Good indicator. Could be expensive. Pedotransfrer Function. See C5ST_06Opt***			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_21***
Short description		*Trafficability*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☒ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*This indicator is already considered in the short term list indicators.* *Expert group in Palencia: Not clear*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_22***
Short description		*Leaching potential*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic*			

	☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*
Rationale	*This indicator would be too difficult to assess (a total ecosystem balance would be needed and there is no agreement on what common methodology should be used to achieve this).*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_23***
Short description		*Erosion potential*			
Reason for non selection		☐ *Already well documented* ☐ *Not relevant for the criteria* ☐ *Lack of knowledge (or method)* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*		☐ *Too easy from existing data* ☐ *Not relevant for the pilot zone* ☐ *Not Strategic*	
Rationale		*This indicator is rather related to (and may be assessed by) the indicators on the short term indicator list.* *See soil loss*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_24***
Short description		*Major element litter composition*			
Reason for non selection		☐ *Already well documented* ☒ *Not relevant for the criteria* ☐ *Lack of knowledge (or method)* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*		☐ *Too easy from existing data* ☐ *Not relevant for the pilot zone* ☐ *Not Strategic*	
Rationale		*This indicator will depend on stand age and also on initial site fertility level. Shifts in total element composition in the litter as well as differences between sites can thus not be considered relevant for a sound evaluation of sustainable forest management. It may be a good indicator for nutritional status. Nutritional stability may be an important risk threatening sustainability (at least in Galicia). Besides there is the need to measure C (G1). See C5ST_08Opt*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_25***
Short description		*Litter amount*			
Reason for non selection		☐ *Already well documented* ☒ *Not relevant for the criteria* ☐ *Lack of knowledge (or method)* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*		☐ *Too easy from existing data* ☐ *Not relevant for the pilot zone* ☐ *Not Strategic*	
Rationale		*See C5LT_24: too much dependent on stand age and local site quality. : It is going to be measured as in IPCC C (G1). Content vs. concentration see C5LT_24. Reference values to compare with. More discussion is needed. It is also important for Biodiversity. Litter could be a nutrient reservoir (nutritional stability) that may be dependent on sylviculture. As such it may be relevant..*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_26***
Short description		*Organic matter content*			
Reason for non selection		☐ *Already well documented* ☐ *Not relevant for the criteria* ☐ *Lack of knowledge (or method)* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*		☐ *Too easy from existing data* ☐ *Not relevant for the pilot zone* ☐ *Not Strategic*	
Rationale		*We'd prefer total carbon (C5LT_27) to this indicator.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_28***
Short description		*Organic carbon*			
Reason for non selection		☐ *Already well documented* ☐ *Not relevant for the criteria*		☐ *Too easy from existing data* ☐ *Not relevant for the pilot zone*	

	☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*
Rationale	*We'd prefer total carbon (C5LT_27) to this indicator. Most of the total carbon is organic. The choice of only one indicator among the three potential indicators is cost efficient. It must be taken into account that limestone could be a common parent material at some places. Organic carbon may be a better indicator*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_30***
Short description		*Organic nitrogen*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We'd prefer total nitrogen (C5LT_29) to this indicator. Most of the total nitrogen is organic. The choice of only one indicator among several potential indicators for nitrogen is cost efficient.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_31***
Short description		*Mineral N*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We'd prefer total nitrogen (C5LT_29) to this indicator. The choice of only one indicator among several potential indicators for nitrogen is cost efficient. Also, mineral N is very fluctuating over time and a correct assessment would require many measurements within one season or even throughout several seasons.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_32***
Short description		*Extractable NH4*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We'd prefer total nitrogen (C5LT_29) to this indicator. The choice of only one indicator among several potential indicators for nitrogen is cost efficient. Also, mineral N is very fluctuating over time and a correct assessment would require many measurements within one season or even throughout several seasons.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_33***
Short description		*NO3*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We'd prefer total nitrogen (C5LT_29) to this indicator. The choice of only one indicator among several potential indicators for nitrogen is cost efficient. Also, mineral N is very fluctuating over time and a correct assessment would require many measurements within one season or even throughout several seasons.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_35***
Short description		*Available and reserve P*			

Reason for non selection	☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☒ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*
Rationale	*We prefer total P (C5LT_36) and extractable P (C5LT_38) to this indicator. For the available P many methods exist but there is no consensus on what would be the best method.*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_37***
Short description		*Mineral P*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Most of mineral P is not available for plant growth.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_39***
Short description		*P sorption*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Assessment of P sorption is very complicated and time consuming and goes way beyond the scope of the current study. Expert group in Palencia****: The P retention test developed in New Zealand is easy to perform. Besides it can be determined by pedotransfer functions. For example in acid soils P sorption is much related to Al. Besides, it can be an indicator of management.***			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_43***
Short description		*Exchangeable K*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We prefer exchangeable K, Ca and Mg (C5LT_45) which is more informative.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_44***
Short description		*Extractable K, Ca, Mg*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*We prefer exchangeable K, Ca, Mg and NH4 (C5LT_45) for which the methodology varies less. Also, this enables to combine a characterisation of K, Ca, Mg and NH4 with the assessment of an effective CEC and is thus more cost efficient.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_47***
Short description		*Cation ratios*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)*			

	☒*Other : (specify)(tick using right button)*
Rationale	*Much debate exists on the question whether cation ratios are very relevant or not to evaluate sustainable forest management. In any case, the assessment of individual cation values (e.g. exchangeable K, Ca, Mg, NH4, Al, H, Mn) would permit to calculate cation ratios if needed.*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_48***
Short description		*CaCO3 %*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*This indicator is not the most relevant for the current study and also is not expected to vary over time. The interaction with other nutritional aspects (available Ca, Mg, P or acid neutralizing capacity) is assessed directly by or can be evaluated from the other indicators retained for the current study.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_49***
Short description		*Al oxides*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐*Other : (specify)(tick using right button)*			
Rationale		*Not relevant and not expected to vary over time.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_50***
Short description		*Fe oxides*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐*Other : (specify)(tick using right button)*			
Rationale		*Not relevant and not expected to vary over time.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_51***
Short description		*Active Al fractions*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐*Other : (specify)(tick using right button)*			
Rationale		*Far too complicated and through its dependence on pH may be predicted partly by pH changes.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_52***
Short description		*Al and basic cation ratios*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*The usefulness of such ratios is questionable. If needed, the assessment of individual cation values (e.g. exchangeable K, Ca, Mg, Al, H, Mn) should permit us to calculate cation ratios if needed.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_53***
Short description		*Electrical conductivity*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*Interpretation of this parameter may be difficult (it is an integrative measurement).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_55***
Short description		*pH-KCl or pH-CaCl2*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☒ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*This indicator might give some additional information to the pH-H2O value, but we consider that this is not of strategic importance in the current context.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_56***
Short description		*Total organic contaminants in soils*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Too expensive. Also we believe that this is probably not an issue that is strongly related to forest management (if contamination exists).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_57***
Short description		*Total heavy metals in soils*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Too expensive. This may only be justified in case forest management would comprise the use of residual products of waste water sludge.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_58***
Short description		*Potential respiration*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Too complicated to carry out. Also, potential N mineralization (C5LT_60) is to be preferred to this indicator. Expert group in Palencia****: It may be a Short term indicator. See C5ST_07Opt***			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_59***
Short description		*Microbial C biomass*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)*			

	☒*Other : (specify)(tick using right button)*
Rationale	*This indicator is quite variable over time and is thus time consuming to assess.* ***ST** Expert group in Palencia: **It may be a Short term indicator. See C5ST_07Opt***

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_61***
Short description		*Net N mineralization*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*We prefer using the potential N mineralization which is easier to carry out. Expert group in Palencia: **It may be a Short term indicator. See C5ST_07Opt***			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_62***
Short description		*Functional groups of soil invertebrates*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*This indicator would probably be taken into account by the criteria on biodiversity.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_63***
Short description		*Soil micro-organisms community structure*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐*Other : (specify)(tick using right button)*			
Rationale		*This indicator is too time consuming and requires specific skills.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_64***
Short description		*Pathogen infection risk*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☒ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*This indicator would probably be taken into account by the criteria on forest health.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_65***
Short description		*Foliar nutrient contents*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒*Other : (specify)(tick using right button)*			
Rationale		*As trees regulate their foliar nutrient contents, changes in soil fertility are detected with a delay in foliage. This indicator is not very sensitive to small environmental changes. It may be important for nutritional diagnosis to estimate nutritional stability. It needs more discussion.***.**			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_66***
Short description		*Plasmatic resistance of leaf tissue*			
Reason for non		☐ *Already well documented* ☐ *Too easy from existing data*			

selection	☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*
Rationale	*Too complicated.*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_67***
Short description		*Fluorescence response of leaves*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*As for C5LT_66.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_68***
Short description		*Active mycorhization of root tips*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Very time consuming and probably not that relevant (in general all root tips have mycorrhizae; and this does not give information on what type of mycorrhizae).*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_69***
Short description		*Stand nutrient balance over the rotation*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*This indicator would require a completely instrumented field site with continuous investigations over several years.* *Affects Nutritional stability. Inputs and output can be estimated form available data, growth models and known sylvicultural practices. Some times available in literature.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_70***
Short description		*Runoff and lixiviation water quality*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☒ *Other : (specify)(tick using right button)*			
Rationale		*This indicator should be considered for the Water Quality related indicator list.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_71***
Short description		*Potentially lixiviation index*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*See C5LT_22.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5LT_72***
Short description		*Total element loads*			

Reason for non selection	☒ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*
Rationale	*Several research networks and structures exist and have already reported on this matter. We should take into account the existing data. Indicator may be compiled on existing data*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ09***
Short description		*Intercropping period /cropping rotation*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Too expensive (need surveys on the catchments)*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ12***
Short description		*Bare soils area*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Too expensive (need surveys on the catchments)*			

2. Water Quality Related Indicators

As it can be seen in the following tables the main reasons to reject water quality indicators are two. On one hand most indicators that have to do with erosion risk have been grouped in three that point directly to the *Erosion Risk*, the density and typo of *forest roads* and the presence of Riparian buffers that may mitigate sediment loads to water courses. On the other hand, indicators directly measuring water quality through chemical analysis have been rejected. On one hand they are highly variable in time, some sampling procedures would become very demanding. On the other hand, they do not directly point to forest management, since water chemistry is the result on al processes and land uses at the draining basin. Thus, indicators directly related to forest management that surely have direct relation to water quality where preferred.

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ14***
Short description		*Ditches density /watershed area*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☐ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other : (specify)(tick using right button)*			
Rationale		*Air photography needed and field surveys (too expensive)*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW15***
Short description :		*pH*			
Rationale in favour of this indicator		*PH of running waters depends not only on substrate nature but also on tree species growing on the watershed, biological aquatic cycles (photosynthesis) and rain chemistry. Each modification of these parameters may occur changing in pH.*			
The evaluation of this indicator		☐ *GIS processing* ☐ *Data processing*			

require		☒ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*
Equipment	Computers Softwares	*No specific requirements*
	Field material	*pH meter*
Personal	Qualification/ Time	*One person every two week or, at least, every month*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*No specific requirements*
	To acquire	*No specific requirements*
	Bibliography	*Not relevant*
Detailed protocols		*For the reasons exposed above, the assessment of this indicator should be carried out every 15 days, or at least every month. To expensive*
General comments		*This indicator should be combined with other indicators concerning water quality. Sampling very demanding. No mainly related to forest management in most areas*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW16***
Short description :		*Dissolved Carbon, Total Organic Carbon (concentration)*			
Rationale in favour of this indicator		*Changing in soil occupation and clear cutting may generate a decrease of water carbon organic loading.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*One operator for chemical analysis*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one climate and river flow.*			
General comments		*This indicator should be combined with other indicators concerning water quality The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW17***
Short description:		*Suspended matter (concentration)*			
Rationale in favour of this indicator		*Changing in soil occupation and clear cutting may occur an increase in suspended matter* *in water rivers in relation to a greatest erosion*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			

	To acquire	*One operator for chemical analysis*
	Bibliography	*Not relevant*
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one climate and river flow.*
General comments		*This indicator should be combined with other indicators concerning water quality. The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW18***
Short description :		*Total phosphorus (concentration)*			
Rationale in favour of this indicator		*The increasing in suspended matter is often linked with the total phosphorus one*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*One operator for chemical analysis*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one climate and river flow.*			
General comments		*This indicator should be combined with other indicators concerning water quality. The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW19***
Short description :		*Total nitrogen (concentration of nitrates, nitrites, ammonium and N Kjeldahl)*			
Rationale in favour of this indicator		*The replace of forested areas by agriculture led to the increase of mineral nitrogen and the decrease of organic nitrogen in running waters.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*One operator for chemical analysis*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one climate and river flow.*			
General comments		*This indicator should be combined with other indicators concerning water quality. The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW20***
Short description :		*pesticides*			
Rationale in favour of this indicator		*The replace of forested areas by agriculture led to the increase of pesticides in waters*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*One operator for chemical analysis*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one time, climate and river flow.*			
General comments		*This indicator should be combined with other indicators concerning water quality. The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas. Pesticides are difficult to detect in running waters as concentrations dilute very rapidly after application.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW21***
Short description :		*Heavy metals*			
Rationale in favour of this indicator		*The replace of forested areas by agriculture can, by long term utilisation of pesticides, increase the concentration of metals such as mercury, copper and lead*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Material for water sampling (glass bottles)*			
Personal	Qualification/ Time	*One person every two week or, at least, every month*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*One operator for chemical analysis*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every 15 days, or at least every month because it depends one time, climate and river flow.*			
General comments		*This indicator should be combined with other indicators concerning water quality. The knowledge of daily water flow (C5WQ22) allows calculating annual fluxes. Sampling very demanding. No mainly related to forest management in most areas*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW22***
Short description :		*River flow*			
Rationale in favour of this indicator		*The evolution of watershed soil occupation nature can be followed by changing in water and chemical annual fluxes..*			

The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☒ *Other : document compile nearby relevant services (Water Agency)*
Equipment	Computers Softwares	*No specific requirements*
	Field material	*No specific requirements*
Personal	Qualification/ Time	*No specific requirements because automated measurement*
Data	To buy	*No specific requirements*
	To compile	*Data can be available nearby relevant authorities (watershed national net work)*
	To investigate	*No specific requirements*
	To acquire	*Not relevant*
	Bibliography	*Not relevant*
Detailed protocols		*Flow is measured in continuous using automatic flow meters located on river stations of the french watershed national net work*
General comments		*The assessment of this indicator should be carried out every day. His daily knowledge allows calculating annual fluxes of nutrients and toxics.*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW23***
Short description:		*Water treatment plants (number location)*			
Rationale in favour of this indicator		*Potential pollution assessment*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☒ *Other : document compile nearby relevant services (Water Agency, Drire)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			
	Bibliography	*Not relevant*			
Detailed protocols		*Bibliographic study*			
General comments		*Not related to forest management*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5QW24***
Short description:		*Factories (number, location)*			
Rationale in favour of this indicator		*Potential pollution assessment*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☒ *Other : document compile nearby relevant services (Water Agency, Drire)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			
	Bibliography	*Not relevant*			
Detailed protocols		*Bibliographic study*			
General comments		*Not related to forest management*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ01***
Short description :		*Crop area/ watershed area*			
Rationale in favour of this indicator		*The increase in crop areas is linked with changes in discharge and nutrient fluxes at the outlet of the watershed.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*GIS specialist*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			
	Bibliography	*Not relevant*			
Detailed protocols		*The area can be obtained either using statistics either by GIS processing.*			
General comments		*The assessment of this indicator should be carried out every year. The information provided for this indicator is included and improved in the Erosion Risk Indicator*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ02***
Short description :		*Forested area/watershed area*			
Rationale in favour of this indicator		*The forested area is linked with discharge and nutrient fluxes at the outlet of the watershed.*			
The evaluation of this indicator require		☒ *GIS processing*☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols		*The area can be obtained either using statistics (in France IFN data) either by GIS processing.*			
General comments		*The assessment of this indicator should be carried out every year. The information provided for this indicator is included and improved in the Erosion Risk Indicator*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ03***
Short description :		*Forestry area/watershed area*			
Rationale in favour of this indicator		*The spatial distribution and the impact of upstream activities must be estimated as elements for a sustainable management. Forestry practices affect revolution period, drainage density, …and are also linked with discharge and nutrient fluxes at the outlet of the watershed.*			
The evaluation of this indicator require		☐ *GIS processing*☐ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☒ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares				

	Field material	*No specific requirements*
Personal	Qualification/ Time	*No specific requirements because automated measurement*
Data	To buy	*No specific requirements*
	To compile	*Data are available nearby relevant authorities*
	To investigate	*No specific requirements*
	To acquire	*Not relevant*
	Bibliography	*Not relevant*
Detailed protocols		*The area can be obtained either using statistics (in France IFN and CRPF data).*
General comments		*The assessment of this indicator should be carried out every year. Erosion Risk Indicator*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ04***
Short description :		*Clearcuttings area/watershed area*			
Rationale in favour of this indicator		*The most critical periods for losses of nutrients (phosphorus) take place at felling and replanting, which changes the equilibrium of the soil, and to a lesser extent, lopping and thinning*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols		*The area can be obtained using statistics (in France IFN) and GIS processing if data are spatialised.*			
General comments		*The assessment of this indicator should be carried out every year. The information provided for this indicator is included and improved in the Erosion Risk Indicator*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ05***
Short description :		*Fertilization (organic and mineral nitrogen, phosphorus) amount/culture/hectare*			
Rationale in favour of this indicator		*The spatial distribution and the impact of upstream activities must be estimated as elements for a sustainable management. An high level of fertilization increases the potential risk of nutrient transfers.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols					
General comments		*Agricultural statistics (field surveys too expensive)*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ06***
Short description :		*Fertilization (organic and mineral nitrogen, phosphorus) amount/culture/ watershed unit*			
Rationale in favour of this indicator					
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every year (harvest). Agricultural statistics (field surveys too expensive) and GIS processing.*			
General comments		*No spatial statistics are available. Too many assumptions to be made. It could be interesting is calculated as typical silvicultural procedure, and plotted in a map by forest type and/or management regime.*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ07***
Short description :		*Breeding (type, stock, N equivalent)*			
Rationale in favour of this indicator					
The evaluation of this indicator require		☒ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☒ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols		*The assessment of this indicator should be carried out every year using agricultural statistics.*			
General comments		*Not relevant*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ08***
Short description :		*Pesticides (number of treatments/culture, sprayed area)*			
Rationale in favour of this indicator		*The use of pesticides by human activities (agriculture, forestry) is linked to pesticide concentration in freshwaters*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			

Data	To buy	*No specific requirements*
	To compile	*Data are available nearby relevant authorities*
	To investigate	*No specific requirements*
	To acquire	*Not relevant*
	Bibliography	*Not relevant*
Detailed protocols		*Data can be obtained using statistics (agriculture) and GIS if spatial distribution of activities is available.*
General comments		*The assessment of this indicator should be carried out every year. The information provided for this indicator is included and improved in the Erosion Risk Indicator*

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ10***
Short description :		*Clearcuttings duration*			
Rationale in favour of this indicator		*The most critical periods for losses of nutrients (phosphorus) take place at felling and replanting, which changes the equilibrium of the soil.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares				
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols					
General comments		*The assessment of this indicator should be carried out every 5 years to monitor practices evolution on the studied area. The information provided for this indicator is included and improved in the Erosion Risk Indicator*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ11***
Short description :		*Revolution period*			
Rationale in favour of this indicator		*Short revolution period is linked to intensive forestry and is led to higher losses during clearcuttings.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares				
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols					
General comments		*The assessment of this indicator should be carried out every 5 years to monitor practices evolution on the studied area. The information provided for this indicator is included and improved in the Erosion Risk Indicator*			

Criteria	***5***	***Process***	***Cf part II***	***ID***	***C5WQ13***
Short description :		*Drainage density/watershed area unit*			
Rationale in favour of this indicator		*Drainage is linked to the increase of hydrologic response of the watershed and uploads of nutrients.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : document compile nearby relevant services (Water Agency)*			
Equipment	Computers Softwares	*GIS software*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements because automated measurement*			
Data	To buy	*No specific requirements*			
	To compile	*Data are available nearby relevant authorities*			
	To investigate	*No specific requirements*			
	To acquire	*Not relevant*			
	Bibliography	*Not relevant*			
Detailed protocols					
General comments		*The assessment of this indicator should be carried out every year using images or geographic data. This is more a characterization of the pilot zone. Not an indicator.*			

D. List of approved indicators

1. Long Term Indicators

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_01***
Short description		*Parent material*			
Rationale in favour of this indicator		*The parent material has a strong influence on many nutritional and pedological parameters and should be known in order to evaluate these parameters correctly.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*Geological and Soil maps*			
	To compile	*No specific requirements*			
	To investigate	*1 man-day to read the parent material from the maps for all the sample points*			
	To acquire	*No specific requirements*			
	Bibliography	*No specific requirements*			
Detailed protocols		*1 man-day to read the parent material from the maps for all the sample points.*			
General comments		*This assessment of parent material should be carried out only once.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_02***
Short description		*Total soil depth*			
Rationale in favour of this indicator		*This indicator defines the total soil volume that can be explored by tree roots and where nutrients are taken up. It further corresponds to an interface between atmosphere and the underground water.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers	*No specific requirements*			

	Softwares	
	Field material	*Simple field tools (auger, metal bar, spade …)*
Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*No specific requirements*
	To acquire	*Around 20 minutes per sample point (1 operator; may be combined with other soil sampling)*
	Bibliography	*No specific requirements*
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 3; more replicates should be acquired in case of great variability). This indicator may be combined with other soil sampling (e.g. sampling for C, N and CEC…) by using some soil existing soil pits and deepening them.*
General comments		*This assessment of total soil depth should be carried out only once.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_05***
Short description		*Topsoil depth*			
Rationale in favour of this indicator		*The topsoil depth is here considered as the depth of high organic content. Indeed, activities of roots and micro-organisms and also the nutrient contents and fluxes are highest in this volume.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Spade*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*On average around 2 minutes per sample point (1 operator)*			
	Bibliography	*No specific requirements*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 10; more replicates should be acquired in case of great variability).*			
General comments		*This assessment of topsoil depth should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_06***
Short description		*Soil texture*			
Rationale in favour of this indicator		*This parameter allows estimating many others by pedotransfer functions.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools (auger, metal bar, spade …)*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*Previous soil analyses of the studied area.*			
	To investigate	*No specific requirements*			
	To acquire	*Around 20 minutes per sample point (only for soil sampling; 2 operators; may be combined with other soil sampling). Additional time for sample processing and analysis*			
	Bibliography	*No specific requirements*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 3;*			

	more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C, N and CEC…)
General comments	*This assessment of soil texture should be carried out only once.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_10***
Short description		*Soil bulk density*			
Rationale in favour of this indicator		*This indicator gives information on soil structure status. Moreover, this parameter is needed for nutrient stock calculations.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools (cylinder, hammer, spade …)*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*By help of existing Pedotransfer functions using other soil parameters (e.g. soil texture and total carbon) for estimating soil bulk density.*			
	To acquire	*If no PTF exists, around 1 to 2 hour(s) per sample point (only for soil sampling;1 operator; needs a pedological pit).*			
	Bibliography	*Regional soil studies*			
Detailed protocols		*Cylinder method (at least 3 replicates per horizon and pit).*			
General comments		*This assessment of soil bulk density should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_14***
Short description		*Water holding capacity*			
Rationale in favour of this indicator		*This indicator is very important as it allows estimating the available water.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*Several pedotransfer functions using other soil parameters (e.g. soil texture) allow the estimation of water holding capacity. Some time should be spent investigating the most appropriate function.*			
	To acquire	*No specific requirements*			
	Bibliography	*Pedotransfer function studies.*			
Detailed protocols		*Impossible to determine at this stage.*			
General comments		*The assessment of water holding capacity should be carried out only once.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_27***
Short description		*Total carbon*			
Rationale in favour of this indicator		*This parameter is needed for estimations of other indicators. Furthermore, it is useful for the criteria on carbon.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			

Equipment	Computers Softwares	*No specific requirements*
	Field material	*Simple field tools*
Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*No specific requirements*
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*
	Bibliography	*No specific requirements*
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for N and CEC…)*
General comments		*Some discussions should be initiated with colleagues of the "carbon" criteria. The assessment of total carbon should be carried out only once every decade.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_29***
Short description		*Total nitrogen*			
Rationale in favour of this indicator		*Nitrogen content is a common limiting factor for tree growth.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*			
	Bibliography	*No specific requirements*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C and CEC…)*			
General comments		*The assessment of total nitrogen should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_34***
Short description		*C/N ratio*			
Rationale in favour of this indicator		*This indicator gives general information on the quality and the degradability of the soil organic matter.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			

	Bibliography	*No specific requirements*
Detailed protocols		*Derived / Calculated based on total C and total N values*
General comments		*The assessment of C:N ratio should be carried out only once every decade.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_36***
Short description		*Total P*			
Rationale in favour of this indicator		*Phosphorus content is a common limiting factor for tree growth.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*			
	Bibliography	*No specific requirements*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C and CEC…)*			
General comments		*The assessment of total P should be carried out only once.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_38***
Short description		*Extractable P*			
Rationale in favour of this indicator		*Phosphorus content is a common limiting factor for tree growth. However, total P is not sufficiently informative as most of soil P is not available in the short term. The quantification of the extractable P gives information on readily available P.* *Olsen and/or Water extractable phosphorous will be measured*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling).*			
	Bibliography	*Not relevant*			
Detailed protocols		*There are plenty of methods to determine "extractable" or "available" P in forest soils (e.g. Olsen, Dyer, Duchaufour & Bonneau, Joret & Berh …). However, it is quite difficult to determine which one is the most appropriate to all the soils of the FORSEE study. Therefore, we propose to measure the P content of a simple soil suspension (e.g. 1 g of soil in 5 ml of distilled water).* *This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C and CEC…)*			

General comments	*The assessment of extractable P should be carried out only once every decade.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_40***
Short description		*Total CEC*			
Rationale in favour of this indicator		*The CEC gives important information related to the short term fertility and the buffering capacity.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			
	Bibliography	*No specific requirements*			
Detailed protocols		*CEC is the sum of C5LT_45 and C5LT_46*			
General comments		*There are two kinds of CEC: effective CEC (eCEC) and measured CEC (mCEC). eCEC is calculated as the sum of the exchangeable cations. mCEC is determined with a specific extractant (e.g. cobalthihexamine).Unfortunately, eCEC often differs from mCEC due to methodological imperfections. In the present document, we prefer eCEC as it is calculated with other indicators.* *The assessment of CEC should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_41***
Short description		*CEC base saturation*			
Rationale in favour of this indicator		*CEC base saturation is an important information related to the short term fertility, to the buffering capacity and the acidifying status of the soil.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*No specific requirements*			
	Bibliography	*No specific requirements*			
Detailed protocols		$BS = (K_{ech}+Ca_{ech}+Mg_{ech}+NH4_{ech})/eCEC$			
General comments		*The assessment of base saturation (BS) should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_42***
Short description		*Total K, Ca, Mg*			
Rationale in favour of this indicator		*Total K, Ca and Mg partly represent the very long term fertility of soils. The nutrient stocks (calculated with soil bulk density) also participate to the resiliency of the ecosystem.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements*			

		☐ *Other : (specify)(tick using right button)*
Equipment	Computers Softwares	*No specific requirements*
	Field material	*Simple field tools*
Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*No specific requirements*
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*
	Bibliography	*Not relevant*
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C and CEC…)* *PM: Needs more discussion. Maybe from lithology and soil type.*
General comments		*This assessment should be carried out only once.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_45***
Short description		*Exchangeable K, Ca, Mg, NH4*			
Rationale in favour of this indicator		*This indicator is needed to calculate soil CEC and base saturation.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*			
	Bibliography	*Not relevant*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C)*			
General comments		*The assessment of exchangeable K, Ca, Mg and NH4 should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_46***
Short description		*Exchangeable H, Al, Mn*			
Rationale in favour of this indicator		*This indicator is needed to calculate soil CEC and base saturation.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2*			

		operators; may be combined with other soil sampling)
	Bibliography	*Not relevant*
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C)*
General comments		*The assessment of exchangeable H, Al and Mn should be carried out only once every decade.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_54***
Short description		*pH-H2O*			
Rationale in favour of this indicator		*Soil pH is a common and useful indicator of soil quality.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*			
	Bibliography	*Not relevant*			
Detailed protocols		*This indicator needs to be estimated with several replicates (at least 20; more replicates should be acquired in case of great variability). This indicator should be combined with other soil sampling (e.g. sampling for C)*			
General comments		*The assessment of pH-H2O should be carried out only once every decade.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5LT_60***
Short description		*Potential N mineralization*			
Rationale in favour of this indicator		*This indicator is interesting as it gives information on potential microbial activity.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other : (specify)(tick using right button)*			
Equipment	Computers Softwares	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling)*			
	Bibliography	*Not relevant*			
Detailed protocols		*Initial mineral N is determined in a KCl soil suspension. Then, the soil samples are incubated in controlled conditions for several days. At the end of the incubation period, final mineral N is determined in a KCl soil suspension.* *The assessment of this indicator needs several replicates (at least 3 bulk samples).*			
General comments		*The assessment of potential N mineralization should be carried out only once every decade.*			

a) INDICATOR PACKS TO BE MEASURED AT EACH REGION

REGION:	***Basque Country***
Main sustainability hazards to be addressed	*Soil physical degradation due to clear-cut sylviculture with heavy machinery operations, on a very hilly and rainy landscape. This also contributes to high hazards for water quality*
Sub set of indicators to evaluate	*Soil perturbation pack, within the Specific Study*
Rationale	*Is the indicators pack that better addresses the identified risks*

2. Short term indicators

Short term indicators will be measured during the inter-rotation period, which is the period between harvesting and next crown closure because it is a critical period for soil sustainability, as there is no plant cover and as such erosion and compaction hazards are high. Besides the use of machinery during harvesting, logging and site preparation makes the aforementioned hazards to be even higher.

- The first set of indicators (*C5ST_01* to *C5ST_03*) is the one that has to be measured in every region.
- A second set of validating parameters is presented (*C5ST_04Opt* to *C5ST_08Opt*) is intended as a validation tool of the visual estimation of the soil disturbance categories described in the survey analysis (C5ST_02). This indicators are optional measurements.

a) Sampling Strategy

At every region the most representative management regimens will be identify. In relation to these indicators, management regimes are defined by type of harvesting, logging and site preparation techniques being used, with special attention to mechanized forestry practices. Some examples of management regimes could be:

- Clear cut with skidder logging and mechanical site preparation
- Clear cut with skidder logging and manual site preparation
- Shelterwood cut with, animal force logging and manual site preparation

At each region one or more key factors that are critical to soil perturbation should be identify. This could be:

- Soil texture / bed rock type…
- Time of the year when operations are done (winter logging vs. summer logging)
- Slope

Between 3 and 5 representative plots will be studied for each combination of management regimen and key factors. Only representative combinations of real live operations will be included.
The plots to be studied, are real live plots that should be localized with the help of regional forest services and/or owners associations.

It is considered that 20 plots per region is a very good number, but probably very valuable information will be provided even **with half that number**, as long as the plots are representative or real life operations.

At the selected plots the following indicators will be measured:

b) List of selected Indicators

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_01***
Short description		***Percentage of non-forested area***			
Rationale in favour of this indicator		*Lineal structures (roads, firebreaks…) and non lineal ones (backspars,*			

		landings…) are necessary for forest management, but a high density of this kind of structures has a deleterious effect on production and on soil and water protection (erosion)
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*
Equipment	Computers Software	*No specific requirements / Data base for data processing*
	Field material	*Measuring tapes, clinometer.*
Personal	Qualification/ Time	*Need of training. But skills are acquired easily (see General Comments).*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*No specific requirements*
	To acquire	*4 men-day to do the field survey in each stand (if <4 ha). This survey must be carried out together with the one proposed for the next indicator (C5ST_02).*
	Bibliography	*B.C. Ministry of Forests. 2001. Soil Conservation Surveys Guidebook. 2nd ed. Forest Practices Code of British Columbia Guidebook. Victoria. Canada. 63 pp.*
Detailed protocols		***Lineal Structure Surveying*** *A different survey for different lineal structures must be carried out, for example roads, firebreaks or electrical lines. If roads differ in width more than 2 m they are also considered as different structures. For each structure the whole horizontal length and at least 10 horizontal widths will be measured to estimate the area occupied by it. A visual estimation of the length of the structure to be surveyed is done and this is divided into at least ten intervals in order to estimate the length at which the width is going to be measured. The width is measured as the distance from the outer points of the structure. The length of this interval and its slope is then recorded along with the width of the structure at that point and its slope. The first width to be measured is set up at half of the interval and afterwards the measures are done on the interval basis. The slopes are recorded in order to estimate the horizontal area of the structure and to be able to estimate the percentage of the stand's surface that is covered by such structures. When the interval for width measurement falls in a non-lineal structure it is not recorded and its length is not considered for lineal structure calculation. If it falls on a junction of structures the point for width measure is moved until the junction finishes and the width is measured there. The next width is then measured at the point where the interval falls. With the width values measured this way and the t probability values table (one sided; 90%) the width confidence interval can be calculated and thus the area error for the surface that each structure occupies.* ***Non-Lineal Structure Surveying*** *Non-lineal structures are landing areas, logging areas… that are left unplanted. To estimate the area occupied by these structures, four measures are taken in each of them. The length of the structure is divided into quarters and the width at the first and third quarters along with their slopes are measured. The width of the area is also divided into quarters and the length of the area and their respective slopes at the first and the third quarter are measured. The mean of the horizontal lengths and of the horizontal widths are calculated and the area is estimated as the product of these figures for each of them, that can afterwards be added up to estimate the percentage area occupied by these structures.* *The percentage of the occupied by unplanted structures is calculated as the horizontal surface of lineal structures plus the area of non lineal ones to the total area of the stand and the area to be reforested is considered as the subtraction of the horizontal surface calculated this way from the stand area.*

General comments	*It would be desirable to celebrate a meeting with all the regions in order to standardise protocols.* *As an example of adaptation of the survey method developed in the British Columbia to the Basque Country the reading of the following is recommended: González-Arias, A. Martínez de Arano, I., Gartzia N. and Aizpurua, A 2004. Soil Disturbance Surveys in Pine Tree Plantations of the Basque Country. Presented in "Soil conservation in a changing Europe". 4th International Congress of the European Society for Soil Conservation held in Budapest, Hungary in May 2004.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_02***
Short description		*Percentage of soil surface on different disturbance categories in each stand.*			
Rationale in favour of this indicator		*This indicator gives information about the impact that the use of heavy machinery may have on the area to be reforested in each stand. This way disturbance can be related to stand's characteristics: slope, parent material…; to a particular worker or enterprise; to climate: soil wetness…*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field surveys* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements/ Data base for data processing*			
	Field material	*Compass, measuring tapes, clinometer, penetrometer*			
Personal	Qualification/ Time	*Need of training. But skills are acquired easily (see General Comments).*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*4 men-day to do the field survey in each stand (if <4 ha). This survey must be carried out together with the one proposed for the previous indicator (C5ST_01).*			
	Bibliography	*B.C. Ministry of Forests. 2001. Soil Conservation Surveys Guidebook. 2nd ed. Forest Practices Code of British Columbia Guidebook. Victoria. Canada. 63 pp.*			
Detailed protocols		*A soil survey recording form (an electronic counterpart would be desirable) has to be designed in order to standardise data recording and processing.* ***Soil Disturbance Categories Definition*** *Each regional group should define their whole set of disturbance categories based on the knowledge of the forest operations that are carried out in each region and the possible impacts these operations may have on the soil. As a starting point, the ones proposed in the Soil Conservation Surveys Guidebook and published by the British Columbia Ministry of Forests (2001) are recommended. As this is a feedback mechanism, the definitive set of disturbance categories will be adopted after having surveyed several stands. This definitive set of disturbance categories may be periodically revised to redefine it.* ***Transect surveys for disturbance categories in the area to be reforested*** *A regular grid of points to be surveyed are laid out in the area to be reforested using parallel transect lines. They are laid out perpendicular to the maximum disturbance assessed visually. Distance between transects and between the points that are going to be surveyed are calculated depending upon the surface of the area to be reforested. If the surface is smaller than 1.0 ha distance from point to point in each transect is 4 m and distance form transect to transect will be calculated to survey 100 points regularly. From 1 ha onwards the distance between points will be 5 metres and the distance between transects will be calculated to be 200 points to 2 ha, 300 points to 5 ha and 500 to areas to be reforested bigger than 5 ha. The first transect is laid out using a*			

	randomly generated number list from 0 to 100, and this figure will be used as the percentage of the distance between transects calculated before. Once the grid of points is laid out in field the survey is done recording a disturbance category defined before in each point. In order to evaluate each point the maximum disturbed surface around the point will be considered. With these figures and with the tables for probabilities (90%) for the binomial distribution the percentage of the surface of the area to be reforested and its confidence limits can be assessed. *In stands with a surface higher than 1 ha the first survey will be carried out in half of the points will be surveyed (one out of two proposed transects and at least 100 points). The percentage of disturbed area and its confidence interval (CI) will be calculated this way. If the threshold value proposed in C5ST_03 falls inside the CI, the other half of the transects should be surveyed.*
General comments	*It would be desirable to celebrate a meeting with all the groups in order to standardise protocols.* *As an example of adaptation of the survey method developed in the British Columbia to the Basque Country the reading of the following is recommended: González-Arias, A. Martínez de Arano, I., Gartzia N. and Aizpurua, A 2004. Soil Disturbance Surveys in Pine Tree Plantations of the Basque Country. Presented in "Soil conservation in a changing Europe". 4th International Congress of the European Society for Soil Conservation held in Budapest Hungary in May 2004.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_03***
Short description		*Percentage of stands with soil disturbance above a certain threshold.*			
Rationale in favour of this indicator		*The use of machinery disturbs the soil. Nevertheless, a threshold must be defined in order to assess the sustainability of forest operations. With this indicator sustainability of forest soil management at a regional basis can be achieved.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*Specific threshold has to be developed.*			
	To acquire	*No specific requirements*			
	Bibliography	*No specific requirements*			
Detailed protocols		*Number of stands with a soil disturbance measured as in C5ST_01 and C5ST_02 above a certain threshold value divided by the total number of surveyed stands. (Given as percentage)*			
General comments		*It has to be considered that if the developed threshold falls inside the confidence limit reported when the "Percentage of disturbed soil surface in each stand" indicator (C5ST_02) is carried out in a concrete stand, this survey should be finished (the other half of the points should be surveyed)*			

c) Perturbation Categories Validation Parameters (optional)

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_04Opt***
Short description		*Topsoil bulk density*			
Rationale in favour of this indicator		*This indicator gives information on soil structure and porosity status. Besides, this parameter may be needed for nutrient and carbon stock and*			

		for the Least Limiting Water Range calculations.
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*
Equipment	Computers Software	*No specific requirements*
	Field material	*Simple field tools (cylinder, hammer, spade…)*
Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*No specific requirements*
	To investigate	*By help of existing Pedotransfer functions using other soil parameters (e.g. soil texture, total carbon and soil strength along with soil moisture) for estimating soil bulk density.*
	To acquire	*If no PTF exists, around 1 to 2 hour(s) per sample category (only for soil sampling;1 operator).*
	Bibliography	*No specific requirements*
Detailed protocols		*After doing the survey (C5ST_02) the most common disturbance categories in each stand are defined. Categories for measurement are selected and at least 3 cylinders are taken in at least three replicates for each category.*
General comments		*Topsoil is preferred because disturbance done by heavy machinery will be higher in topsoil.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_05Opt***
Short description		*Topsoil strength (penetrometry)*			
Rationale in favour of this indicator		*This indicator gives information on the resistance that soil gives to the root growth and it may give information about soil compaction and porosity.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*Penetrometer (preferred with a data logger)*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*Penetrometer*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 3 hours per stand (1 operator). Depending on the surface of the stand and the number of categories selected.*			
	Bibliography	*No specific requirements*			
Detailed protocols		*After doing the survey (C5ST_02) the most common disturbance categories in each stand are defined. Categories for measurement are selected and measures are taken in at least three replicates for each category. In each replicate ate least 15 measurements are to be carried out. Non disturbed soil is always selected as a category to have a reference value. A composite soil sample in each measured replicate is taken to estimate soil moisture. Texture can be either measured or taken up from previous studies. Organic matter content (or total carbon) can also be estimated (C1).*			
General comments		*Topsoil is preferred because heavy machinery's disturbance will be higher in topsoil.* *Penetrologgers are preferred because of operational feasibility and to estimate possible changes in compaction with soil depth.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_06Opt***
Short description		*Water holding capacity/Least Limiting Water Range*			
Rationale in favour of this indicator		*This indicator is very important as it allows estimating the available water.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*Several pedotransfer functions using other soil parameters (e.g. soil texture, organic matter) allow the estimation of water holding capacity. Some time should be spent investigating the most appropriate function???*			
	To acquire	*No specific requirements*			
	Bibliography	*Pedotransfer function studies??*			
Detailed protocols		*After doing the survey (C5ST_02) the most common disturbance categories in each stand are defined. Categories for measurement are selected and measures are taken in at least three replicates for each category. In each replicate samples and measurements are taken following the procedures in C5ST_04Opt and C5ST_05Opt. Samples in the laboratory: Richard's plates, bulk density and penetrometry. For Water Holding Capacity(WHC): Water between –33kPa and –1500kPa and for Least Limiting Water Range (LLWR): Water as in WHC or between porosity >10% in volume and resistance to penetration ≥ 3 MPa.*			
General comments		*It would be desirable to estimate these values for the disturbance categories at specific sites rather than estimating them from PTF. Resistance to penetration should be achieved at least twice a year. With wet and with dry soil.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_07Opt***
Short description		*Total C/Total N and respiration N mineralization*			
Rationale in favour of this indicator		*This indicator gives some insight of the influence of machinery on soil organic matter and on the biological functioning of the soil.*			
The evaluation of this indicator require		☐ *GIS processing* ☐ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*Simple field tools*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*No specific requirements*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling). Additional time for sample processing and analysis*			
	Bibliography	*No specific requirements*			
Detailed protocols		*After doing the survey (C5ST_02) the most common disturbance categories in each stand are defined. Categories for measurement are selected and measures are taken in at least three replicates for each category. A composite soil sample in each measured replicate is taken and divided in two sub samples. One of them is analysed for C and for N.*			

	In the other sub sample initial inorganic N is determined in a KCl soil suspension. Then, they are incubated in controlled conditions for several days. At the end of the incubation period, final inorganic N is determined in a KCl soil suspension. *For respiration "Microresp" procedure is being tested in the Basque Country*
General comments	*Non disturbed soil should always be selected as a category to have a reference value*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5ST_08Opt***
Short description		*Total Nutrient loss (topsoil litter)*			
Rationale in favour of this indicator		*This parameter allows estimating the loss of nutrients due to the use of machinery.*			
The evaluation of this indicator require		☐ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☒ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*Previous soil analyses of the Pilot zone. Data and samples from the C1 group.*			
	To investigate	*No specific requirements*			
	To acquire	*Around 100 minutes (only for soil sampling) per sample plot (2 operators; may be combined with other soil sampling). Additional time for sample processing and analysis*			
	Bibliography	*No specific requirements*			
Detailed protocols		*Topsoil* *After doing the survey (C5ST_02) the most common disturbance categories in each stand are defined. Categories for measurement are selected and samples are taken in at least three replicates for each category. A composite soil sample in each measured replicate is taken. This sample could be one of the sub samples taken for the C5ST_07Opt. Nutrients to analyse could be different in each region or in different stands in the same pilot zone depending on knowledge of nutrient availability for forest growth at each site. Comparison between undisturbed soil and disturbed soil can be achieved either in concentration or in content (if bulk density is measured) and comparison between the whole-undisturbed stand (theoretically) to the actual estimated value for the topsoil nutrient content or concentration.* *Forest floor* *As one of the proposed disturbance categories is removal of forest floor, the comparison between the quantity of nutrients removed with the O horizon if it was present to the actual value could also be considered.*			
General comments		*Samples of the organic horizon should be taken for the C1 (carbon) group and its quantity should be estimated. These samples could be used for chemical nutrient analysis and the estimation of forest floor quantity to calculate nutrient content of forest floor.*			

3. Water Quality Related Indicators

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5WP_01***
Short description		*Percentage of stream length with "appropriate" riparian buffer*			
Rationale in favour of this indicator		*This parameter allows estimating the percentage of river length protected by a riparian buffer and the changes of this value in time.*			
The evaluation of this indicator		☒ *GIS processing* ☐ *Data processing*			

require		☒ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*
Equipment	Computers Software	*No specific requirements*
	Field material	*No specific requirements*
Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*Maps and Aerial photographs of the pilot zone.*
	To investigate	*No specific requirements*
	To acquire	*10 man-day to determine length and of streams covered with a riparian buffer, and to assign "appropriateness" to them. Field visits to confirm.*
	Bibliography	*No specific requirements*
Detailed protocols		*Determine length and of streams covered with a riparian buffer in maps using the latest aerial photographs available and assigning "appropriateness" from them. In a number of them, field survey to validate the "appropriateness" assigned from the photograph.*
General comments		*Appropriateness for riparian buffer system must be defined for each pilot zone/watercourse depending on risks.*

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5WP_02***
Short description		*Erosion Risk*			
Rationale in favour of this indicator		*This parameter allows estimating the erosion risk in the pilot zone.*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*No specific requirements*			
Personal	Qualification/ Time	*No specific requirements*			
Data	To buy	*No specific requirements*			
	To compile	*Maps of the pilot zone.*			
	To investigate	*No specific requirements*			
	To acquire	*10 men-day to determine the factors used in the USLE. (Map has to be generated afterwards).*			
	Bibliography	*USLE; previous studies of the regional soils. Forest inventories, Pilot zone maps*			
Detailed protocols		*Determination/estimation of organic matter, texture, structure and permeability for different parent material, altitude, forest species and management practices in the pilot zone in order to estimate the K factor. Estimation of the P factor for different management scenarios. Estimation of the C factor for different species and management practices. Estimation of the L; S and R factor for the pilot zone.*			
General comments		*This protocol may be carried out for main forest regimes for main forest types.*			

Criteria	***5***	***Process***	***Cf. part II***	***ID***	***C5WP_03***
Short description		*Road density and type*			
Rationale in favour of this indicator		*This parameter allows estimating the erosion risk in the pilot zone due to high density of roads*			
The evaluation of this indicator require		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other: (specify)(tick using right button)*			
Equipment	Computers Software	*No specific requirements*			
	Field material	*No specific requirements*			

Personal	Qualification/ Time	*No specific requirements*
Data	To buy	*No specific requirements*
	To compile	*Maps of the pilot zone. C3 accessibility. Aerial photographs.*
	To investigate	*No specific requirements*
	To acquire	*10 men-day to assign road type and to determine the length and area occupied by roads in pilot zone.*
	Bibliography	*USLE; previous studies of the regional soils. Forest inventories, Literature about roads and erosion*
Detailed protocols		*Determination of total length and length per ha occupied in the pilot zone by different type of roads Determination of total surface and surface per ha occupied in the pilot zone by different type of roads. The evolution of this figure with time may be an indicator of sustainability. Form the figures obtained this way and as in C5WP_02, it may be estimated the erosion due to roads in the pilot zone.*
General comments		*Road type should be defined in relation to water and runoff management. Data of road density should be obtained from the accessibility evaluated by the C3 group.*

E. Expert group time chart

1. November 2004 Group meeting (proposed):
    a. Subsets of indicators to be measured at each region
    b. Field training in soil perturbation (short term) indicator assessment
    c. Final discussion on water quality related indicators
    d. Protocol revisions for some indicators.
    e. Group coordination and agenda
2. March 2005. FORSEE technical committee for indicator evaluation.
3. Mid 2005. Group meeting
    a. Evaluation of advance in indicators evaluation
    b. Corrective measures
4. Final discussion on lab. protocols

F. Conclusion

There is a good agreement on how to address the problem of monitoring sustainability on forest soils. A good revision of proposed indicators has been made.
Some Long term indicators packs could be somehow modified to better fit the sustainability risk of some regions.

VIII. Report of the Expert Group of Criterion 6: Maintenance of other socio-economic and cultural functions and conditions of forests (By Américo M. S. Carvalho Mendes)

A. Objectives of the group

The specification of most of the indicators related to criterion 6 should rely on a good official forest statistical system. With very few exceptions in Europe, such a system does not exist. There are some data on forestry collected and published together with agricultural statistics and some data on forest industries and forest related services collected and published together with industry and services statistics. Besides these sources of data which often are not detailed enough, and which lack comprehensiveness to cover the whole forest cluster, there are some useful socioeconomic data collected by public and private institutions related to forest activities but which is not always published or even processed. The third useful source of information also existing in a scattered way is the stock of socioeconomic research available on the forest sector.

In such a situation it would not be feasible, within the resource constraints of this project, to set up data collection networks and to carry on all or even some of the major field censuses and surveys needed to make up for the insufficiencies in the official forest statistical system, with the possible exceptions of inventories, at the pilot zone level, of forest recreation areas or of forest areas with cultural or spiritual values. So what else is feasible in this component of the project is the following:

a) To do a **state of the art comparability study** across the participating regions about the data needed for the specification of the selected indicators;

b) to do an **exploratory specification study** of the selected indicators using existing and available data sources (official and unofficial) identified in the state of the art comparability study, following common concepts, but taking into account the fact that the situation in the participating regions is very heterogeneous in terms of their initial conditions regarding socioeconomic forest data;

c) To complement this data with data collected by the other groups in this project and by new data that can be generated by this group with the resources available;

d) To make **recommendations** concerning expansions, corrections and methodological improvements in the existing official forest data.

To complete our statement about the objectives of this part of the project, they are the following:

a) to propose a justified choice of socio-economic indicators for sustainable forest management taken from the list adopted by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) which may be feasible for testing at the pilot zone level, or which may be relevant and feasible for testing at a wider spatial level (regional or national) with the resources available in this project;

b) to propose improvements to the indicators chosen from the MCPFE list, as well as specific study to work more in depth on some of them or to add new ones to that list;

c) To propose methodologies for the specification of the chosen indicators;

d) To compile, acquire and investigate the data needed for the specification of the chosen indicators according to the chosen methodologies;

e) To acquire information on the resources and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available);

f) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;
g) To establish contacts with the regional, national and European official institutions in charge of the production and publication of official data related to the chosen indicators in view of contributing to the improvement of the existing forest statistics.

B. Functioning of the group

1. Group coordinator

Américo M. S. Carvalho Mendes (Portuguese Catholic University – Faculty of Economics and Management – Porto)

2. Participants

- **Aquitaine**: Dominique d'Antin de Vaillac, Sébastien Drouineau, Guillaume Chantre, Jean Paul Guyon, Francis de Morogues, M. Cocula, Olivier Picard, Mr Malfaix, M. Delize, Elizabeth Le Nouet
- **Castilla y León**: Natividad Gomez
- **Catalunya**: Gloria Dominguez
- **Centro de Portugal**: Pedro Ochoa Carvalho, Sara Morão, João Soveral, José Guilherme Borges, Helena Martins, Fernando Páscoa and Rui Silva
- **Euskadi**: Eider Arrieta
- **Galicia**: Manuel Francisco Marey Perez
- **Ireland** : Ray Gallagher and Marina Conway
- **Navarra**: Carmen Traver
- **Norte de Portugal**: Américo M. S. Carvalho Mendes and Diana Feliciano
- **USSE**: Iñaki Isasi Perez and Oscar Barreiro Mouriz

3. Meetings and other forms of exchange of information

a) General comments

The crucial event in the series of exchanges of information among the group members was the Bilbao meeting since it was there that were discussed and approved the list of indicators selected by the group.
The functioning of the group, so far, showed a clear and urgent need for strengthening the individual capacities of some of the IEFC members participating in the project in terms of socio-economic research. This is something that needs to be fixed by project leaders in each concerned region in order to achieve a good success for this component of the project.

b) List of meetings and other forms of exchange of information

(1) All regions meeting

Bilbao, February 26, 2004

(2) Regional meetings (sub-group for Aquitaine)

- 3 meetings for coordination with other « C » groups, federated under the Scientific Information Group for the Aquitanian forests (GIS)
- 25th of February 2004: meeting about the coordination of administrative statistical data concerning the periodical account of forest employment
- July 2004: meeting with Bertand Roucher (Regional Direction for Agriculture and Forestry - Regional Service for the Agricultural Statistics)

(3) Communication through e-mail between the group coordinator and the other group members

- Distribution of a previous draft of this report for comments and other contributions
- Written contributions received from the following regions: Ireland, Aquitaine and Centro de Portugal.

C. List of indicators checked by the expert group

1. Orientations for the selection of indicators

The orientations followed by the group in the choice of the indicators to be tested were the following:

a) use as reference the list of indicators adopted by the Ministerial Conference for the Protection of Forests in Europe as presented in the document entitled "Improved Pan-European Indicators for Sustainable Forest Management, as adopted by the MCPFE Expert Level Meeting of the 7-8 October 2002, in Vienna" since this is the international process to which all the countries involved in the process are committed to;

b) Drop from the prioritary list of indicators to be tested those (contribution of the forest sector to GDP, international trade data) meeting the following conditions:

- Their spatial scope is essentially national;
- They have already been the object of intensive and very good comparative studies and regular reporting by major international organisations (UNECE, FAO, and EFI);
- They cannot be substantially improved by the work to be carried out in the different groups of this project;

c) Keep in the prioritary list of indicators to be tested in all the participating regions those meeting the following conditions:

- Their spatial scope is essentially regional or local;
- They have not deserved as much attention as the indicators mentioned above in terms of international comparative studies;
- They can be improved by the type of work to be carried out in the different groups of this project;

d) add to the priority list of indicators some already in the MCPFE list, or some new ones with a national scope to be examined in specific studies which can gain from the expertise existing in some of the participating regions and from contributions expected from the groups dealing with the other criteria;

e) Leave room for optional specification and reporting on non selected indicators for the participating regions where it is feasible to do so with the data and resources available.

2. List of indicators checked in the group

Criterion	***Indicators***	***Nature of the indicators***	***Process***	***ID***	***Approved for FORSEE test***
6	*Forest holdings*	*Quantitative*	*MCPFE Vienna*	*6.1*	*Yes*
6	*Contribution of forest sector to GDP*	*Quantitative*	*MCPFE Vienna*	*6.2*	*No*
6	*Net revenue of forest enterprises*	*Quantitative*	*MCPFE Vienna*	*6.3*	*Yes*
6	*Expenditure for services*	*Quantitative*	*MCPFE Vienna*	*6.4*	*Yes*

6	*Forest sector workforce*	*Quantitative*	*MCPFE Vienna*	*6.5*	*Yes*
6	*Occupational safety and health*	*Quantitative*	*MCPFE Vienna*	*6.6*	*Yes*
6	*Wood consumption*	*Quantitative*	*MCPFE Vienna*	*6.7*	*No*
6	*Trade in wood*	*Quantitative*	*MCPFE Vienna*	*6.8*	*No*
6	*Energy from wood resources*	*Quantitative*	*MCPFE Vienna*	*6.9*	*No*
6	*Accessibility for recreation*	*Quantitative*	*MCPFE Vienna*	*6.10*	*Yes*
6	*Total economic value of forest production*	*Quantitative*	*Added by C6 FORSEE Expert Group*		*Yes*
6	*Cultural and spiritual values*	*Qualitative*	*MCPFE Vienna*	*6.11*	*Optional*
6	*National Forest Programmes or similar*	*Qualitative*	*MCPFE Vienna*	*A.1*	*Optional*
6	*Institutional frameworks (Economic viability)*	*Qualitative*	*MCPFE Vienna*	*A.2, B8.*	*Optional*
6	*Legal/Regulatory frameworks and international commitments (Economic viability)*	*Qualitative*	*MCPFE Vienna*	*A.3, B.8*	*Optional*
6	*Financial instruments/Economic policy (Economic viability)*	*Qualitative*	*MCPFE Vienna*	*A.4, B.8*	*Optional*
6	*Informational means (Economic viability)*	*Qualitative*	*MCPFE Vienna*	*A.5, B.8*	*Optional*
6	*Institutional frameworks (Forest sector employment, safety and health)*	*Qualitative*	*MCPFE Vienna*	*A.2, B.9*	*Optional*
6	*Legal/Regulatory frameworks and international commitments (Forest sector employment, safety and health)*	*Qualitative*	*MCPFE Vienna*	*A.3, B.9*	*Optional*
6	*Financial instruments/Economic policy (Forest sector employment, safety and health)*	*Qualitative*	*MCPFE Vienna*	*A.4, B.9*	*Optional*

Criterion	***Indicators***	***Nature of the indicators***	***Process***	***ID***	***Approved for FORSEE test***
6	*Informational means (Forest sector employment, safety and health)*	*Qualitative*	*MCPFE Vienna*	*A.5, B.9*	*Optional*
6	*Institutional frameworks (Public awareness and participation)*	*Qualitative*	*MCPFE Vienna*	*A.2, B.10*	*Optional*
6	*Legal/Regulatory frameworks and international commitments (Public awareness and participation)*	*Qualitative*	*MCPFE Vienna*	*A.3, B.10*	*Optional*
6	*Financial instruments/Economic policy (Public awareness and participation)*	*Qualitative*	*MCPFE Vienna*	*A.4, B.10*	*Optional*
6	*Informational means (Public awareness and participation)*	*Qualitative*	*MCPFE Vienna*	*A.5, B.10*	*Optional*
6	*Institutional frameworks (Research, training and education)*	*Qualitative*	*MCPFE Vienna*	*A.2, B.11*	*Optional*
6	*Legal/Regulatory frameworks and international commitments*	*Qualitative*	*MCPFE Vienna*	*A.3, B.11*	*Optional*

	(Research, training and education)				
6	*Financial instruments/Economic policy (Research, training and education)*	*Qualitative*	*MCPFE Vienna*	*A.4, B.11*	*Optional*
6	*Informational means (Research, training and education)*	*Qualitative*	*MCPFE Vienna*	*A.5, B.11*	*Optional*
6	*Institutional frameworks (Cultural and spiritual values)*	*Qualitative*	*MCPFE Vienna*	*A.2, B.12*	*Optional*
6	*Legal/Regulatory frameworks and international commitments (Cultural and spiritual values)*	*Qualitative*	*MCPFE Vienna*	*A.3, B.12*	*Optional*
6	*Financial instruments/Economic policy (Cultural and spiritual values)*	*Qualitative*	*MCPFE Vienna*	*A.4, B.12*	*Optional*
6	*Informational means (Cultural and spiritual values)*	*Qualitative*	*MCPFE Vienna*	*A.5, B.12*	*Optional*

D. List of indicators not selected by the expert group

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***6.2***
Short description		*Contribution of forestry, and manufacturing of wood, cork and paper products to Gross Domestic Product*			
Reason for non selection		☒ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☒ *Too complicated (no chance of success being cost efficient)* ☐ *Other*			
Rationale		*This indicator is already available in the national accounts of all the participating regions. When it is also available in the regional accounts, the delimitation of the regions does not fit the pilot zones. To make an estimation just for the pilot zones is not very relevant and would be too complicated since we would have to estimate not only the GDP of the forest sector for those zones, but also the GDP for all the other sectors.*			

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***6.7***
Short description		*Consumption per head of wood and products derived from wood*			
Reason for non selection		☒ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other*			
Rationale		*Wood consumption data at national level are available in the official statistics of all the participating regions. It is also an indicator irrelevant at the pilot zone level, since what drives forest products consumption is not the population at that kind of spatial level, but at much larger scales.*			

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***6.8***
Short description		*Imports and exports of wood and products derived from wood*			
Reason for non selection		☒ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other*			
Rationale		*Trade in wood data are available in the official statistics of all the participating regions. It is also an indicator irrelevant at the pilot zone level, for obvious reasons.*			

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***6.9***
Short description		*Share of wood in total energy consumption, classified by origin of wood*			

Reason for non selection	☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other*
Rationale	*Data on fuel wood consumption at national level are available in the official statistics for all the participating regions. Combining this with data on the other sources of energy, it is possible to come up to an estimation of this indicator, still at the national level, as has already been done for some countries. As far as the pilot zones are concerned, this indicator is not very relevant, since its spatial scope is the country as a whole. Also at the pilot zone level it would be too costly to estimate because it requires data not only on wood, but also on all the other sources of energy.*

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***A.1***
Short description		*Description of the indicator*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other*			
Rationale		*National Forest Programmes have a national scope. Therefore they cannot be appropriately dealt with at the pilot zone level.*			

Criterion	***6***	***Process***	***MCPFE Vienna***	***ID***	***B.11***
Short description		*Description of the indicator*			
Reason for non selection		☐ *Already well documented* ☐ *Too easy from existing data* ☐ *Not relevant for the criteria* ☒ *Not relevant for the pilot zone* ☐ *Lack of knowledge (or method)* ☐ *Not Strategic* ☐ *Too complicated (no chance of success being cost efficient)* ☐ *Other*			
Rationale		*The forest research, training and education system have a much broader scope than the pilot zone level.*			

E. List of indicators approved for testing in all regions

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.1***
Short description		*Distribution of the number and area of forest holdings, classified by type of management and size classes*			
Rationale in favour of this indicator		*1) Relevant for South Atlantic European forests, due to the salience of private forests in this area* *2) Important to understand forest owners' economic and forest management behaviours* *3)Feasible for testing at the pilot zone level*			
The evaluation of this indicator requires		☒ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other*			
Equipment	Software	*Access, Excel, Word, Arc View*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*1 month of a senior researcher + 3 months of a research assistant*			
Data	To buy	*1) Database from the 2000 Farm Census for the pilot zone to be purchased from the National Institute of Statistics* *2) Copies of official publications and other bibliography with data on forest holdings structure*			
	To compile	*1) Data on forest holdings distribution already available in official (land registry, rural cadastre, etc.) and non official sources (organisations of*			

		forest owners, research projects on this topic, etc.) *2) Published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data*
	To investigate	*Compare methodologies and problems in data acquisition and processing between regions with previous experience in forest holdings censuses and surveys and regions with no experience*
	To acquire	*1) Processing of farm censuses, land registry or cadastral data to get the distribution of forest holdings by size classes* *2) Information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available)*
	Bibliography	*See annex 6.*
Synthetic protocols for all regions		*A) State of the art comparability study* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data* *B) Exploratory specification study* *1) Spatial scope: pilot zone* *2) Basic concepts:* *a) Since the indicator concerns the distribution of forest holdings and not of forest ownership, the relevant concept here is the following:* *Forest holding: technical and economic unit possible made of more than one piece of land satisfying the following conditions:* *i) area considered as forest according to the definition of the National Forest Inventory;* *ii) area submitted to one and the same management entity (who is not necessarily the same as the landowner);* *iii) area located in a well defined place.* *This definition could be narrowed down by adding a new criterion concerning the minimum threshold of forest area below which a holding with forest would not be considered as a forest holding. The methodological choice made here is not to do it.* *b) Types of management:* *i) non industrial private forest holdings* *ii) industrial private forest holdings* *iii) communal forest holdings (directly managed by the commoners or managed by delegation to other entities such as the Forest Services)* *iv) public forest holdings (holdings which are State property and are managed by public authorities)* *c) Class intervals of forest area for the distributions of number and area of forest: holdings* *0-<1 ha* *1-<2 ha* *2-<3 ha* *3-<4 ha*

	4-<5 ha *5-<10 ha* *10-20 ha* *20-<50 ha* *50-100 ha* *100-<200 ha* *200-<500 ha* *500 ha or more* *C) Recommendations report* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Specific regional protocols	*IRELAND* *Common and specific variables to be reported:* *- Total number of private forest plantations* *- Number of part-time farmers* *- Number of farm plantations* *- Area of state plantations* *- Private forestry as a % of total forest area*
	AQUITAINE *Main data source: available cadastral data*
	NORTE DE PORTUGAL *A) Data sources and methodology* *Since this is a zone without cadastre and it not feasible to fill in this gap with the resources available for this project, the method used will be to get access to the data from the last farm census (2000) and extract from this database the data on forest holdings.* *Since this data does not contain information on the types of management, this has to be added to what can be extracted from the farm census database. This additional information concerns the forest holdings under public, communal and industrial management, which is a small subset in the whole population of forest holdings in this area. Contacts with the foresters in the local forest owners' association, in the Forest Services and in the pulp and paper companies will be sufficient to obtain this complementary information.* *B) Reporting year: 2000*
Comments	*1) The situation of the participating regions in terms of data sources for the specification of this indicator. They range from those where there are good and updated land registry or cadastral data to those where this data is bad, no updated, or simply does not exist (e.g. Portuguese regions). In the later case it is beyond the resources available for this project to carry on a census or survey of forest holdings, even at the pilot zone level. What may be feasible is to try to have access and process existing data obtained in the most recent farm census.* *2) The smooth follow up of the work on this indicator for the pilot zones where it is necessary to rely on access to farm census data will depend on the goodwill and cooperation of the national authorities in charge of those census.* *3) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology*

	and reporting of useful data; *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.3***
Short description		*Net revenue of forest enterprises*			
Rationale in favour of this indicator		*1) Relevant for South Atlantic European forests, due to the salience of private forests in this area and the associated economic viability issues* *2) Important to understand forest owners' economic and forest management behaviours* *3) Feasible for testing at the pilot zone level*			
The evaluation of this indicator requires		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other :*			
Equipment	Software	*Access, Excel, Word*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*1 month of a senior researcher + 1,5 month of a research assistant*			
Data	To buy	*Copies of official publications and other bibliography with data on forest revenues*			
	To compile	*1) Farms accounts in the pilot zone included in the Farm Accountancy Data Network* *2) Published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data about this indicator*			
	To investigate	*Concepts of net revenue of forest enterprises*			
	To acquire	*1) Data to collect for farms in the pilot zone included in the Farm Accountancy Data Network:* *- revenues from timber sales at stumpage prices* *- non-wood forestry revenues* *- in-house consumption of wood and non wood forest products harvested* *- forestry related subsidies* *- fiscal charges related to forestry* *- family working hours spent in forestry related activities* *- payment of services in forestry related activities* *2) Information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available)*			
	Bibliography	*See annex 6*			
Synthetic protocols for regions without forestry accountancy networks		*A) <u>State of the art comparability study</u>* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data*			

	B) Exploratory specification study *1) Spatial scope: pilot zone* *2) Methodology* *For the regions without forestry accountancy networks the approach proposed here is to start by getting access to the farm accounts in the pilot start included in the Farm Accountancy Data Network (FADN). If this access is possible the next step is to work with the farm accounting services in order to include the following complementary statistics for the FADN farms of the pilot zone:* *a) Receipts from timber sales at stumpage prices* *b) Receipts from sales of non-wood forest products* *c) in-house consumption of wood and non wood forest products harvested* *d) forestry related subsidies* *e) fiscal charges related to forestry* *f) family working hours spent in forestry related activities* *h) payment of services in forestry related activities* *C) Recommendations report* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Comments	*1) The specification of this indicator faces two major challenges: one is theoretical and the other is empirical.* *The theoretical challenge has to do with the need to investigate which concepts of net revenue are relevant to understand the behaviour of a population of forest owners which is heterogeneous in terms of their motivations concerning the management of their forest resources.* *The empirical challenge has to do with the fact that, whatever concept of net revenue is adopted, its quantification faces the problem that in most of the pilot zones there are no forestry accounting networks. To set up such kind of network is incompatible with the resources available in this project.* *The approach proposed here is an attempt to deal with part of these problems, but without pretending to be a full solution for both of them. Concerning the theoretical problems, the set of variables proposed for empirical specification are those that have to be part of every concept of net revenue. Still concerning this issue, a deliverable of this project can be a compilation and comparative discussion of existing approaches to this net revenue concept, especially with regard to their relevant for understanding the behaviours of the types of forest owners in the zones covered by the project. Good starting points for this work are the research carried out in the MOSEFA Concerted Action (Hyttinen & Kallio, 1998, 1999) and the accounting framework developed by Pablo Campos Palacin.* *Concerning the empirical problems, in the impossibility of setting up from scratch a Forestry Accountancy Data Network, the main purpose of our project in this matter for the zones where such network does not exist is to examine to feasibility of expanding towards forestry the existing Farm Accountancy Data Network in order to include some (but not yet all) of the variables needed to assess the profitability of forest enterprises.* *Working with these accounts has one advantage which is to compare costs and revenues in forestry and agriculture in the same farm.* *2) The smooth follow up of the work on this indicator for the pilot zones where it is necessary to rely on access to Farm Accountancy Data Network will depend on the goodwill and cooperation of the national*

	authorities in charge of that network. *3) This quantitative indicator is related to the qualitative indicators A2-B8, A3-B8, A4-B8 and A5-B8* *4) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.4***
Short description		*Total expenditures for long term sustainable services from forests*			
Rationale in favour of this indicator		*Forest environmental services are not accounted for in forest contribution to GDP, but need to be valued because they are important for society's well being.*			
The evaluation of this indicator requires		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☐ *Field measurements* ☐ *Other :*			
Equipment	Software	*Excel, Word, Access*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*0,5 month of a senior researcher + 0,5 month of a research assistant*			
Data	To buy	*Copies of official publications and other bibliography with data on public expenditures related to forest public goods*			
	To compile	*1) Published and unpublished official data on the amount of public expenditures related to the production of forest public goods (carbon storage, protection of forest landscape quality, soil protection, water retention, ground water protection, water purification, biodiversity and habitat protection, protection of cultural values)* *2) Other published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data about this indicator*			
	To investigate	*Other methodologies for the economic evaluation of forest public goods, besides the one corresponding to this indicator*			
	To acquire	*Information on the resources needed and costs of data acquisition and processing about the amount of total public expenditures related to the provision of forest public goods*			
	Bibliography	*See annex 6*			
Synthetic protocols for all regions		*A) <u>State of the art comparability study</u>* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting*			

	5) critical evaluation of the existing data *B) <u>Exploratory specification study</u>* *1) Spatial scope: national for the countries with a centralised State and regional for the countries with a regionalised State* *2) Data to be reported* *Amount of annual <u>public</u> expenditures to support the production of forest environmental services (carbon storage, protection of forest landscape quality, soil protection, water retention, ground water protection and water purification, biodiversity and habitat protection, etc..), if possible, according to the Classification of Environmental Protection Activities 2000 adopted by EUROSTAT (see annex IX.D.2)* *3) Reporting years: three more recent years for which there is data available* *C) <u>Recommendations report</u>* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Comments	*1) The specific study for Portugal North is an application of various methods to estimate the value of forest public goods, as explained in annex 1.* *2) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.5***
Short description		*Number of persons employed and labour input in the forest sector, classified by gender and age group, education and job characteristics*			
Rationale in favour of this indicator		*1) Forest sector contribution to employment is a very important dimension of forest contribution to society's well being, often underestimated by existing official statistics* *2) A comprehensive definition and estimation of forest employment is needed to take into account the employment in the forest cluster, as whole (forestry, forest industries, public and private services related to forestry and forest industries)*			
The evaluation of this indicator requires		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other :*			
Equipment	Software	*Excel, Word, Access*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*1 month of a senior researcher + 1 month of a research assistant*			
Data	To buy	*Copies of official publications and other bibliography with data on forest workforce*			

	To compile	*1) Published and unpublished official data on the employment in the forest cluster* *2) Other published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data about this indicator*
	To investigate	*Range of economic activities to be included in the concept of forest cluster*
	To acquire	*Information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available)*
	Bibliography	*See annex 6*
Synthetic protocols for all regions		*A) State of the art comparability study* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data* *B) Exploratory specification study* *1) Spatial scope: regional or national, depending on the choice made by each regional project team according to the existing data sources* *2) Basic concepts:* *This project will attempt to quantify the total employment in the forest cluster, a wider concept than the one of forest sector (see annex 2 for a detailed definition based on the NACE Rev. 1.1 classification).* *This quantification will attempt to go as far as possible in the correct for possible data gaps of official statistics concerning the estimation of total employment in the forest cluster. These gaps should be filled in using other sources of data, including expert guesses. In annex 3 there is an example of how this was done for employment in the Portuguese forest cluster in 1995.* *Whenever there is data sources available on gender and age group, education and job characteristics this should be reported, but it is beyond the scope of this project to carry on a forest labour survey to fill in this gap, if it exists.* *3) Reporting year: the most recent one for which there is data available.* *C) Recommendations report* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Specific protocols		*AQUITAINE* *a) Spatial scope: regional* *b) Methodology*

	The forest statistics about employment cannot report about the situation of companies (or individual firms) with less than 20 employees. This problem is due to the fact that data is not exchanged between many administrations or services. The first priority of the Aquitaine group is to end that situation through meetings and common work between the services or persons concerned. This task is in progress and the group hopes to set up for Aquitaine a comprehensive indicator about the evolution of employment for the sectors of forestry and forest industries.
Comments	*1) The Aquitaine group intends to develop a specific study for this indicator. For the Portuguese regions the spatial scope of this indicator will be national.* *2) This quantitative indicator is related to the qualitative indicators A2-B9, A3-B9, A4-B9, A5-B9* *3) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.6***
Short description		*Frequency of occupational accidents and occupational diseases in forestry*			
Rationale in favour of this indicator		*Indicator currently not reported by official statistics in most of the participating countries, but for which there might be unpublished data available*			
The evaluation of this indicator requires		☐ *GIS processing* ☒ *Data processing* ☐ *Field survey* ☒ *Field measurements* ☐ *Other :*			
Equipment	Software	*Excel, Word, Access*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*0,25 months of a senior researcher + 0,25 months of a research assistant*			
Data	To buy	*Copies of official publications and other bibliography with data on forest workers accidents and diseases*			
	To compile	*1) Published and unpublished official data about this indicator* *2) Other published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data about this indicator*			
	To investigate				
	To acquire	*Information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available)*			
	Bibliography	*See annex 6*			
		A) <u>State of the art comparability study</u> *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this*			

	indicator; *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data* *B) <u>Exploratory specification study</u>* *1) Spatial scope: regional or national, depending on the choice made by each regional project team according to the existing data sources* *2) Basic concepts:* *Number of accidents and number of professional diseases per thousand of forest workers.* *3) Reporting years:* *The three most recent ones for which there are data available.* *C) <u>Recommendations report</u>* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Comments	*1) This quantitative indicator is related to the qualitative indicators A2-B9, A3-B9, A4-B9, A5-B9* *2) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.10***
Short description		*Area of forest and other wooded land where public has a right of access for recreational purposes and indication of intensity of use*			
Rationale in favour of this indicator		*1) Recreational demand for forest areas is an expanding use of forest and other wooded land for which there is a very insufficient knowledge base.* *2) Feasible for testing at the pilot zone level.*			
The evaluation of this indicator requires		☒ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other :*			
Equipment	Software	*Word, Excel, Access, Arc View*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*1 month of a senior researcher + 1 month of a research assistant*			
Data	To buy	*1) Copies of official publications and other bibliography with data on*			

		forest recreation *2) Digital cartography of the pilot zone at the same scale as the Forest Inventory mapping*
	To compile	*2) Published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data about this indicator*
	To investigate	*Appropriate classification of forest recreation facilities*
	To acquire	*Information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available)*
	Bibliography	*See annex 6*
Synthetic protocol		*A) State of the art comparability study* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data* *B) Exploratory specification study* *1) Spatial scope: pilot zone* *2) Variables to be reported:* *i) area of forest or other wooded land with public access for recreational use, if possible reported in a GIS database* *ii) frequency of use of this amenity: frequently, occasionally, hardly ever* *3) Reporting year: 2005* *C) Recommendations report* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Comments		*1) The specification for the intensity of use proposed here for all regions is qualitative (frequently, occasionally, and hardly ever). In some regions there might be data collection networks on the number and characteristics of visitors to some or to all the forest recreation areas. It beyond the scope of this project to set up such kind of network or to collect such kind of data, even though some recommendations should be made about how to do it.* *2) This indicator can provide some, but not all, of the data needed to estimate the economic value of forest recreation. Bibliography in annex 6 and the specific study to be carried out by the Portugal team make that step.* *3) A possible broadening of the scope of this indicator for a future project, or for some of the pilot zones, if this is feasible with the resources available for this project could be to acquire data on the number and types of forest recreation facilities and their workforce. In some countries (Forestry Commission, 2003a) this kind of data is*

	regularly reported by the forest authorities. *4) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire information on the resources needed and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

F. List of optional indicators

CRITERION	***6***	***PROCESS***	***MCPFE Vienna***	***ID***	***6.11***
Short description		*Sites within forest and other wooded land designated as having cultural and spiritual values*			
Rationale in favour of this indicator		*Feasible for testing at the pilot zone level*			
The evaluation of this indicator requires		☒ *GIS processing* ☒ *Data processing* ☒ *Field survey* ☐ *Field measurements* ☐ *Other :*			
Equipment	Software	*Word, Excel, Access, Arc View*			
	Field material	*No specific requirements*			
Personnel	Qualification/ Time	*1 month of a senior researcher + 1 month of a research assistant*			
Data	To buy	*1) Copies of official publications and other bibliography with data on cultural and spiritual values of forest areas* *2) Digital cartography of the pilot zone at the same scale as the Forest Inventory mapping*			
	To compile	*2) Published bibliography and "grey" literature of general interest and of special interest for each participating region in terms of methodology and reporting of useful data*			
	To investigate				
	To acquire				
	Bibliography				
Detailed protocols		*A) <u>State of the art comparability study</u>* *Collect quantitative and qualitative information about the state of the art in each region concerning the data needed for the specification of this indicators reporting on the following items:* *1) comprehensive list of published and "grey" literature of national or regional scope concerning the data and the issues related to this indicator;* *2) sources of data (official and non official)* *2) responsibility and authority in the collection, processing and dissemination of existing public data;* *3) variables included in the data that is publicly reported and the corresponding definitions* *3) methods of collecting data* *4) timing of data collection and reporting* *5) critical evaluation of the existing data* *B) <u>Exploratory specification study</u>* *1) Spatial scope: pilot zone* *2) Variables to be reported:* *Inventory of archeologically sites and other sites with cultural or spiritual values existing in the forest areas of the pilot zone, if possible*			

	reported in a GIS database *3) Reporting year: 2005* *C) Recommendations report* *Based on the state of the art study and on the exploratory specification study, the final stage of this work is the following:* *1) to propose recommendations common to all participating regions and specific for each region in order to improve the existing official forest statistical data concerning this indicator, possibly including some estimation of the costs of those improvements;* *2) to propose durable forms of partnership between the authorities responsible for this data and the institutions participating in the project or other which can contribute to improve the system .*
Comments	*1) This indicator is related to indicators A2-B12, A3-B12, A4-B12 and A5-B12.* *2) Besides acquiring, investigating, processing and reporting data for the quantitative specification of this indicator, this project will also attempt to go as far as possible in terms of accomplishing the following two aims:* *a) compile and make publicly available on the project website a list of existing bibliography (published, or "grey) of general interest for this indicator and of special interest for each region in terms of methodology and reporting of useful data;* *b) acquire data on the time and costs of data acquisition and processing for the specification of this indicator in various situations of initial conditions of each pilot zone in this matter (from zones with no data available to zones with enough data available).*

G. Institutional frameworks, legal and regulatory frameworks, international commitments, financial instruments and informational means

For the regions who opt for reporting on these qualitative indicators related to forest policy instruments (Ai-Bj), this should be done through **descriptive reports** about the country's and/or the region's **forest policy**.

A frequent situation is one where forest policy is not divided according to each of those instruments, but is organized within the framework of **programmes** with specific **objectives, population and actions targeted** and **policy instruments.**

For each of current programme the report should cover the following items, if possible:

- legal framework regulating the programme
- objectives
- characteristics of the target population
- types of actions targeted
- policy instruments available (institutional, legal, financial and informational)
- implementation of policy instruments

H. Specific studies

1. AQUITAINE

Comprehensive quantification of employment in forestry and forest industries in Aquitaine, improving upon current gaps in official statistics, as developed in annex IX.D.4.

2. NORTE DE PORTUGAL

CRITERION	***6***	***PROCESS***	***Proposed by the FORSEE C6 Expert Group***	***ID***	***TEV***
Short description		*Total economic value of economic production*			
Rationale in favour of this indicator		*1) An evaluation of the whole range of forest outputs is not available in official national accounts, but is needed to have a better idea of the real economic importance of forests.* *2) Even without getting a complete valuation of all the forest outputs, it is possible to approach that value through the integration in a single indicator like this one some of the indicators in group C6 and in the other groups.*			
Personnel	Qualification/ Time	*1,5 months of a senior researcher + 1,5 months of a research assistant*			
Data	To buy	*Official statistics and some bibliography containing relevant data*			
	To compile	*See annexe 1*			
	To investigate	*See annexe 1*			
	Bibliography	*See annex 6*			
Detailed protocols		*a) Spatial scope: national* *b) Methodology (for more details, see annex 1)* *1. Combine, modify and complete data from indicators 1.4 (carbon storage), 3.1 (increment and fellings), 3.2 (marketed roundwood), 3.3 (non wood forest products), 4.1 (Tree species composition), 5.1 (soil protection), 6.3 (net forest revenue), 6.4 (expenditure for services), 6.10 (accessibility for recreation) to get an aggregate value (market and non market values) of forest outputs which can be quantified using the selected indicators;* *2. Modifications needed in the MCPFE indicators:* *- Indicator 1.4 modified: tons of carbon stored by forests per year;* *- Indicator 5.1 modified: agricultural soil erosion prevented due to the existence of forests* *3. Transfer unit economic values from other similar sites or other studies:* *- Carbon storage: euros per ton of carbon stored per year (Fankhauser, 1995; and others)* *- Recreation: euros per day/visit obtained from travel cost studies in other similar locations* *4. Economic values to be estimated locally:* *- Value of market forest outputs (wood and NWFP) from indicator 6.3;* *- Private and public expenditures for forest environmental services from indicator 6.4.* *c) Reporting year: 2003*			
Comments		*This study will build upon a previous study for 2001 presented in annex 1. The main purpose of this study will be to take advantage of the data that will be collected for the other criteria and use it to improve what was done for 2001.* *Where the contribution from the work in the other groups can be more advantageous is for the estimation of the value of some forest environmental services:* *a) Carbon storage: contribution from group 1* *b) Biodiversity conservation: contributions from group 4* *c) Soil protection by forests: contributions from group 5* *d) Water quantity and quality protection by forests: contributions from group 5.*			
Budget (provisional)		*Personnel:* *a) Senior researcher: 1,5 X 3000 € = 4500 €* *b) Research assistant: 1,5 X 1250 € = 1875 €*			

	Data acquisition and processing: 2500 € *Travel (for data collection): 2500 €* *TOTAL: 11375 €*

I. Workplan outline

1. List of indicators or tasks to be achieved for the criteria

	Men month estimation for				
Indicators or task for criteria 6	*GIS processing*	*Data processing*	*Field survey*	*Field measurements*	*Other*
6.1-Forest holdings	*1*	*1*		*2*	
6.3-Net revenue of forest enterprises		*1*		*1,5*	
6.4-Expenditure for services		*1*			
6.5-Forest sector workforce		*1,5*		*0,5*	
6.6-Occupational safety and health		*0,25*		*0,25*	
6.10-Accessibility for recreation	*0,5*	*0,5*	*1*		
6.11-Cultural and spiritual values	*0,5*	*0,5*	*1*		
Country and/or regional reports on forest policy as it relates to institutional frameworks, legal and regulatory frameworks, international commitments, financial instruments and informational means		*1,5*			
Specific study: Total economic value of forest production		*3*			

2. Regional organisation

Partners or subcontractors responsible for developing/applying the protocols

Portugal Centre	***Portugal North***	***Galicia***	***Castille y Leon***	***Euskadi***	***Navarra***	***Aquitaine***	***Eire***
Pedro Ochoa Carvalho (ISA)	*Américo Mendes (Portuguese Catholic University-Porto)*	*Manuel Francisco Marey Perez (Universidad de Santiago de Compostela – Lugo)*	*Natividad Gomez (Federación de Asociaciones Forestales de Castilla y Léon)*	*Eider arrieta (IKT)*	*Carmen Traver (V. R. Navarra)*	*Dominique d'Antin de Vaillac (Université de Bordeaux IV-CAPC)*	*Ray Gallagher & Marina Conway (Western Forestry Coop.)*

3. Expert group time chart and deliverables

a) Workpackage 1 : State of the Art comparability study

The first draft of this workpackage should be available for a side meeting discussion at the time of Technical Committee Meeting to be held in Porto, on March 15, 2005.
The final draft should be ready by mid 2005. It is recommended to hold a meeting with all the socioeconomic teams involved to discuss the results of this workpackage and make the final arrangements for the next ones.

b) Workpackage 2: Exploratory specification study

The exploratory specification study of the selected indicators should start right after the closing meeting of WP1, running through the remaining duration of the project until four months before the time of the final reporting.

At least one progress report should be delivered before the final draft. This report should be in a meeting with all participating teams. This meeting can be organised as a side event of a Technical or Management Committee meeting.
The same should happen with the final report for this workpackage,

c) Workpackage 3: Recommendations report

The four last months of the Project should be reserved for the final reporting of this group, contributing to the overall final report of the Project.

d) Workpackage 4: Specific studies

The specific studies will run in parallel with WP 1 and 2. Their reports should be delivered at the start of WP 3, so that their results can be included in the recommendations report.

J. Conclusions

The current version of the report is not final, but has to be completed soon. Further discussion is needed among the group members and with the leaders of the regional teams and other expert groups on the following issues:

a) Final list of selected indicators for all regions

b) Contents of the protocols for the selected indicators and possible interactions with the work planned for the other criteria.

The expert group members should also contribute much more than they did so far for a starting list of bibliographical references, especially those of specific interest for their regions.

IX. Appendices

A. Annexes Criteria 1

1. Annex C1.1 Bibliography

BRAVO, F., DEL RÍO, M. & DEL PESO, C. (2002). *Inventario Forestal Nacional. Elemento clave para la Gestión Forestal Sostenible.*

BURNHAM, K.P. & ANDERSON, D.A. (1998). *Model Selection and Inference -A Practical Information* Theoretic Approach. Springer, Berlin, 353 pp (quoted in Joosten R., Schumacher J., Wirth Ch., Schulte A. (2004*). Evaluating tree carbon predictions for beech (Fagus sylvatica L.) in western Germany*. Forest Ecology and Management 189. 87-96.

CANADELL, J. (1988*). Biomass equations for Quercus ilex L. in the Montseny Massif, northeastern Spain.* Forestry. Vol 61, nº2.

DIÉGUEZ ARANDA, U. ET AL. (2003). *Dendrometría*. Coedición Fundación Conde del Valle de Salazar y Ediciones Mundi-Prensa, Madrid. 327 pp.

GUTIÉRREZ, A., BAONZA, M.V. & FERNÁNDEZ- GOLFÍN, J. (1997). *Variaciones de la densidad de la madera de pino silvestre de los Sistemas Central e Ibérico*. Proceedings of the I Congreso Forestal hispano-luso, Pamplona, mesa 7: 229-234.

HICHCOCK, H. C. & MCDONNELL, J.P. (1979*). Biomass measurement: a synthesis of the literature.* Proc. For. Inventory Workshop, SAF-IUFRO. Fort Collins, Colorado: 544-595.

KOLLMANN (1959). *Tecnología de la madera y sus aplicaciones.* Tomo primero. IFIE, Madrid.

KURZ, W.A., BEUKEMA, S.J. & APPS, M.J. (1996). *Estimation of root biomass and dynamics for the carbon budget model of the Canadian forest sector*. Canadian journal of forest research 26: 1973-1979.

MADRIGAL, A., PUERTAS, F. ET AL. (1992). *Tablas de producción de selvicultura variable de Fagus sylvatica* L. *en Navarra*. Serie Agraria nº 3. Departamento de Agricultura, Ganadería y Montes. Gobierno de Navarra. Pamplona.

MINISTERIO DE MEDIO AMBIENTE (2003). *Tercer Inventario Forestal Nacional. Comunidad Foral de Navarra.* Ministerio General de Medio Ambiente, Dirección General de Conservación de la Naturaleza, Subdirección General de Montes.

MONTERO, G. (2002). *Cuantificación del potencial de las principales especies forestales españolas para el almacenamiento de carbono a medio y largo plazo*. Curso de verano Bosques, sociedad y cambio climático, en UIMP, Santander.

MONTERO, G., MUÑOZ, M. & DONÉS, J. (2003). *Fijación de CO_2 por Pinus sylvestris L. en el monte "Pinar de Valsain"*. Foresta nº 24: 40-48.

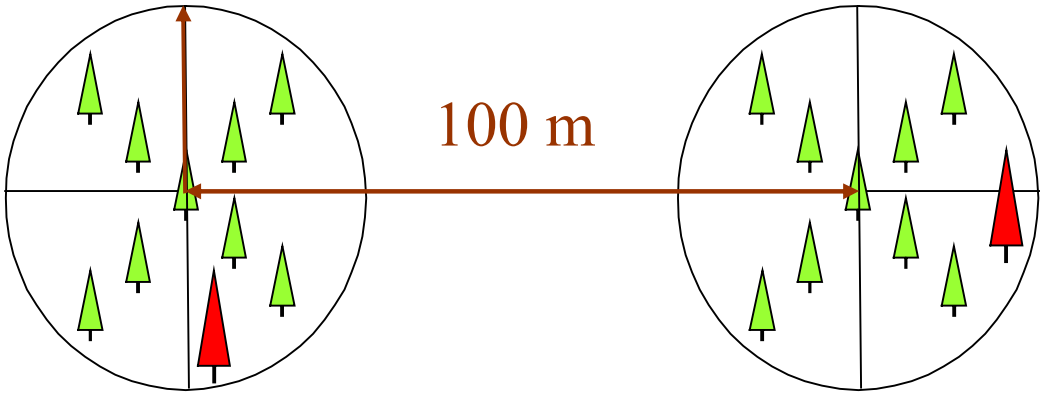
MUÑOZ, M. (2002). *Fijación de CO_2 por Pinus nigra* Arn. subsp *salzmannii en el monte Rocha de la Carcoma nº 148 del CUP, Lebrancón (Guadalajara).* Proyecto Fin de Carrera. E.T.S. Ingenieros de Montes. Universidad Politécnica de Madrid.

PARDE, J. (1980). *Forest biomass*, Forestry abstract (Review article), 41(8):343-362.

SÁNCHEZ PALOMARES, O., CARRETERO CARRERO, Mª.P. & ELENA- ROSELLÓ, R. (1992). *Caracterización de los hábitats en los hayedos de Navarra.* En Elena- Roselló R. (Edit.), Actas del Congreso Internacional del Haya, Pamplona. Vol I: 189-222.

B. Annexes Criteria 2

1. Annex C2.1 Satellites suggested for sanitary risk estimation



Field Card proposed

Methodology of fields measurements FORSEE

Criteria 2: FOREST HEALTH

Country		Region			Nº Stand			Date							
Nº tree	Species	Defoliation		Discolouration	Dead crown	Cankers		Dieback	Miners		Cracks		Direct action of men		Observations
		%	Agent	Code	%	Number/Agent	Length	Yes/Not	Code	Agent	Number/Agent	Lenght	Class	Severity	
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
Model tree															
Description of the stand															
Observations															

2. Annex C2.2 Instructions:

Defoliation is assessed in accordance with the manual of ICP forest (monitoring activities al level I), so the defoliation is assessed in 5 % steps (5, 10, 15, 20,).

a) Assessable crown

The assessable crown of a freely developed tree is defined as the whole living crown from the lowest substantial living branch upwards. The following parts of such a crown must be excluded from the assessment:

- Epicormic shoots below the crown.
- Gaps in the crown where it is assumed that no branches ever existed.

The assessable crown included recently died branches, but excluded snags that have been dead for many years. Snags represent the historic mortality of parts of the crown and have no influence on the current condition of the tree. They are therefore excluded from the assessment. Dieback of shoots and branches represents an active process in the crown and is therefore included.

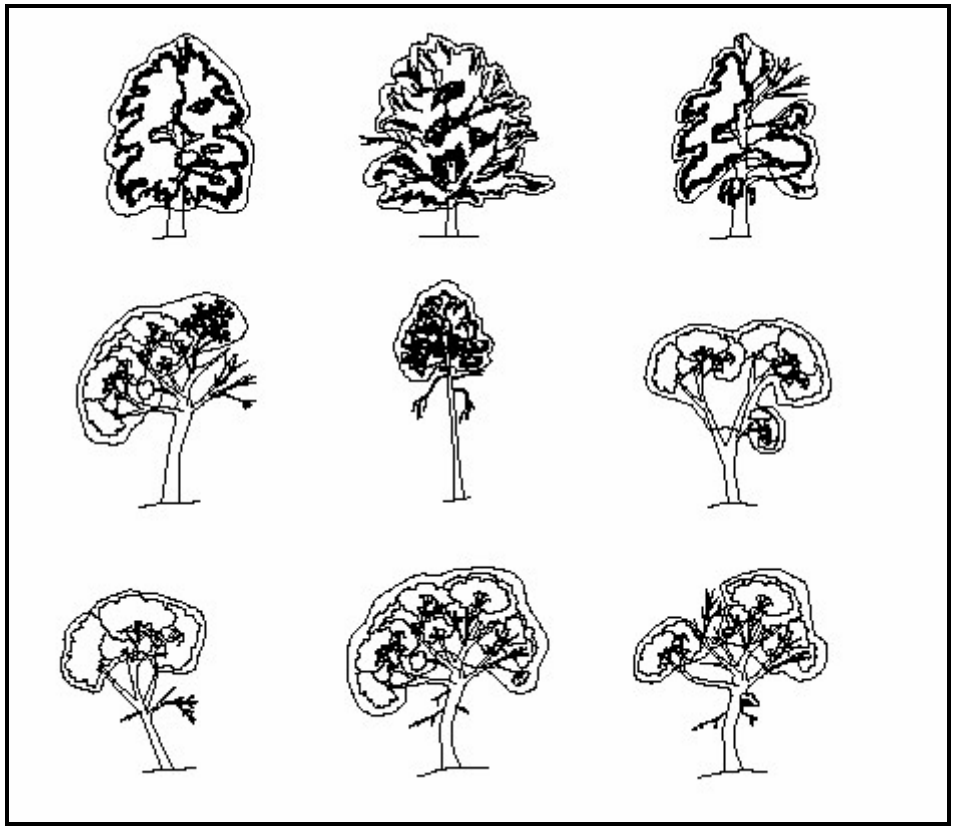


Figure 2: Figure 1: Outlines of the assessable crown showing which areas of dieback to include and exclude

b) Discolouration

also is assessed in accordance with the manual of ICP forest (monitoring activities al level I), so the discolouration is assessed how:

None → 0
Slight → 1
Moderate → 2
Severe → 3
Dead tree → 4

Dead leaves are not included in the assessment, because it are considered how defoliation.

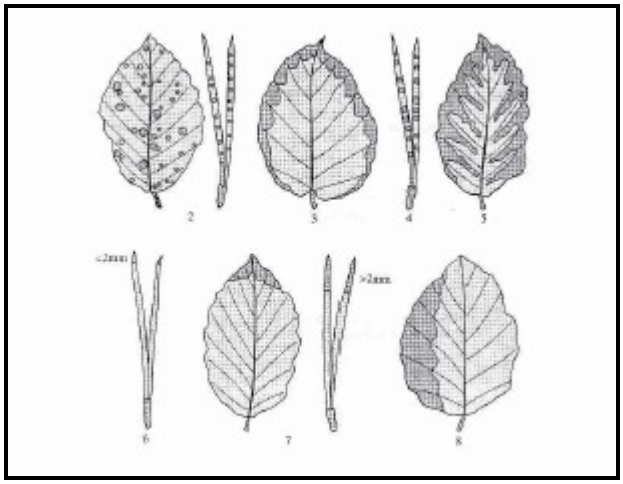


Figure 3 : Shapes of discolouration

Percentage dead crown: thick branches that have been dead for many years, which have already lost their side-shoots.

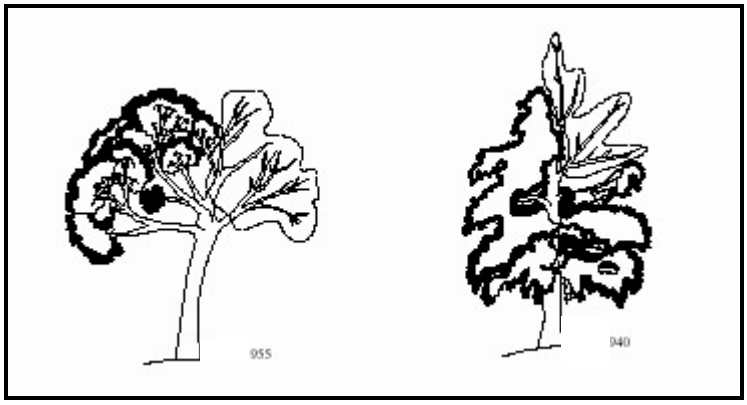


Figure 4: Outline showing which is dead crown.

c) Cankers:

assess of the two first basal meters, thus we would record number of cankers and total length.

d) Dieback:

qualitative variable. Yes/Not.

e) Miners:

it will assess in of the two first basal meters. Codes:

- None → 0
- Slight → 1
- Moderate → 2
- Severe → 3

f) Cracks:

Assess of the two first basal meters, thus we would record number of cankers and total length.

g) Direct action of men: codes:

Class:

- Improper planting technique 1
- Land use conservation 2
- Silvicultural operations or forest harvesting:
    - Cuts 3.1
    - Pruning → 3.2
    - Resin tapping 3.3
    - Cork stripping 3.4
    - Silvicultural operations in close trees and other silvicultural operations 3.5
- Mechanical/vehicle damage 4
- Improper use of chemicals 5
- Other direct action of men 6

Severity:

- None 0
- Slight 1
- Moderate 2
- Severe 3

In all variables, we will note the causing agent (if it is known) and the observations that can be important.

3. Annex C2.2: Bibliography

LANIER, L., JOLY, P., BONDOUX, P. AND BELLEMÈRE, A. (1978). Mycologie et pathologie forestières. Ed. Masson. Pages 487.

MCDONAL, G.T. AND LANE, M.B., (2004). Converging global indicators for sustainable forest management. Forest Policy and Economics 6. pp 63-70.

PETER ROSKAMS (AD HOC WORKING GROUP BIOTIC DAMAGE. ASSESSMENT OF DAMAGE CAUSES). Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests.

PHILLIPS, D.H. AND BURDEKIN, D.A., (1992). Diseases of forest and ornamental trees. Ed. The Macmillan Press LTD London and Basingstoke. Pages 581.

STONE, C.; MATSUKI, M. AND CARNEGIE, A. (2003). Pest and disease assessment in young eucalypt plantations: field manual for using the Crown Damage Index, ed. Parsons, M, National Forest Inventory, Bureau of Rural Sciences, Canberra.

SPCAN-DGCN. Red de Seguimiento de Daños en los Montes (Red CE de Nivel I). Manual de campo. Ministerio de Medio Ambiente, 2002.

SPCAN-DGCN. Red de parcelas permanentes para el seguimiento intensivo y continuo de los ecosistemas forestales (Red CE de Nivel II). Manual de campo. Ministerio de Medio Ambiente 2002.

VORA, R.S.,(1997). Developing programs to monitor ecosystem health and effectiveness of mangement practices on lakes states national forests, USA. Biological conservation 80. pp 289-302.

C. Annexes Criteria 4

1. Annex C4.1: Bibliography

BLONDEL J., FERRY C., FROCHOT B. 1981 Point counts with unlimited distance. *Studies in Avian Biology* 6 : 414-420.

BULLOCK, J.M. 1996. PLANTS. IN : SUTHERLAND, W.J. (ED.), *Ecological census techniques : a handbook.* Cambridge University Press, Cambridge : 111-38.

EISWERTH, M.E., HANEY, J.C. 2001. Maximizing conserved biodiversity: why ecosystem indicators and threshold matter. *Ecological Economics* 38, 259-274.

FAILING, L., GREGORY, R. 2003. Ten common mistakes in designing biodiversity indicators for forest policy. *Journal of Environmental Management* 68, 121-132.

FRANC, A., LAROUSSINIE, O, KARJALAINEN, T. 2001. Criteria and indicators for Sustainable Forest Management at the forest management unit level. *EFI Proceedings* 38, 277pp.

HUMPHREY, J., FERRIS, R., JUKES, M., PEACE, A. 2002. Biodiversity in planted forests. *Annual Report and Accounts 2000-2001*, Forest Research UK, 24-33.

LARSSON, T.B. 2001. Biodiversity Evaluation Tools for European Forests. *Ecological Bulletin* 50, 237pp.

LINDENMAYER, D.B., MARGULES, C.R., BOTKIN, D.B. 2000. Indicators of biodiversity for ecologically sustainable forest management. *Conservation Biology* 14, 941-950.

MACNALLY, R., FLEISHMANN, E. 2002. Using "indicator" species to model species richness: model development and predictions. *Ecological Applications* 12, 79-92.

NEWTON, A.C., KAPOS, V. 2002. Biodiversity indicators in national forest inventories. *Unasylva* 53, 56-64.

REMPEL, R.S., ANDISON, D.W., HANNON, S.J. 2004. Guiding principles for developing an indicator and monitoring framework. *Forestry Chronicle* 80, 82-90.

SPENCE J.R., NIEMELÄ J. 1994 Sampling carabid assemblages with pitfall traps: the madness and the method. *Canadian Entomologist* 126 : 881-894.

STOCKLAND, J.N., ERIKSEN, R., TOMTER, S.M., KORHONEN, K., TOMPPO, E., RAJANIEMI, S., SODERBERG, U., TOET, H., RIIS-NIELSEN, T. 2003 Forest Biodiversity Indicators in the Nordic countries. *TemaNord* 514, 108pp.

WEBER, D., HINTERMANN, U., ZANGGER, A. 2004 Scale and trends in species richness: considerations for monitoring biological diversity for political purposes. *Global Ecology and Biogeography* 13, 97-104.

D. Annexes Criteria 6

1. Annex C6.1 Estimation of the total economic value of Portuguese forests for 2001 *(baseline work for the specific study of Portugal North)*

by

Américo M. S. Carvalho Mendes

a) Scope of the estimates

The scope of this estimation is the economic valuation of annual **outputs** of forests in Continental Portugal, including those that are not marketed. Some of these outputs contribute

positively to the society's well being and are therefore referred to as **social benefits**, while others contribute negatively, being referred to as **social costs**. This study is mainly concerned with the 'resources' side of a forestry production account (in the national accounting sense of the word), extended to include some forest public goods and other non-marketed forest goods and services (Bergen, 2001). Estimates of some of the 'uses' in the forestry production account are given only for the depreciation in forestry capital due to fires. Therefore, a complete estimate of the net social added value for forestry is not obtained.
We will also not attempt to analyse whether or not society uses of forest outputs are above or below **sustainable** levels. So we leave out **capital gains,** with a few exceptions which will be mentioned later on.

In Portuguese forests, especially in those with a more Mediterranean nature, but also in the other forest ecosystems, forestry has strong **technical interdependencies** with livestock and farming. Here are just a few of them:

- forests produce grass and acorns which may be used to feed animals;
- animal dung and shrubs may be used for the fertilisation of farmland;
- farm use of shrubs and other forest vegetation may reduce the risk of forest fire;
- farming and livestock rearing in cork oak systems, if appropriately done, may be beneficial to cork production.

We will not attempt to deal with all the outputs of these agro-forestry systems, but simply with the outputs of their **forest component**. This does not mean that we will restrict our attention to timber production only. Besides timber production we will also look at non wood forest goods and services (marketed, marketable and non marketable), including those that are intermediate consumptions for the livestock and farming activities technically and economically integrated with forestry, like grazing in forest lands and acorn production, as well as services provided by forests due to the action of the public sector, and some environmental services which are public goods.
Timber and cork production is evaluated at roadside prices. This implies that we are dealing with the 'resources' side of the consolidated production account of forestry, logging and cork extraction. Hunting and animal production based on acorns and grazing from forest areas are not included in this consolidation. What is estimated related to these two activities is the value of forest outputs that are their intermediate consumption.

The estimates presented here should be taken with care because of their limitations on three counts, at least:

- in some cases, the estimates are based on very fragmentary, shaky data and bold assumptions which we tried always to make as explicit as possible;
- in other cases, there are forest outputs and values which are missing because of a total lack of basic data even for valuations based on bold assumptions.

These limitations are due to the fact that, given the constraints and the resources available for this project, no new field work could be undertaken to fill in the gaps in the very scarce empirical literature available. So the estimates presented here should be seen as not much more than a current sate of the art in the country, contributing to set the ground for so much work that remains to be done.

b) Direct use values

(1) Timber harvested

Data regarding the production of the different types of timber harvested is provided by the official agricultural statistics (INE, 2003b). This data, published in cubic meters under bark, was converted[4] in cubic meters over bark. Monetary valuation is based on roadside prices for

[4] Using the coefficients: 1 m^3 o.b. = 0.7 m^3 u.b. for conifers and 1 m^3 o.b. = 0.82 m^3 u.b. for broad-leaves.

2001 (SICOP, 2003a), considering that: the price for coniferous pulpwood, saw-logs and fuelwood refers to maritime pine; the price for broad-leaved pulpwood refers to eucalyptus; the price for broad-leaved saw-logs refers to oak saw-logs[5]; the price for other industrial wood refers to oak saw-logs and the price for broad-leaf fuelwood is a weighted average of the roadside prices for eucalyptus, chestnut and oak fuelwood.

[5] Probably due to the small number of observations, the roadside price reported in SICOP's leaflet for oak saw-logs in 2001 is lower than the stumpage price. However, the information reported in SICOP's website gives a price lower than those two prices, but does not provide data on road side prices. So the road side price reported in the SICOP's leaflet was retained.

(2) Net growth in timber stock

Physical valuation considers the difference between the annual forest increment and timber harvested in 1998. DGF (1999) reports a forest increment of 15 million m3 o.b., of which 54% accrues to conifers and 46% to broad-leaves. Based on INE (2002a) data[6], the quantity of timber harvested is 11.3 million m3 o.b., of which 55% is coniferous and 45% is broad-leaved. Monetary valuation is based on half of the stumpage price for saw logs, considering that not all of the net growth of timber stock has an exchange value. This valuation does not include the annual variation in the value of timber stock as a carbon sink, which is a public good. The latter is incorporated in the value of the forest environmental services. The stumpage prices are the price of maritime pine (for coniferous growing stock) and of oak (for broad-leaved growing stock) (SICOP, 2003b).

Outputs	Physical production (intermediate or final)	Valuation method	Unit value (euros per physical unit)	Value of production (000 euros)
DIRECT USE VALUES				
WOOD FOREST PRODUCTS				**543,590**
Timber harvested				**430,600**
Pulpwood				
Coniferous	2,153,000 m³ o.b.	Roadside market price	€19.54/m³ o.b.	42,070
Broad-leaved	6,684,000 m³ o.b.	Roadside market price	€31.70/m³ o.b.	211,883
Saw-logs				
Coniferous	4,733,000 m³ o.b.	Roadside market price	€33.42/m³ o.b.	158,177
Broad-leaved	221,000 m³ o.b.	Roadside market price	€41.89/m³ o.b.	9,258
Other industrial wood	220,000 m³ o.b.	Roadside market price	€41.89/m³ o.b.	9,212
Fuelwood				**37,273**
Coniferous	286,000 m³ o.b.	Roadside market price	€38.22/m³ o.b.	10,931
Broad-leaved	488,000 m³ o.b.	Roadside market price	€53.98/m³ o.b.	26,342
Net growth in standing timber stock				**75,717**
Coniferous	2,060,000 m³ o.b.	50% of the stumpage price	€19.53/m³ o.b.	40,232
Broad-leaved	1,794,000 m³ o.b.	50% of the stumpage price	€19.78/m³ o.b.	35,485
NON WOOD FOREST GOODS				**584,771**
Cork harvested				**390,726**
Reproduction cork	128,000 t	Roadside market price	€2.94 /kg	375,936
Virgin cork	30,000 t	Roadside market price	€0.49 /kg	14,790
Resin	15,444 t	Roadside market price	€0.20/kg	**3,089**
Honey				**7,619**
Origin labelled honey production	172.5 t	Market price at producer group gate	€3.97/kg	684
Other honey production	4,361.5 t	Average export price	€1.59/kg	6,935
Fruits collected				**53,310**
Pine nuts	70,000,000 pine cones	Market price at farm gate	€0.20/pine cone	14,000
Chestnuts	26,118 t	Market price at farm gate	€0.99/kg	26,055
Carob	31,500 t	Market price at farm gate	€0.27/kg	8,577
Arbutus berries (Arbutus unedo)	15,130 ha x 200 kg/ha	Market price paid to pickers at distillery gate	€1.13/kg	3,404
Elderberries (Sambucus nicra)	650 t	Market price paid to pickers	€1.96/kg	1,274
Edible wild mushrooms picked up for sale	6,500 t	Market price paid to pickers	€2.5/kg	**16,250**
Plants picked up for sale				**1,400**
Thyme, laurel and other cooking plants	80 t	Market price paid to pickers	€3.75/kg	300
Aromatic and medicinal plants	1,100 t	Market price paid to pickers	€1/kg	1,100
Forest goods for intermediate Consumption in animal production				**112,377**
Acorns grazed big pigs in extensive rearing	51,450,000	Surrogate market price	€0.13/FU	6,704
Grazing resources under forest cover	673,900,000	Surrogate market price	€0.13/FU	87,809
Grazing resources in scrub land (consumption by goats)	137,100,000	Surrogate market price	€0.13/FU	17,864
Acorns and other products grazed by other animal species				No estimate
Net growth in the production capacity of Non wood forest goods				No estimate, but probably positive
RECREATIONAL SERVICES				**37,883**
Hunting	219,005 hunters	Cost-based method		21,383
Informal forest recreation	6,000,000 day-visits	CVM	€2.75/day-visit	16,500
TOTAL DIRECT USE VALUES				**1,166,244**
INDIRECT USE VALUES				
Carbon storage	1,450,000 tC	Shadow pricing	€20/tC	29,000

[6] Converted into m³ o.b. by using the same coefficients as for the timber harvested.

Protection of agricultural soil				49,209
Protection of water resources	8,772,520 ha	Cost avoided method	€3.30/ha	28,934
Forest landscape and biodiversity conservation	594,509 ha	Cost based method	€95.36/ha	56,695
TOTAL INDIRECT USE VALUES				**163,838**
NEGATIVE EXTERNALITIES				
Damages caused by forest fires		Cost based method		**136,850**
Costs of fire prevention				17,350
Social costs of fire fighting				35,853
Losses of forest products burnt				38,320
Reforestation costs				45,327
Other forest externalities				No estimate
TOTAL NEGATIVE EXTERNALITIES				**136,850**
TOTAL ECONOMIC VALUE				**1,193,232**

Table 5 : Economic values of forest products in Continental Portugal (2001)

(3) Cork

Data for production of virgin and reproduction cork in 2001 comes from the official agricultural statistics (INE, 2003b). The source for the roadside market price (*'preço de venda na pilha'*) of reproduction cork is SICOP's leaflet (SICOP, 2003a). The price for the virgin cork is given by the SICOP website (SICOP, 2003b). It was assumed that the price reported for virgin cork is a roadside price.

(4) Resin

Data for production comes from the official agricultural statistics (INE, 2003b). The producer market price per kg for 2001 was calculated considering the producer market price per incision for 2001, according to SICOP (2003a), and a production of 1.8 kg of resin per incision (Goes, 1991).

(5) Honey

Valuation of honey distinguishes between origin labelled production and other production. For the former, data regarding production and price in 2001 is provided from the answers to questionnaires sent by Instituto de Desenvolvimento Rural e Hidráulica (Oliveira, 2004) to producer groups. The price refers to sales of those groups to wholesalers and other buyers.
Data for the other production was obtained by subtracting the origin labelled production from the total production of the country in 2001 (except 4 t of production in Azores), as reported by official agricultural statistics (INE, 2003b). The price is the average export price in 2001 according to these statistics (INE, 2002a).

(6) Pine nuts

There has been no official data regarding the production of pine nuts since 1972. The volume of production reported in Table 5 is an estimate made by Alpuim *et al.* (1998), and not the actual production for 2001. The price for 2001 is the producer market price, according to SICOP (2003a).

(7) Chestnuts

The data for production and the market producer price in 2001 comes from the official agricultural statistics (INE, 2003b).

(8) Carob

There has been no official data for carob production since 1977. According to the official agricultural statistics, the average annual production for 1968/1977 was 43,193 t. Current opinions of local experts give estimations ranging from 28,000 to 35,000 t. The valuation considers the average of the two estimates (31,350 t) and the producer market price for 2001 as reported by the official agricultural statistics (INE, 2003b).

(9) Arbutus berries

The most recent data for *Arbutus unedo* comes from the first revision of the Forest Inventory (1969/1974), according to a Forest Services' publication (DGOGF, 1979). The production of berries per hectare comes from Goes (1991). The price paid to pickers at the distillery gate is

the author's own estimate based on a price of €15 per litre of arbutus brandy, a transformation ratio of 100 kg of berries per 15 litres of brandy (Goes, 1991) and about 50% of the price of the brandy corresponding to the cost of berries at the distillery gate.

(10) Elderberries

Data regarding quantity is the author's own estimate of the average annual production for Continental Portugal based on local informants from the area where this species is more frequent (Vale do Varosa) published in the CESE report (CESE, 1996; Mendes, 1997). The market price paid to pickers is the price for 1995 obtained from local informants in that area inflated to 2001 according to the producer price index for agricultural products (INE, 2002a).

(11) Mushrooms

Production is based on the author's own estimate for the average quantity of mushrooms picked and sold in the period 1997/1999, based on a report prepared by ICN *et al.* (2001). The price paid to pickers is based on information collected in October 2000, from local sources, in the border regions with Spain where this activity is more intense (Paulino, 2000). This price is less than half the export price.

(12) Plants

The production is the author's own conservative estimate based on the quantities exported in the period 1988-1992, under positions 0910 and 1211 of the Nomenclature of Foreign Trade Statistics. The averages for this period were 60.6 t for cooking plants (with a maximum of 75.3 t in 1992) and 822.6 t for the aromatic and medicinal plants (with a maximum of 1,027.5 t in 1992). The market prices paid to pickers in 2001 are the author's own estimates.

(a) Forest products for intermediate consumption in animal production

Acorns

The main sources of acorns currently grazed by animals are the cork oak and holm oak stands in the southern regions. The total and mean annual production of acorns of these stands are reported in Table 5, as given by the Forest Inventory of 1995 (DGF, 2001). Not all this production is actually grazed by animals. For the farms surveyed in the project carried out by Moreira *et al.* (1995), the production of acorns grazed by pigs in extensive regime (*'porco de montanheira'*) is 37 kg/ha/year. This is about 5.5% of the mean production reported in Table 7. Applying this percentage to the total production reported in that table, a total of 22,714t for the cork oak stands and 16,903t for the holm oak stands is obtained, which makes a total of 39,617t. This is possibly a lower bound estimate of the amount of acorns grazed by pigs in extensive rearing. Another estimate can be made based on the number of pigs in this regime and their feeding needs. According to the same research project (Moreira *et al.*, 1995), in 1989 there were 6,000 sows, each of these animals giving birth to 10 sucking-pigs per year. If 8 out of these 10 sucking-pigs go on for fattening up to the age of 2, this gives 48,000 fattening pigs per year. If each of these pigs needs 1,400 kg of acorns, a total of 67,200 t of acorns grazed by fattening pigs in extensive regime is obtained. An estimate for this kind of use of acorn production is around 70,000 t/year.

Species	Type of stand	000 t	kg/ha
Sobreiro	Pure	343.0	579
	Mixed dominant	49.5	411
	Mixed dominated	20.4	177
Azinheira	Pure	266.4	688
	Mixed dominant	31.8	428
	Mixed dominated	9.1	130

Table 6: Total and mean annual production of acorns in cork oak and holm oak stands in 1995 (Source DGF 2001)

To convert this quantity into forage units, the coefficients proposed by Vieira da Natividade (1950, p.317) are taken as a basis: 730 FU/t for acorns from cork oak and 743 FU/t for acorns from holm oak. Considering an intermediate value of 735 FU/t, 70,000 t/year of grazed acorns correspond to 51.5 million FU/year. This quantity of grazed acorns is a lower bound estimate of the amount of acorns used in animal production because there are other animal species, besides pigs, in extensive regime, fed with this type of forest good. An attempt is not made to estimate this kind of intermediate consumption of acorns. To value this forest good, the price of barley for animal consumption in 2001 (INE, 2002a) is used as a surrogate market price, assuming the equivalence 1 kg of barley = 1 FU.

(b) Grazing resources under forest cover

Based on information provided by the 1995 Forest Inventory (DGF, 2001) on natural and artificial grazing grounds under forest cover, their total forage production is estimated as as reported in Table 8. The mean annual production of forage in terms of dry matter (DM) is the author's own estimate, based on the information provided by Moreira (1980), as is the ratio of FU per kg of DM: 0.3 FU/kg DM for the natural grazing grounds and 0.45 FU/kg DM for the artificial grazing grounds.

With a total of 1.4 million t DM/year, most of which from cork oak and holm oak stands, it is possible to raise livestock equivalent to 1.4 million heads of sheep. According to Moreira *et al.* (1995), in 1989, the livestock in the southern regions of *'montados'* (forest stands dominated by cork oak and holm oak trees), pigs excluded, corresponding to authoctonous races usually in extensive regime, amounted to a number of female adult animals equivalent to 1.5 million heads of sheep. This is an indication that the estimate of forage production presented in Table is probably of the same magnitude as the forage production actually used by livestock (pigs excluded) in extensive regime, at least for the southern regions. To value this forest good we use, as a surrogate market price, the price of barley for animal consumption in 2001 (INE, 2003b), assuming the equivalence 1 kg of barley = 1 FU.

Forest species	Natural grazing grounds				Artificial grazing grounds			
	ha	t DM/ha/year	t DM/year	000 FU/year	ha	t DM/ha/year	T DM/year	000 FU/year
Maritime pine	0		0.0	0	29,283	3.0	29,283.0	13,177
Cork oak	46,282	1	46,282.0	13,885	690,569.5	2.5	644,287.5	289,929
Holm oak	22,336	1	22,336.0	6,701	645,466.0	2.5	623,130.0	280,409
Eucalyptus	0		0.0	0	33,607.5	2.5	33,607.5	15,123
Other oaks	4,690	2	9,380.0	2,814	45,160	4.0	35,780.0	16,101
Stone pine	4,101	1.5	6151.5	1,845	27,019.5	3.0	20,868.0	9,391
Chestnut	0		0.0	0	26,680.0	4.0	26,680.0	12,006
Other broad-leaves	0		0.0	0	27,820.0	4.0	27,820.0	12,519
Other coniferous	0		0.0	0	0.0	3.0	0.0	0
TOTAL	**77,409**		**84,149.5**	**25,245**	**1,525,606.0**		**1,441,456**	**648,655**

Table 7: Estimate of the forage production of grazing grounds under forest cover in Continental Portugal, in 1995

(c) Grazing resources in scrub land

According to Rego (1991), the mean forage production of scrub lands is 1.5 t DM/ha/year. According to the 1995 Forest Inventory, there were 2 million ha of scrub lands. Applying that coefficient, a total of 3 million t DM/year is obtained. Considering a ratio of 0.5 FU/kg DM (1978), a total of 1,540.9 million FU/year can be calculated. Most of this production is left without being used by animals, and therefore contributes to forest fires. The animals more likely to consume this type of vegetation are goats. In Continental Portugal, in 2001, there were 544 thousand animals of this species (INE, 2002a). Assuming that each of them consumes 300 FU per year from this kind of grazing ground, a total of 137.1 million FU is obtained. This amount is assumed to have been consumed in animal production, in 2001.

(d) Litter lying on the forest floor

Litter composed of leaves and fallen branches lying on the forest floor is a product that can be consumed by livestock, at least partially. Another part of these materials is needed to maintain the fertility of the forest soils. What is unused for these purposes contributes to the risk of forest fires.

Based on the coefficients proposed by Rego (1991) and the areas of forest in the 1995 Forest Inventory, the annual production of litter is 1.2 million t DM in cork oak and holm stands (1.2 million ha x 1 t DM/ha) and 5.0 million t DM in other forest stands (2.0 million ha x 2.5 t DM/ha). Adding up these estimates gives a total of 6.2 million t DM/year. Based on a coefficient of 0.6 FU/kg DM (Vieira de Sá, 1978), this corresponds to 3,744.7 million FU/year. It is assumed that all this production is left on the ground, or burns in forest fires.

(13) Comparison between the value of forest goods used as intermediate consumption in animal production and the value of animal production

Since grazing resources are the most valuable non-wood forest good after cork, it is important to verify the reliability of the estimate using a different method. In national accounts, the estimated value of €112.4 million of forest products used in animal production in 2001 are part of the value of animal production and not part of the value of forest production. That amount should be compared to the value of the following components of animal production: meat, milk and cheese from goats; origin labelled meat and cheese; origin labelled meat from cattle; and origin labelled meat from pigs.

According to the official agricultural statistics (INE, 2003b), the value of meat production from sheep and goats in 2001 was about €163 million. According the to questionnaires sent by Instituto de Desenvolvimento Rural e Hidráulica (Oliveira, 2004) to the producers' groups of origin labelled products, in 2001, the value of origin labelled meat products from bovines and pigs was €117.2 million and the value of origin labelled cheese from sheep and goats was €12.8 million. Adding up these values, a total of €187.4 million is obtained for the animal production likely to be dependent on grazing products from forests and scrub lands. Therefore, the previous estimate of €112.4 million for the value of these forest products can be considered as a reasonable approximation.

(14) Net growth in the production capacity of non wood forest goods

The net growth in the production capacity of non wood forest goods is not estimated; instead, qualitative information regarding the trends in this forest resource is given. Cork harvesting is subject to regulations preventing removals beyond sustainable limits. It is believed that the industrial demand for cork induces harvesting all sustainable production. Since the end of the 1930s, the cork oak area did not change substantially, but the stand's quality improved considerably during a programme carried out by the Forest Services in the late 1950s. Since the mid-1980s, the financial EU incentives prompted a renewal and expansion of the cork oak stands. Thus, the future trends in the productive capacity of cork oak stands are likely to be positive.

The demand for pine nuts, chestnuts and carob is in tandem with the harvest, which is believed to be within sustainable limits. Since the mid-1980s, these species have also benefited from public financial incentives. So, the conclusion for this group of products, is similar to the case of cork. In the case of mushrooms, there are situations of overpicking, but there are also areas of underpicking where there are no workers available and willing to do this job. Therefore, it is difficult to make a well founded guess about the trend in the production capacity of this product. With respect to resin, honey, arbutus berries, elderberries, plants, acorns and grazing resources, there are reasons to believe that the trends in production

harvested may not be following the trends in the production capacity. Starting with resin, the situation can be described as follows:
- a sharp decline in resin tapping since the mid-1980s: from 115,200 t on average per year in the period 1980-1986 to 21,300 t in the period 1996-2002;
- a decline in the area of maritime pine not as large as the decline in resin tapping: from 1.3 million ha in the second revision of the Forest Inventory (1980/85) to 976 thousand ha in the third revision (1995/98), the declining continuing in more recent years because of forest fires[7].

These trends led to a decline in production capacity of resin, with no overuse of the resource. Other products (honey, berries, plants, acorns and grazing resources) are harvested below potential production; their production capacity is probably growing, not only because of no overuse, but also due to the growth in forest and other wooded land. The global conclusion is that the net change in production capacity of non wood forest goods is probably positive.

(15) Forest hunting benefits

The value of the hunting benefits of forests is estimated by using the costs paid by hunters, including hunting permits, fees for gaming services in hunting zones with excludable access, and membership fees to associative hunting areas.

(a) Hunting permits

In the 2001/2002 hunting season, 219,000 hunters paid €5.5 million for their hunting permits[8].

(b) Gaming services paid by hunters in hunting zones with excludable access

According to Cipriano (1999), in the 1996/1997 hunting season, average expenditures per hunter on gates, posts, game management and other gaming goods and services in hunting zones with excludable access was €674 in touristic zones, €311 in associative zones, and €104 in social zones[9]. Assuming that the distribution of hunters across types of zones in the 2001/02 hunting season was the same as in 1996/97, the total amount paid is €26.5 million[10].

(c) Membership fees to associative hunting areas

Membership fees to associative hunting areas averaged €207 (Cipriano, 1999, updated to 2001 euros). Given 96,000 members in 2001 (Bugalho and Carvalho, 2001), this amounts to €19.9 million.

Adding up these figures result in a total cost paid by hunters of €51.9 million. Not all of it can be attributed to forests, however. Although forests are very important for game feeding, other areas – agricultural areas and uncultivated lands – also play a role. A crude but simple criterion to impute the value of hunting to forests is to multiply it by the percentage of forests and other wooded lands in the total area with hunting capacity, which is 41% (Bugalho and Carvalho, 2001). Thus the value of hunting benefits attributable to forests is estimated at about €21.4 million.

---

[7] 47,264 ha of maritime pine burnt from 1996 to 1999, according to the Forest Services.

[8] 134,000 national hunting permits issued for residents (€24.94); 85,000 regional hunting permits for residents (€12.47); 2,000 hunting permits for non residents (€44.89); and 33,000 special hunting permits for big game (€29.93) (DGF data).

[9] All amounts have been converted to 2001 euros using the consumer price index for leisure, recreation and culture.

[10] According to Cipriano (1999), 17% of hunters go only to zones with excludable access (touristic, associative, social or national); 44.4 % go only to zones in the 'general' regime (free access); and 38.6 % go to both types of zones. Within zones with excludable access, 16.7% go to touristic zones, 64.7% to associative zones, 2.5% to social zones, and 16.1% to national zones. The distribution of hunters as reported by Cipriano is somewhat ambiguous because it may include some double counting; in the calculations, it is assumed that this is not the case.

(16) Informal forest recreation

No data is available regarding the number of visits to forests and other wooded lands for recreational purposes. Therefore, available data reporting the number of days spent in camp sites is used as part of a proxy for that variable; as almost all camping grounds are under forest cover, it is reasonable to assume that enjoyment of forests may be one of the motivations of most campers[11]. This makes a total of 4.6 million days spent in campgrounds, in 2001 (INE, 2002b, 2003c).

In addition, 0.4 million nights were spent by guests in rural tourist facilities. These numbers do not include a large and increasing number of urban people who visit forest areas on weekends and holidays without staying overnight. The number of such visits is estimated very roughly by assuming that half the households in the two metropolitan areas of Porto and Lisbon (1.2 million households in 2001, INE, 2003a) visit forest areas at least once a year, and count for just one day visit per household, for a total of 0.6 million day visits. This gives a total of about 6 million days a year for all types of visitors to forest areas.

The willingness to pay per day visit is based on the only available empirical study of the recreational value of a Portuguese forest area (Loureiro and Albiac, 1996). Using a contingent valuation method, the authors found a mean willingness to pay for access to a forest reserve in the Terceira Island of Azores value of €2.75/day visit (in 2001 euros). Given the estimated 6 million day visits, the total value of informal recreation in forests is estimated at about €12.5 million.

c) Indirect use values

(1) Carbon storage

The net annual increment of carbon storage in the woody biomass of Portuguese forests amounts to 1.45 million tC/year, based on UN-ECE/FAO (2000). If this flow is evaluated at the mean social cost of carbon emissions of €20/tC, as estimated by Fankhauser (1995, p. 64) for the decade 1991-2000, an estimate of €2.9 million is obtained.

(2) Protection of agricultural soil

Estimating the protection of agricultural land begins with the regions with a higher risk of desertification, such as Trás-os-Montes, Beira Interior and Alentejo, where the annual erosion of agricultural soil is 5-10 t/ha (Poeira *et al.*, 1990). Considering an apparent specific weight for sediments of 1.5 t/m^3 and a depth of 30 cm for agricultural soil, this erosion corresponds to an annual rate of soil loss between 0.11-0.22%. The average of these rates (0.165%) is used, assuming that it corresponds to the rate of loss in agricultural production.

Based on Rocha *et al.* (1986), the ratio of erosion between land with forest cover to land without is 2/3. Assuming this is proportional to the forests' contribution in reducing erosion, the value of the crops preserved due to soil protection by forest cover is equal to

$$\frac{1-2/3}{2/3} \times 0.165\% \times \text{gross value of crops.}$$

	Gross value of crops in the year 2000 (000 €)	Gross value of crops preserved in the year 2000, due to the soil protection provided by forests (000 €)
Trás os Montes	526,260	434
Beira Interior	236,470	195
Alentejo	531,970	439
TOTAL	1,294,700	1,068

Table 8: The value of crops preserved due to the soil protection provided by forests (Source INE 2003e)

[11] The number of stays in the campsites of the Algarve has been omitted since they are mainly located near beaches. Therefore going to the beach, and not enjoying the forest, is likely to be the motivation for camping.

If the (avoided) losses of crops were irreversible, for a 2% discount rate, the value of €1 million (Table 9) would correspond to a capital loss avoided of €53.4 million. If an amount of losses equal to v lasts for n years, the corresponding capital loss V_n is given by the following expression:

$$V_n = v\left[\frac{1-(1+r)^{-n}}{r}\right]$$

Considering a period of 50 years to recover from soil losses due to erosion and a 2% discount rate, the annual value of losses avoided in the three regions is €33.6 million.

To estimate the value of agricultural soil protection in other regions, an annual rate of soil erosion of 0.055% is assumed - one third of the average for the three regions. Based on the same method, a gross value of crops of €1,812 million is obtained, corresponding to an annual value of about €15.6 million. Adding up the two estimates (annual flows) gives a total value of €49.2 million.

(3) Protection of water resources

The protection of water resources is estimated by using the public costs of watershed management avoided by the existence of forests. These costs are considered as a lower bound for the forests' benefits in water conservation. The Management Plans for the main watershed basins (INAG, 2000) provide data for the total public costs planned for 2001-2020. They relate to the protection of ecosystems (PO3), flood prevention (PO4), fish and wildlife management (PO5) and water management (PO6) (Table 9).

Watershed	PO3	PO4	PO5	PO6	Total cost for 2001-2020	Annual cost
Minho	980	206	858	630	2,674	134
Lima	391	1,021	63	2,076	4,118	206
Douro	1,498	763	578	10,572	18,613	931
Tejo	11,739	822	450	15,910	28,921	1,446
Guadiana	1,460	7,840	2,915	1,250	13,465	673

Table 9: Total public costs of watershed management for the Portuguese international rivers planned for the period 2001-2020 (million escudos)

To estimate the costs that would be born in the absence of forest, it was assumed that the watershed management costs would increase in the same proportion as erosion would increase without forest cover. The increases in erosion were estimated for each watershed based on data from the 1995 Forest Inventory as reported by the DGF software AreaStat, and data taken from the work of Rocha *et al.* (1986) on soil erosion. The sixth column in Table 11 is the coefficient by which we have to multiply the costs in order to obtain the amount of public costs annually avoided in watershed management due to existence of the current forest cover. The results of this estimation for each watershed are reported in the last columns of Table 11. Since the Watershed Management Plans on which this estimation is based are from 2000, the estimate is not corrected for inflation. Converting into euros, a value of €28.9 million is obtained.

Watershed	Total area (000 ha) (1)	Forest area (000 ha) (2)	(2)/(1) %	C	(1-C)/C	Annual costs with current forest cover for 2001-2020	Annual costs avoided for 2001-2020 due to the existence of the current forest cover	
							Total	Per ha
Minho	79.9	29.4	36.8%	1/3	2	133,675	267,350	3.3
Lima	117.2	34.7	29.6%	2/3	1/2	205,900	102,950	0.9
Douro	1,853.9	506.0	27.3%	2/3	1/2	930,650	465,325	0.3
Tejo	2,432.9	1,124.3	46.2%	1/3	2	1,446,054	2,892,108	1.2
Guadiana	1,146.0	344.2	30.0%	2/3	1/2	673,235	336,618	0.3
Rest of Continental Portugal	3,142.6	1,310.8	41.7%	1/3	2		3,736,534	1.2
CONTINENTAL PORTUGAL	8,772.5	3,349.3	38.2%				5,800,885	0.7

Table 10: Rates of forest cover, forest cover correction factors for soil erosion rates and the annual public watershed management costs avoided by the existence of forest cover (thousand escudos)

(4) Forest landscape and biodiversity conservation

(a) Forest landscape conservation in protected areas

The estimated value of forest landscape and biodiversity conservation is based on the only study available in Portugal (Santos, 1997). Using CVM, Santos estimated the willingness to pay of visitors to the Peneda-Gerês National Park for three different programmes of rural landscape conservation, one of which dealt with oak forest conservation. The best point estimate he obtained for the year 1996 amounted to 6,634 escudos per household per year (Santos, 1997, p. 587). Based on the total number of households visiting the park between September 1995 and August 1996, an aggregated willingness to pay of 397,377 million escudos per year was calculated (Santos, 1997, p. 590).

Data regarding the area of forests and other wooded land in Peneda-Gerês National Park is not available, but can be estimated at around 60,000 ha, natural pastureland included. Dividing the aggregated benefit by this surface gives an estimate of 6,623 escudos/ha. In order to arrive at a national level estimate, it is assumed that all protected forests in Continental Portugal have the same characteristics (visitor numbers, visit frequency and site composition) as those in the Peneda Gerês National Park. Extrapolating this estimate to the total forest and other wooded land existing in the Nature 2000 sites (Table 3) results in a total WTP of €3,937.4 million in 1996. Converting and updating[12] this value to 2001 prices, an aggregate WTP of about €20.4 million is obtained.

(b) Public expenditure for forest landscape and biodiversity conservation

The official statistics regarding the environment (INE, 2003d) report data for investment and operating expenditures for landscape and biodiversity conservation by the Public Administration (Central Administration, municipalities and public institutes) and the public non profit organizations. This data does not, however, specify the share of these expenditures attributed only to Continental Portugal. Based on this data, it is estimated that, in 2001, the operating expenditures for this part of the country is about €145 million. It is assumed that 39.1% of this amount refers to forests and other wooded land, based on the share of forests in the total area under some protection status. This gives an estimate of €56.7 million. This value does not include the contribution of public investment expenditures in landscape and biodiversity conservation for the increase in the capacity of forest areas to provide these kinds

[12] By using the consumer price index for recreation, leisure and cultural services, as of December 2001, base 100=1997.

of services. Therefore, this value is a lower bound for the cost based estimate of these services.
Adding up the €56.7 million with the €20.4 million estimated above for forest landscape conservation in protected areas would be double counting. Therefore, the former value is considered as the estimate for these services.

d) *Forest negative externalities*

(1) Costs of forest fires

In 2001, of the 866 forest fires for which the cause was discovered, 95.2% were started by human actions: negligence (such as the burning of pasturelands, picknicking and cigarettes); accidental ignition (due to the operation in or near the forests of farm or forestry machinery, vehicles, trains, and electric lines); conflicts regarding hunting; and arson.
This illustrates that forest owners are seldom among the initiators of forest fires; however, they bear part of the costs, together with other people in society (such as volunteer fire fighters and tax payers) not responsible for starting fires. Therefore, the costs of most of the forest fires in Portugal may be considered as negative externalities born by the forest owners and other people in society who share those costs with them. Some of the components of these costs are estimated below:

(2) Costs of forest fire prevention

There are five main stakeholders in the forest fire prevention system: the non industrial private forest owners, the pulp and paper companies, the Ministry of Interior, the Ministry of Agriculture and the municipalities. In recent years, the pulp and paper companies spent more than €3 million per year in this kind of operations (CELPA, 2003). In 2001, the Ministry of Interior spent €8.1 million, most of it in transfers to forest owners' associations and municipalities for fire prevention actions (MAI-GM, 2003). Out this funding, €3.1 million were allocated to the co-funding of brigades of fire sapers managed by forest owners associations. This co-funding represents about 50% of the total operating costs of those brigades. Through the EU co-funded programmes of the Ministry of Agriculture, €3 million were transferred to public and private beneficiaries in 2000 to support forest fire prevention (MADRP-GPPAA, 2001). Although no data for 2001 is available, the same amount as in 2000 can be assumed. Data on how much the Ministry of Agriculture spent from its own funding in running its network of forest fire detection is not available.

Adding these four components we get a total of €17.4 million, which is a lower bound for the social costs of forest fire prevention in 2001.

(3) Social costs of forest fire fighting

There are three main stakeholders involved in fire fighting: the Ministry of Interior[13], the local fire departments[14] and the pulp and paper companies. In 2001, the Ministry of Interior spent more than €21 million in forest fire prevention and fire fighting (MAI, 2002), through its special agency in charge of supervising the fire departments (SNB-Serviço Nacional de Bombeiros). This money was spent directly by SNB and indirectly through transfers to the local fire departments. The source of this information does separate the amount allocated for fire prevention and fire fighting. Subtracting the €8.1 million spent by the Ministry in fire prevention, a figure of €12.9 million spent for fire fighting is obtained. The data source does not specify neither the amount allocated to the local fire departments, nor the matching funding added by these departments. The pulp and paper companies contributed more than €1.5 million (CELPA, 2003). The calculation of the opportunity cost of the voluntary fire

[13] From where originates most of the public funding for this purpose transferred to the local fire departments, or spent in the lease of airplanes and helicopters.
[14] The majority of which are based on volunteers.

fighters is based on the number of fires - 26,942 acoording to DGF - and the assumption of 20 volunteers per fire, each contributing one day of work per fire, giving an equivalent total of 2,700 full time workers per year. The value added per full time worker in agriculture and forestry, in 2001, was €8,000. Assuming the same labour productivity for volunteer fire fighters, the opportunity cost of their time spent in fire fighting amounts to about €21.5 million.

(4) Costs of losses in wood and non wood forest production

For 2001, DGF estimates wood production losses at about €38.3 million (DGF-CNGF, 2003). Valuing the losses of non wood forest products could be based on previous estimates (Table 6). However, as the burnt areas are not those where the more valuable non wood forest products grow, such an attempt would overestimate these losses. Therefore, without further information, the estimate is limited to the losses of wood production.

(5) Costs of the restoration of burnt forests

DGF estimates the area of burnt forests as about 45,300 ha in 2001. Reforestation through new plantations would cost around €2,250/ha. Reforestation through management of natural regeneration (in the case of pine forests) and stand improvement would cost up to €1,000/ha. Using the least expensive option, a value of €45.3 million is obtained.

(6) Other negative forest externalities

Other possible negative forest externalities not estimated here include: erosion, floods, and landslides due to poor forest management; loss of landscape quality and recreational opportunities due to poor forest management; loss of biodiversity and landscape quality and other losses due to intensive forestry and damage due to pest infections. It should be noted that the main consequence of poor forest management is the increase in the risk of forest fires. Therefore, some of the consequences of this kind of management are already covered by the estimation presented above.

2. Annex C6.2: Definition of the concepts of forest sector and forest cluster for indicator 6.5 based on the NACE classification Rev. 1.1 adopted by EUROSTAT

a) Forest sector

Agriculture, hunting and related service activities (Division 01)

From this division should be included in the forest sector the following activities:

• Growing and gathering of mushrooms or truffles (01.12)

• Gathering of berries or nuts (01.13)

Forestry and logging (02.01)

This **c**lass includes:

- growing of standing timber: planting, replanting, transplanting, thinning and conserving of forests and timber tracts

- growing of coppice and pulpwood

- operation of forest tree nurseries

- growing of Christmas trees

- logging: felling of timber and production of wood in the rough such as pit-props, split poles, pickets or fuelwood

- growing of vegetable materials used for plaiting

- gathering of wild growing forest materials: balatta and other rubber-like gums, cork, lac, resins, balsams, vegetable hair, eel grass, acorns, horse-chestnuts, mosses, lichens

This class excludes:

- growing and gathering of mushrooms or truffles (see 01.12)

- gathering of berries or nuts (see 01.13)

- production of wood chips (see 20.10)

Forestry and logging related service activities

This is class 02.02 which includes:

• Forestry service activities: forestry inventories, timber evaluation, fire protection

• Logging service activities: transport of logs within the forest

Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (division 20)

This division includes the following classes:

a) class 20.10: sawmilling and planing of wood; impregnation of wood

b) class 20.20: manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards

c) class 20.30: manufacture of builders' carpentry and joinery

d) class 20.40: manufacture of wooden containers

e) class 20.51: manufacture of other products of wood:

- wooden handles and bodies for tools, brooms, brushes
- wooden boot or shoe lasts and trees, clothes hangers
- household utensils and kitchenware of wood; coat and hat racks
- wooden statuettes and ornaments, wood marquetry, inlaid wood
- wooden caskets and cases for jewellery, cutlery and similar articles
- wooden coffins
- wooden spools, cops, bobbins, sewing thread reels and similar articles of turned wood
- other articles of wood

f) class 20.52: manufacture of articles of cork, straw and plaiting materials:

- natural cork processing
- manufacture of articles of natural or agglomerated cork
- manufacture of plaits and products of plaiting materials: mats, matting, screens, etc.
- manufacture of basketware and wickerwork

Manufacture of pulp, paper and paper products (division 21)

This division includes the following classes:

a) class 21.11: manufacture of pulp
b) class 21.12: manufacture of paper and paperboard
c) class 21.21: manufacture of corrugated paper and paperboard and of containers of paper and paperboard
d) class 21.22: manufacture of household and sanitary goods and of toilet requisites
e) class 21.23: manufacture of paper stationery
f) class 21.24: manufacture of wallpaper
g) class 21.25: manufacture of other articles of paper and paperboard n.e.c.

b) Forest cluster

We will consider here the forest cluster as being the set of economic activities which includes the forest sector, as defined above, together with the following ones:

- class 01.50 (**hunting, trapping and game propagation, including related service activities**) which includes:
  - hunting and trapping of animals for food, fur, skin, or for use in research, in zoos or as pets
  - production of furskins, reptile or bird skins from hunting or trapping activities

- game propagation
- service activities to promote commercial hunting and trapping.

- part class 24.63 (**manufacture of essential oils**) which includes:
  - manufacture of extracts of natural aromatic products
  - manufacture of resinoids
  - manufacture of aromatic distilled waters
  - manufacture of mixtures of odoriferous products for the manufacture of perfumes or food
- part of class 29.32 (**manufacture of other agricultural and forestry machinery**)
- part of class 29.43 (**manufacture of other machine tools n.e.c.**) which includes:
  - manufacture of machine tools for working stone, wood and similar hard material; presses for the manufacture of particle board and the like
  - manufacture of soldering, brazing and welding tools, surface tempering and hot spraying machines and apparatus
  - manufacture of tool holders and self-opening dieheads
  - manufacture of work holders for machine tools
  - manufacture of dividing heads and other special attachments for machine tools
  - manufacture of parts and accessories for wood, cork, hard rubber and similar hard materials working machine tools
  - manufacture of parts and accessories for welding equipment
- class 29.55: **manufacture of machinery for paper and paperboard production**
- section 36.1 (**manufacture of furniture**), except division 36.15 (Manufacture of mattresses)
- class 51.13: **agents involved in the sale of timber and building materials**
- part of class 60.24 (**freight transport by road**) for the transport of forest products from the forest to the factory
- part of division 73 (**research**) concerning the forest research institutions
- part of class 74.14 (**business and management consultancy activities**) concerning consultancy activities specialised in the forest sector
- part of division 75 (**public administration and defence; compulsory social security**) concerning the public Forest Services and other public agencies related to the forest cluster
- part of division 80 (**education**) concerning the educational institutions related to the forest cluster
- part of class 91 (**activities of membership organizations n.e.c.**) concerning the organizations grouping stakeholders in the forest cluster (forest owners, forest industries, forest contractors, etc.)

Some authors and institutions (e.g. Ministry of Agriculture and Forestry of Finland, 1997, 2001) adopt a concept of forest cluster broader than this one which also includes, for example, the printing industry and energy production in forest areas.

3. Annex C6.3: Employment in the Portuguese forest cluster in 1995

(baseline work for indicator 6.5 in the Portuguese regions)
by

Américo M. S. Carvalho Mendes

a) Underestimation of forest employment in official statistics

Official statistics underestimate the employment in forest sector. For this reason, we corrected and expanded those data for one year (1995) for Continental Portugal. The results show that the **forest cluster** (forestry, forest industries, other forest related industries, forestry and forest industries' related services) gave work to **227794** persons, which is **5,13%** of the total employment. This number is broken down as follows:

- forestry, logging, hunting and related services: 34290 persons

(8000 of which in hunting and game propagation)

- forest industries: 69337 persons
- other forest related industries: 80923 persons
- other forest related services: 43244 persons

To see how official data **underestimates** employment in the forest cluster here are the values for these variables according to a recent paper issued by major international organisations such as ILO, UNECE and FAO, based on EUROSTAT and UNIDO databases which, in turn, rely on national official statistics (Blombäck, Poschen & Lövgren, 2003):

- forestry, logging and related services: 13700 persons
- forest industries: 65067 persons
- other forest related industries: no data
- other forest related services: no data

The following table taken from a recent piece of national official statistics provides further evidence that official data underestimates employment in the forest sector.

		1995	1996	1997	1998	1999
Forest Sector	Forestry	10 700	11 000	11 100	11 200	11 600
	Forest industries (except furniture)	72 000	70 400	71 200	73 400	71 500
	(1) Total	82 700	81 400	82 300	84 600	83 100
(2) All sectors		4 403 900	4 472 100	4 545 400	4 677 700	4 751 000
(1)/(2)		**1,87 %**	**1,82 %**	**1,81 %**	**1,81 %**	**1,75 %**

Table 11: Employment in forestry and forest industries (number of employees in equivalent full time workers) [Source: INE 2003c][15]

b) Relative position of the forest cluster in total employment

Now some data for comparison between employment in the forest cluster and employment in the other main clusters of the Portuguese economy, in 1995 (INE, Contas Nacionais 1995):

a) agriculture and food industries: 698600
b) wholesaling and retailing: 596400
c) construction: 365500
d) non marketed services of Public Administration: 358800
e) textile and clothing industries: 287000
f) education and research: 257100
g) marketed services to private companies: 196600

[15] forestry corresponds to branch 02; forest industries include branches 20 (wood and cork processing industries, except furniture) and 21 (pulp, paper, paperboard, and paper and paperboard products)

h) equipment goods (electric, no electric, vehicles, etc.): 139900

As we can see, the forest cluster is one of the most important in terms in employment.

c) Presentation of the results

Activities		Workforce (full-time equivalents)
Forestry and logging	Forestry and logging (except planting and replanting, operation of forest tree nurseries and cork related activities)	10 000
	Activities related to cork and cork oak trees (cork extraction, pruning, grazing, etc.): a) Permanent employment b) Seasonal employment (number of equivalent permanent workers)	 4 700 4 200
	Resin tapping	2 000
	Forest contractors (planting and replanting)	3 750
	Operation of forest tree nurseries	1 000
Forestry service activities	Fire protection (CNEFF)	10
	Forest fire fighters	580
	Forest owners' associations	50
Hunting, trapping and game propagation, including service related activities	Game propagation	5 000
	Game guards	3 000
Manufacture of wood and of products of wood and cork, except furniture	Sawmilling and planing of wood; impregnation of wood	17 800
	Manufacture of builders' carpentry and joinery	14 576
	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	2 000
	Wood and cork handcrafting	1 000
	Natural cork processing (cork planks)	1 000
	Manufacture of articles of natural or agglomerated cork (cork manufacturing industry)	14 000
	Manufacture of articles of natural or agglomerated cork (fabrication of cork granulates and agglomerates)	3 400
Manufacture of pulp, paper and paper products	Manufacture of pulp	5 224
	Manufacture of paper and paperboard	4 897
	Manufacture of corrugated paper and paperboard, containers of paper and paperboard, household and sanitary goods and of toilet requisites, paper stationery, wallpaper and other articles of paper and paperboard n.e.c.	5 440
Other forest related industries	Manufacture of resinoids	2 000
	Manufacture of furniture	75 116
	Restoration of furniture	1 000
	Construction and repair of wooden boats	300
	Manufacture of woodworking machinery	2 349
	Fabrication of painting, gluing, preservation and other chemical products for wood and furniture industries	n. d.
	Manufacture of cork manufacturing machinery	158
Other forest related services	Haulage and transportation of timber and cork (from forest to factory)	2 300
	Wood import and export	770
	Wholesale of furniture	3 692
	Retail sale of furniture	31 834
	Forest Institute[16]	2 775
	Nature Conservation Institute	918
	National Forest Research Station	100
	Forest high education institutions	150
	Forest professional training	600
	Trechnological Centres for the wood and cork industries (CTIMM & CTCOR)	55
	Business associations of forest industries	50
TOTAL EMPLOYMENT	**FORESTRY, LOGGING, HUNTING AND RELATED SERVICES**	**34 290**
	FOREST INDUSTRIES	**69 337**

[16] This is the English translation of the official denomination of the public Forest Services, in 1995.

IN THE FOREST CLUSTER	**OTHER FOREST RELATED INDUSTRIES**	**80 923**
	OTHER FOREST RELATED SERVICES	**43 244**
	TOTAL	**227 794**
TOTAL EMPLOYMENT IN THE COUNTRY		**4 437 000**
FOREST EMPLOYMENT IN % OF TOTAL EMPLOYMENT		**5,13 %**

Table 12: Employment in the forest cluster in Continental Portugal in 1995

d) Sources and methodology

1. ***Forestry and logging***: estimate made with contributions from Victor Louro of the Forest Institute, for an annual production of 14 300 000 m^3 of pine wood and eucalyptus wood (average for 1991/93), assuming that a worker can extract 6 m^3 per day and works 240 days per year.
2. ***Forest contractors***: estimate based on the following sources:
- number of firms: C. A. Loureiro (1995);
- number of workers per firm: estimate made with contributions from Rodrigo Corrêa de Sá, General Secretary of the National Association of Forest and Agricultural Contractors, based on the average number of permanent workers (administrative staff and machine operators) per firm, excluding seasonal workers.
3. ***Cork oak related activities***
a) Permanent workers: AGRO.GES (1997);
b) Seasonal workers: full time equivalent of 10000 seasonal workers referred in the AGRO.GES report (1997), assuming each of them works 5 months per year.
The following activities are not included: transportation of cork from the farm to the factory, forest gards, gards of hunting reserves, operation of forest nurseries, staff in the Forest Services in cork oak related activities and staff in the forest owners' associations in cork oak areas.

ACTIVITIES		**NUMBER OF JOBS**
PERMANENT WORKERS	Cork harvesting and complementary activities	2 600
	Cork oak prunning and other regular sylvicultural operations	500
	Transportation of cork from farm to factory	277
	Charcoal	100
	Livestock rearing	1 500
	Gards (forestry and gaming)	150
	Operation of nurseries, Forest Services, Forest owners' associations	200
	TOTAL	**5 327**
SEASONAL WORKERS		**10 000**

Table 13: Employment in activities directly related to cork oak (Source AGRO GES- 1997)

4. ***Resin tapping***: estimate based on the number of seasonal workers referred in the article by Manuel Gil da Mata (1990), (8000 for 9 months, in 1988), taking into account the decline in resin tapping observed since 1988.
5. ***Haulage and transportation of timber and cork***: estimate made with contributions from João Soares (SOPORCEL) based on the number of round trips (from forest to factory and back to forest) assuming 60 km per trip for pine and eucalyptus wood and 200 km per trip for cork, one day of work per round trip and 240 days of work per year.
6. ***Game propagation***: number of workers in the game propagation firms supplying the associative hunting areas, according to FENCAÇA (*in* Público, 15/8/96, p.4).

7. ***Game gards***: estimate based on the number of areas under the special hunting regime in the hunting season of 1993/94 (1675).
8. ***Operation of forest tree nurseries***:
a) nurseries operated by the Forest Institute: data collected directly from the institute/
b) private nurseries (registered and not registered): estimate made by Victor Louro, from the Forest Institute.
9. ***Manufacture of wood and of products of wood and cork, including furniture and import and export of timber***: estimate of the employment in the firms affiliated to Associação das Indústrias da Madeira e do Mobiliário de Portugal (AIMMP, 1996) and to Associação de Industriais da Madeiras do Centro que não são sócios da AIMMP, based on data collected directly from these associations on the number of firms and their distribution by employment size.
This estimate is far above the official data for this industry, but is closer to the estimate made up Jakko Pöyry (1990) which amounts to 60000 workers.
10. ***Restoration of furniture***: estimate based on the number of firms listed in "Anuário de Antiguidades e Restauro 1996".
11. ***Manufacture of woodworking machinery***: GAPE (1992).
12. ***Wholesale and retail sale of furniture***: INE (1995).
13. ***Manufacture of resinoids***: Ferreira (1995).
14. ***Cork industries***: estimate based on data collected from Associação dos Industriais e Exportadores de Cortiça do Norte on the distribution of the number of production units by size of employment in 1993, and assuming that 240 informal small units are all operating in cork manufacturing.
15. ***Manufacture of cork manufacturing machinery***: Ministério da Indústria e Energia-Direcção Geral da Indústria (1993)
16. ***Manufacture of pulp, pape rand paperboard***: INE (1996).
17. ***Manufacture of corrugated paper and paperboard, containers of paper and paperboard, household and sanitary goods and of toilet requisites, paper stationery, wallpaper and other articles of paper and paperboard n.e.c.***: estimate based on the list of firms affiliated to Associação Portuguesa das Indústrias Gráficas e Transformadoras do Papel, as report in their "Anuário 94/95".
18. ***Manufacture and repair of wooden boats***: direct employment data directly collected from Associação das Indústrias Marítimas, excluding sub-contractors for electrical, mechanical and other kinds of works.
19. ***Personnel of the Forest Institute***: total number of persons working in the Forest Institute according to "Plano de Actividades do Instituto Florestal para 1996", excluding 256 workers in the operation of forest nurseries belonging to the institute.
20. ***Personnel of the Nature Conservation Institute (ICN)***: data collected from ICN, including 568 persons with clear contractual status and 350 persons without a a clear contractual status.
21. ***Personnel of CNEFF, EFN, CTIMM, CTCOR***:: data collected directly from these institutions.
22. ***Forest fire fighters (sapers)***: Baptista (1993).
23. ***Forest fire fighters (GEI's)***: estimate based on the number of "Special Intervention Groups" (GEI) reported by Loureiro (1995) assuming 5 fire fighters per group, working 3 months per year.
24. ***Other services***: own estimates.
25. ***Total employment in 1995***: INE, Contas Nacionais 1995.

4. Annex C6.4: Preliminary thoughts for the specific study on employment in the forest cluster of Aquitaine (By Dominique D'antin de Vaillac, Bordeaux 4)

Among the socio-economic benefits of the forest[17], the employments that may result from it are, in evidence, one of the main aspects to take into account. And if measuring the employment would be possible (or, at least, a precise evaluation according to a homogeneous method), the definition of an indicator for the sustainable development would be done without difficulty. In order to achieve it, it is essential to establish a protocol of common interest between all the countries engaged in the pan-European[18] process, which repercussions will be multiple. All research engaged in this direction will be inevitably confronted with prior obstacles such as the status of the statistics used by each country, the definition of the economic forest sector, or also the regional inter-dependences established on critical moments. The accomplished progress will allow us to update the socio-economic consistence of the European forest. This challenge of research is done within the context of a large measure, yet not finished, which consists on having available, at the European level, reliable forest statistics, completed, homogeneous and updated. Establishing the forest accountancy – including employment – is still an experimental measure which is closely followed by the Laboratory of Forest Economy of Nancy. Two years ago, this laboratory regretted the absence of regular forest accountancy.[19] So the « forest » employments must be searched by exploiting the several resources of a single wood-chain, and also from a range of hypothesis done for the forest. In these conditions, answering to the question: "What are the employments connected to the forest?" is a delicate task, especially for the Lands' massif. We will start by examining the status of the French statistics on this matter, before enlarging the definition of employment connected to the forest, in order to examine, at last, the approaches of other countries on this subject.

a) The limits of the French measuring tools: the partial inventory of the employments on the wood-paper chain.

The first reaction of any observer in the first place is to be interested on the employment that comes from **the wood-paper chain**. The work offered by the forest is linked, first of all, to the wood work and to the employment that may result from the different trades. Theses last ones are definitely the most easily classified by the statistics, given the fact that they are only about salaried employments. Three main resources allow us to understand it:

-The annual companies' survey (EAE) done by the Ministry of Industry (SESSI)

- The annual companies' survey from the Ministry of Agriculture (SCEES)

-The annual branch survey (EAB) and the inventory as a complementary source

We cannot forget that the categories of the Annual branch survey (E. A. B.) and those done by the INSEE are not exactly the same[20]. This statistic tool **only takes into account the companies with more than twenty employees**.

---

[17] corresponding to the criterion nr.6 of the intergovernmental process of Helsinki, Lisbon, and Vienna regarding the sustainable forest management

[18] or the Helsinki process

[19] JL Peyron Odile Colnard: « *Contribution au rapport de la Commission des Comptes et de l'Economie de l'Environnement sur la forêt »* Laboratory of Forest Economy UMR ENGREF/INRA Nancy. November 2001.

[20] Categories according to the EAB (annual branch survey): Forestry, forest exploitation, sawmill, planning, sanding and fertilization.

According to INSEE: forestry and forest exploitation; wood mechanical work; furnishing; paper pulp, paper, cartons; wood market and wood products; manufacturing wood tools-machines.

After some precautions and reprocessing[21], we can thus identify in the Lands, during 1999, 6 851 employees of the forest-wood-paper chain, which are divided as follows:
- 2 299 employees for all forestry, forest exploitations and sawmills
- 4 552 employees on the transformation activities, including paper.

23% of the industrial salaried employments on the Lands are assured by the wood-paper chain, being an important part of it. But this contribution is less significant if we take into account the total of the salaried employments: the wood-paper chain only assures 4% of the salaried employments of the entire district. A small number no doubt, but the highest of all the districts of Aquitaine (1% for the Gironde). We will also notice an equivalent number of the employees on food industry, while on the other districts of Aquitaine, there is a higher number. At the Aquitaine regional level, the wood and paper industry is the second one after the food industry in what regards industrial employments. On a historical perspective and comparative view, these numbers testify an undeniable recession of the industrial employments related to forest. Let us remember of the 15 000 gemmeurs between the two Wars, but also, closer to our time, in the beginning of the seventies, the 2400 sawmill employees, that were not more than 1522 in 1995[22]. We shall leave to other specialist the task of analysing if we are dealing with a simple concentration, or a real deindustrialisation...

But from this number is missing the employees of the companies with less than 20 employees, the freelance workers, the voluntary, the families, the associations that make small investments on this sector, they are all ignored by the statistics for the moment. So it is essential, if we want to now the real power of this sector in what concerns employment, « within all categories », to find a way to inventory it. It is likely that the number of employments created by the "small wood companies", having between one and twenty employees, might be revealed as quite influent on the districts of the Lands: so it is urgent to flush them out!

This - essential – first stage being achieved, it would be advisable to put aside the concept of wood – chain, so that we can take interest on the forest as a whole. The forest sector, as any other economic sector, only knows how to limit its impact, in terms of employment, to the usually pre – established activities. The categories in use such as: *forestry, forest exploitation, wood mechanical work*s are related to the tree's transformation.

But these filters put aside the management activity of the natural park, or the manufacture of forest tractors, or even, the nurseries, that are directly linked to the forest. The statistics seem to be quite restricted on this matter.

Moreover, due to the globalisation, the geographical identification of the employments created by a certain forest sector is even a more delicate aspect to take into account. The work, and to start with, the employment, related to the transformation of the trunks carrying wood across the borders will be « lost » by the national or regional statistics of its original forest. A quick look, at the right of the N 10 next to Saint Geours de Maremne, allow us to note the parks of stocked wood before leaving to Spain and that have been increasing since the last years. It competes directly with the employment of the Spanish sawmills or the transformation structures that might be associated with. But how shall we measure it?

When measuring the employment created by the forests there is a problem of definition and of appreciation, two methodological difficulties that must be worked out.

[21] Done by Elisabeth Le Net, in the study: *« Suivi de la filière-bois en Aquitaine »* AFOCEL. December 2002, were the number are taken from.

[22] Numbers quoted by AUBY (Jean François): *« Economie du département des Landes »* Sud-Ouest Université. 1998. p.81

b) The classical definitions of employment and its application to the forest

The economists such as the representatives of important professional branches have the same difficulties to do a precise evaluation of the total number of employees. As a result there is a conceptual vision that we might try to adapt it to the forest.
So the tourist economic sector, confronted with extreme varieties of activities, which most of them are seasonal, has developed the following definitions:
* the direct Employments: it gathers marketing activities totally dedicated to the satisfaction of the tourists' needs: international tourists transports, consumptions along the tourist journeys and during the tourist activities and other activities.
Transposed to the forest, this notion could cover the employments coming from the marketing activities connected to the exploitation of forest products, but also of marketing activities connected to the composition and maintenance of the forest.

(1) The direct employment related to the forest commercial products

Under this concept, the direct employments created by the forest must include those related to all the renewable resources coming from the forest given the fact that they are commercial. We are talking about wood (including the firewood), but the wood is not the only renewable resource created by the forest. It can also be mushrooms, cork, and medical plans, according to an inventory as varied as the type of forest. The forests of the South of Europe present certain uniqueness and particular advantages on this matter, such as it is specially revealed on the document about « the Spanish forest strategy »[23]. It has also been revealed that the main resource of the forest on the region of Murcie come from the pinions harvesting, used on jam production, exported to Japan, and coming from trees with a small commercial value. For measuring this employment category we must answer to the question: What comes out from such a forest massif and what is sold?

(2) The direct employment connected to the composition, the maintenance and the valorisation of the forest

If the forest is understood as an economic sector, it is logical that after having foreseen its products (outputs) we also take into account the marketing values needed for its composition (or its renovation) and its maintenance (inputs). The same case can be applied for the employments created by the forest works, mechanic (plantations, clearing, pruning…) or intellectuals (consulting, expertises, research, syndicalism etc.). For measuring this employment category it is better to do an inventory of the production activities, goods and services, which are around the forest subject, despite their juridical organisation or the source of funding (public or private).
If the definitions that precede it are tangible, the statistical information usually available shall be reprocessed so that we can separate the employments selected according to this point of view. In France, we dispose of several sources regularly updated: The Annual Declarations of the Social Data (D.A.D.S) that are systematic for all the industrial, commercial or service establishments, private or semi-public, and that offer the advantage of "following" the employees year after year. It is asked for a representation if we want to separate a geographic area and a precise activity, as in the case of the forest. We will only get information about the employees.

[23] « Spanish forest strategy ». Ministry of the Environment. Madrid.1999

The file SIRENE saves the declarations of creation and suspension of an independent activity. For that reason it helps to the inventory of the non salaried employment, provided that the forest activity appears on the declarations[24].
The Annual Branch Surveys and the INSEE data base, already mentioned, are worth to be established at the regional level and updated annually.
At the European level, the information is supplied by the statistic Directory of the regions done by Eurostat. But there is usually an overall inscribed, not allowing, by it-self, to determine the direct employment. It has been noted by the Finnish experts of the European Forest Institute (EFI): « *The availability of the forest socio-economic statistics is not enough to do a deeper statistical analysis. To improve this situation, the efforts to collect even more information at the regional level are needed. On the forest socio-economic research we must give priority to the collection and the gathering of the regional sources in a unified and detailed way. »*[25]
The difficulties of information and its insufficient sharpness, even if they can be solved, will not allow us to take into account the direct employment created beyond the regional sphere, considered as the most suitable one. How to value, for example, the impact of the forest sector on the industrial employments that it helped to create, when an important part of its wood resource is transformed on another region or country?
The approach by the direct employments, on its real term, does not avoid the losses on the observation scale. We can say the same for the indirect employments, and the induced ones, which are extrapolated from the direct employments.
*The indirect employments
They regroup the employment created by the purchases (or the consumptions) of the branch considered as part of other economic sectors. That is the case of the truck drivers working on the supply of sawmill, or also the suppliers of forest material. These are taken into account (but only these ones) in the category of: « machine manufacturing – wood tools » that come on the I.N.S.E.E list.
*The induced employments
Its concerns all the employments created for the all the economy due to the final expenses of the economic stakeholders on a given branch. So one (or several) forest owner that buy a work of art might create, without knowing it, an induced employment in the antiquary that supplied it.
Trough the agreement established with the International Organisation of Work, for evaluating the indirect or induced employments we use the following formula:
Direct employments x 2= total of direct, indirect and induced employments
By applying this formula on the Lands we would have about 14 000 employments around the wood-paper chain, this number is far from the 15 000 direct employments[26] offered by the hydrotherapy of the Lands, that is transformed in 30 000 if we apply the same calculation.
So after this quick exam on the definitions that are used we can observe that the definition of direct employment is facing some difficulties, in what concerns the forest, on the observation scale, or on the identification of it-self as a main activity, as in the case of the farmer as an incidentally forester. In fact this method allows us to set the boundaries of the employments connected to **the wood paper chain** on a given area, with the restrictions that we have

[24] Ce qui est loin d'être le cas lorsque l'activité forestière est accessoire, comme, par exemple, dans le cas de boisements qui se greffent sur une exploitation agricole, et qui ne changent pas la qualification « d'agriculteur » du chef d'établissement.
[25] « Le rôle des forêt et de la sylviculture dans le développement rural. Conséquences pour la politique forestière ». Séminaire international 5-7 Juillet 2000. Vienne. Autriche. Conférence Ministérielle sur la protection des forêts en Europe. Unité de Liaison. Vienne.
[26] Jean Bernard Auby « *L'économie du département des Landes »* op.cit.

mentioned. This method is much more difficult to be implemented on a forest massif clearly identified. The employments, even seasonal, that are needed for the manipulation of the canoes that come down the Leyre or the Ciron are they attached to the water sports, tourism or the forest? These concepts considered on a higher level will be attached to tourism or the water sports, even though it is obvious that these sports would not be as attractive without the forest as a context. We can say the same for the employees of the natural park of the Lands of Gascoigne that would not be there if this region was not forested and it looked like the Beauce!

This difficulty is also found by other countries has prevented until today the implementation of a unified protocol that allows us to know, with the maximum precision, the employment connected to the forest. It should, in a large perspective, on one hand to let us know the employments conditioned by the existence of a forest and, on the other hand, to let us know the employments that would not exist if there was not a forest.

This point of view might be surprising. However it has recently been imposed on a sector equally "natural", the sea. Today we talk about the "jobs of the sea" involving the maritime peach, the marine cultures, the pleasantness and the harbour activities. Why will not the "jobs of the forest" have the same impact?

It is towards a definition of that type, with that same concept, that is orientated the research started by the European processes of Helsinki and Montréal. On both cases, the experts try to improve the models for evaluating the employments created by the forest and not only by the wood chain. Two studies have caught our attention by the uniqueness of its approaches and by the methods applied.

c) The Forest as a support of activities (and employment) that would not exist without it: the Canadian approach

First of all, it is about applying, in Canada, the criterion 5 of the sustainable management supported by the Montreal process, entitled « multiply advantages for the society» having a paragraph dedicated to the "contribution to the national economy" divided into two indicators:

- contribution to the gross domestic product from the wood and non wood sectors of the forest economy.

- total employment on all the sectors related to forest.

While putting in evidence the stagnation of the employments connected to paper and wood industries, this study reveals that « *besides the traditional forest products sector, the forest territory is hosting a great number of small industries, such as suppliers, producers of maple and derived products, and Christmas trees, and also a increasing number of activities satisfying the tourists. The incomes of tourism connected to the forest have doubled in the last ten years. The incomes coming from the goods outside the wood sector have also increased, helped by the sales of the maple products that have almost tripled since1991*[27].

If in Canada the forest tourism does not stop increasing its economic importance, it will not be difficult to measure its impact in terms of employment. But the event that gave place, on 1999, to a « National Study about the importance of nature for the Canadians » is taken very seriously today:

« The participation of Canadians on forest hobbies is growing, and it is obvious that the non wood usages of the forest must be taken into account such as all the other usages. This will allow us to assure that the forest will continue to have a sustainable management and satisfy the requests that it has raised ».

This function of leisure is measured by counting the visits in the natural parks, and also by the expenses registered. In 1996, they have reached a considerable number of 11 billions dollars. It is true that the large forest spaces in Canada are more and more like a large game field, with

[27] underlined by us

multiple activities, including salmon fishing, hunting, camping, observation of the wild life, ski touring, marine aviation etc...
These social practices allow us, on the Canadian case, to present multifunctionality as an objective statement, and not a simple « statement of principle » somewhat a theory, as what happens on several European forests.
We must also dispose of the methods that allow us to observe this phenomenon, even if they are often stammering, so that we can approach them and then follow its possible evolutions. However the Canadian methodology, even if it allows us to say how many persons have frequented the forest and how much money it has been spent, it does not allow us to precise how many employments have been created : *« The expenses of those that travel on retreated spaces create employment and contribute to the economic development »*. But the precise numbers are missing once again.
Despite the fact that we do not have enough tools for evaluating the impact of these tourist activities, we have the same concern of evaluation that there is on the other side of the Atlantic. Thus the Government of Quebec[28] implemented for the forest a method of analysis of the economic repercussions, evaluating the repercussions ofr an investment project on the territory. By crossing two calculation models[29], « we analyse not only the direct effects of the project, coming from its immediate undertaking of benefits, but also the indirect effects that involves the suppliers, and the induced effects that will be produced in the economy when the workers that have a direct or indirect participation to the project will spend their salaries. These results are presented in terms of **employment**, added value and impact on public finances. »
These two models are to be retained to identify the investments related to the forest, such as the creation of a natural park, or the transformation of an agricultural space into a forest space. They can, from this point of view complete usefully an inventory approach of directs employments, observed at a certain moment. The calculation can be done with the following formula:
- amount of investment= created employment
We end up progressively with a method that is far from the simple inventory (and that escapes from the already mentioned difficulties) to become deductive, by using a correlation between the available aggregate (in this case the flux of investment) and the number of employments created by that flux. It is an enlargement of the method that has been used on two studies carried out in Scotland, the Wales and England, on the occasion of the International Symposium[30] organised by the unity in charge of the preparation of the last ministerial conference about the protection of the European forests.

d) The assessment of the employment from the production flux: British approach

On the request of the British forest administration (Forestry Commission), a series of studies entrusted to private consultants allowed to improve the methods relatively simple for measuring the economic impact (production and employment) of the forest on the regional and national economy. However its objectives were very ambitious:
To measure, in terms of production, the economic power and its effects on the employment connected to the forest management and the wood lands. This approach should be done with the concern of distinguish the direct effects, as the indirect ones, by *sector or activity*

[28] Ministry of the natural resources
[29] inter-sector model the Quebec statistical office(BSQ) and calculation model of the socio-economic repercussions of the Ministry of the natural resources (MRN)
[30] « The role of forest and forestry in rural development. Consequences for the forest policy » International Symposium 5-7 July 2000 Vienna

To measure the impact of the economic activities on the pre-commercial phase, of distribution and sales of the woods products at different levels
To measure the impact of the forest multifunctionality on the direct employment of other sectors such as leisure, or the environmental management and the nature preservation
At last, to measure the effect of forestry and other exploitations on production, incomes and employment, by using isolated multipliers and tested at the time of the analysis mentioned.
Tree studies carried in 1995-1996 by tree independent teams, reviewed Scotland, Wales and England, by using regional statistics with the matrix « input-output » putting in evidence the interdependence between all the economic branches. At the same time, a summarized classification by type of forest was used systematically as a base for the ulterior calculations. This allowed the identification:
Of forest with strong wood production (commercial conifers)
Of collective forests (community forests)
The wooded parts of the agricultural exploitations
The work consisted on determining the direct employments related to each type of forest and multiplier of employment on the other economic sectors; the same method was used for the wood transformation activities (specially sawmills and paper mills).
So we end up with regional variables allowing to test the scenarios of action (ex: prolonging help to the plantation of Scots forests), and to put in evidence precise characteristics. So the forest of Wales and its sector of primary transformation assure a production of £475 m and 4400 direct and indirect employees. « *In Scotland, the commercial plantation of conifers and its exploitation have record effect of 45 employments for £1m raise of production, but they have the lowest multiplier (1,584), revealing its poor links to the rest of the economy*».
Taking advantage from the statistics supplied by the forest administration it-self, the analysis done about England has allowed not only, a precise assessment of the forestry power, but also doing the spatial distribution of its impact. So we have:
The assessment of the effect on the employment, the gross production, the net production divided between the forestry on one hand, and the transformation network, on the other
The assessment of the effect on the employment, the gross production, the net production according to the type of forest activity (creation, maintenance, forest exploitation)
The assessment of the effect on employment, the gross production, the net production according to the type of forest property
The assessment of the effect on the employment, the gross production, the net production according to the specie
The results obtained are synthetic and allow a better modelling (simulations). However these are still centred on the economy – wood, and cannot show the externalities or the multifunctionalities. As it is stated by Mr. Bill Slee[31] « *the special challenge revealed by the forest multifunctionality is of being able to value all benefits coming from the forest ».* [32]
Thus, tourism is not taken into account on the tree British studies, while all it had to be done was to integrate it without changing the method of analysis. This seems to be comprehensive and easy to be implemented, provided that we dispose of regional statistics with an inter-sector presentation of the economy (matrix input - output).
From this first inventory we can conclude that the assessment of the employments created by the forest, if it must be carried homogeneously between several regions, it must be involved on an area already marked out.

[31] Department of forest and agriculture. University of Aberdeen. UK.
[32] «*Methods for measuring the contribution of the forest to the rural development»* in« The role of forest and forestry in the rural development. Consequences of the forest policy» International Symposium 5-7 July 2000 Vienna

Of what statistics do we dispose of and how to they describe identical realities?
What forest are we going to work on: only on the forest – wood chain, or the multifunctional forest?
What are the relevant observation scales (and the perceived economy): the type of property, the type of activity, the dominating specie?
The same provisions and precautions are imposed when finding specific indicators. Even the most easy ones to be inventoried, as for example those of the employments on sawmills and paper mills, shall be integrated on particular problems such as locating raw material.
If the objective is to implement a same methodology for at least tree countries of South Europe (France, Spain, Portugal), and to end up with a « social » indicator related to the forest activity, it would be advisable to work on preliminary surveys which answer to the previous questions.

5. Annex C6.5: Bibliography

a) Bibliography of general interest for all indicators

Brang, Peter; Courbaud, Benoît; Fischer, Anton; Kissling-Näf; Pettenella, Davide; Schonenberger, Walter; Spork, Josef; Grimm, Volker (2002). *Developing Indicators for the Sustainable Management of Mountain Forests using a Modelling Approach*. Vol. 4. London & New York: Elsevier. pp. 113-123.

Canada Council of Forest Ministers (1997). *Criteria and Indicators of Sustainable Forest Management in Canada*. Ottawa: Natural Resources Canada-Canadian Forest Service. 47 p.

Commission of the European Communities (1987). *Forestry statistics 1980-1984*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1998). *Forestry statistics 1992-1996*. Luxembourg: Office for Official Publications for the Offcial Publications of the European Communities.

Commission of the European Communities (2003). *Forestry Statistics. Data 1990-2002*. Luxembourg: Office for Official Publications for the Offcial Publications of the European Communities.

Commission of the European Communities (2004). *Eurostat yearbook 2004. The statistical guide to Europe. Data 1992-2002*. Luxembourg: Office for Official Publications for the Offcial Publications of the European Communities.

European Parliament (1997). *Europe and the Forest*. Directorate General for Research. Division for Agriculture, Fisheries, Forestry and Rural development.

Finnish Forest Research Institute (several years). *Finnish Statistical Yearbook of Forestry*. Helsinki: Finnish Forest Research Institute.

FAO/ECE/ILO (1997). *People, Forests and Sustainability. Study prepared by the team of specialists on Socioeconomic aspects of sustainable forest management*. Geneva: ILO.

Forestry Commission (2003). *Forestry Statistics 2003*. Edinburgh: Forestry Commission.

Ministerial Conference on the Protection of Forests in Europe (2002a). *MCPFE Advisory Group Recommendations for Improved Pan-European Indicators for Sustainable Forest Management (ELM Oct 02 - Document 7a) as adopted by the MCPFE Expert Lever Meeting of 7-8 October, Vienna, Austria*. Vienna: Liaison Unit Vienna of the Ministerial Conference on the Protection of Forests in Europe.

Ministerial Conference on the Protection of Forests in Europe (2002b). *Improved Pan-European Indicators for Sustainable Forest Management; MCPFE Expert Lever Meeting, Vienna, Austria, 7-8 October*. Vienna: Liaison Unit Vienna of the Ministerial Conference on the Protection of Forests in Europe.

Ministerial Conference on the Protection of Forests in Europe (2002c). *Relevant Definitions Used for the Improved Pan-European Indicators for Sustainable Forest Management*. Vienna: Liaison Unit Vienna of the Ministerial Conference on the Protection of Forests in Europe.

Ministerial Conference on the Protection of Forests in Europe (2003). *Background Information for Improved Pan-European Indicators for Sustainable Forest Management*. Vienna: Liaison Unit Vienna of the Ministerial Conference on the Protection of Forests in Europe.

Ministry of Agriculture and Forestry of Finland (1997). *Criteria and Indicators for Sustainable Forest Management in Finland*. Helsinki: Ministry of Agriculture and Forestry.

Ministry of Agriculture and Forestry of Finland (2001). *The State of Forestry in Finland 2000. Criteria and Indicators for Sustainable Forest Management in Finland*. Helsinki: Ministry of Agriculture and Forestry.

Wardle, Philip; van Brusselen, Jo; Michie, Bruce; Schuck, Andreas (2003). *Forest Products Statistical Information Systems of EU and EFTA*. European Forest Institute Research Report 16. Leiden, The Netherlands: Koninklijke Brill NV.

b) Bibliography for indicator 6.1

(1) Of specific interest for the Portuguese regions

Coelho, Inocêncio Seita (2003). Propriedade da Terra e Política Florestal em Portugal. *Silva Lusitana* 11(2), pp. 185-199.

Geadas, M. D. B.; Baptista, M. P. (coord.) (1999a). *Entre-Douro-e-Minho. Panorama Florestal*. Lisboa: Instituto Superior de Agronomia & Direcção Regional de Agricultura de Entre-Douro-e-Minho.

Geadas, M. D. B.; Baptista, M. P. (coord.) (1999b). *Beira Litoral. Panorama Florestal*. Lisboa: Instituto Superior de Agronomia & Direcção Regional de Agricultura da Beira Litoral.

Geadas, M. D. B.; Baptista, M. P. (coord.) (1999c). *Entre-Douro-e-Minho. Panorama Florestal*. Lisboa: Instituto Superior de Agronomia & Direcção Regional de Agricultura da Beira Interior.

Instituto Nacional de Estatística (1997). *A floresta nas explorações agrícolas 1995*. Lisbon: Instituto Nacional de Estatística.

(2) Of specific interest for the Spanish regions

Asociación Española de Normalización y Certificaciòn-AENOR (2001a). *Sustainable Forest Management – Management Unit Criteria and Indicators. Part 1: General Criteria and Indicators (UNE 162002-1) June 2001*. Madrid: AENOR.

Asociación Española de Normalización y Certificaciòn-AENOR (2001b). *Sustainable Forest Management – Management Unit Criteria and Indicators. Part 2: Complementary Criteria and Indicators for Regional Assessment (UNE 162002-2) June 2001*. Madrid: AENOR.

c) Bibliography for indicator 6.3

(1) Of general interest

Campos Palacín, P. (1994). The total economic value of agroforestry systems. In Koch, N. E. (ed.): *The scientific basis for sustainable multiple-use forestry in the European Community*. European Commission/Directorate General for Agriculture, VI/4135/94-EN, Brussels, pp. 33-47.

Campos Palacín, Pablo (1996). *Análisis técnico y económico de sistemas de dehesas y de montados. Informe final*. Madrid: CSIC/UTL (Lisboa)/SDIT (Badajoz)/UNEX(Cáceres).

Campos Palacín, P. (1999a). Un sistema de cuentas microeconómicas del uso múltiple de un espacio natural de interés ambiental. In Casado, J.M.; Azqueta D. (comps.): *Lecturas de economía y medio ambiente*. Madrid: Consejo General de Colegios de Economistas de España. pp. 71-98.

Campos Palacín, P. (1999b). Hacia la medición de la renta de bienestar del uso múltiple de un bosque. *Investigación Agraria: Sistemas y Recursos Forestales*, Vol. 8 (2), págs. 407-422.

Campos Palacín, Pablo (2000a). An agroforestry economic accounting system. Towards the Measurement of Social Income. In Jöbstl, Hans; Merlo, Maurizio; Venzi, Lorenzo (eds.): *Proceedings of the International Symposium on Institutional Aspects of Managerial Economics and Accounting in Forestry, 15-18 April, 1998, Roma, Ostia*. Viterbo: Stabilimento Tipolitografico Agnesotti. pp. 9-19.

Campos Palacín, P. (2000b). Las nuevas cuentas del bosque europeo. *Fuentes estadísticas* Nº. 41, pp. 14-15.

Campos Palacín, P.; Y. Rodríguez; A. Caparrós (2001). Towards the dehesa total income accounting: theory and operative Monfragüe study cases. *Investigación Agraria - Sistemas y Recursos Forestales*, Fuera de Serie, N.º 1, pp. 43-67.

Firn Crichton Roberts L.td; John Clegg & Co (2000). *Monitoring the health and financial viability of forest industry businesses*. Survey Report to the Forestry Commission and the Forest Industry Associations.

Hyttinen, P., Kallio, T. (eds.) (1998). *Cost Accountancy in European Farm Forest Enterprises*. *Proceedings of the MOSEFA Concerted Action Project Workshop, Zeist, The Netherlands, 28-31 August 1997*. EFI Proceedings N.º 20. Joensuu: European Forest Institute.

Hyttinen, P., Kallio, T. (eds.) (1999). *Sampling Schemes for Monitoring the Socioeconomics of Farm Forestry*. *Proceedings of the MOSEFA Workshop B, Trento, Italy, 19-22 April 1998*. EFI Proceedings N.º 28. Joensuu: European Forest Institute.

Hyttinen, P.; Kallio, T.; Olischläger, T.; Sekot, W.; Winterbourne, J. (1997). *Monitoring Forestry Costs and Revenues in Selected European Countries*. EFI Research Report 7. Joensuu: European Forest Institute.

Jöbstl, H.; Hogg, J. (1998). On the state of forest accounting in some European countries. In Recent Developments In *Accounting And Managerial Economics For An Environmentally-Friendly Forestry. International IUFRO - INRA Symposium, Nancy, 21 - 23 April 1997*.

Sekot, W. (1996a). Sampling Profitability Data of Farm Forestry in Austria. In: Brandl, H.(ed..): *Small Scale Forestry: present problems and prospects for the future*. Mitteilungen der Forstlichen Versuchs-und Forschungsanstalt Baden-Württemberg, Heft 195. Freiburg. pp.223-229.

Sekot, W. (1996b). Cost and Revenue Studies in Austrian Forestry. In: Skoblik, J. (ed.): *Evaluation of Forest Benefits through a Total Evaluation of Production, Environmental and Social Functions of Forests*. Jiloviste. pp. 130-140.

Sekot, W. (2001). *Monitoring the profitability of small scale farm forestry in Austria*. Discussion Paper N.º B/2001-2, Publication Series of the Institute of Forest Sector Policy and Economics, University of Natural Resources and Applied Sciences, Vienna.

(2) Of specific interest for the Portuguese regions

Moreira, M. B.; Coelho I. S.; Reis, P. S. (1995) *Análise Técnico Económica de Sistemas de Dehesa/Montado. Relatório Final (UE-DGVI-Programa CAMAR: CT90-0028)*. Lisbon: Instituto Superior de Agronomia. (unpublished manuscript).

(3) Of specific interest for the Spanish regions

Campos Palacín, Pablo (1996). *Análisis técnico y económico de sistemas de dehesas y de montados. Informe final*. Madrid: CSIC/UTL (Lisboa)/SDIT (Badajoz)/UNEX(Cáceres).

Campos Palacín, Pablo (2000). An agroforestry economic accounting system. Towards the Measurement of Social Income. In Jöbstl, Hans; Merlo, Maurizio; Venzi, Lorenzo (eds.): *Proceedings of the International Symposium on Institutional Aspects of Managerial Economics and Accounting in Forestry, 15-18 April, 1998, Roma, Ostia*. Viterbo: Stabilimento Tipolitografico Agnesotti. pp. 9-19.

Campos Palacín, P. (2001). Medición de la renta de bienestar en sistemas agroforestales mediterráneos. In Labrador, J.; Altieri, M. (coords.): *Agroecología y desarrollo: Aproximación a los fundamentos agroecológicos para la gestión sustentable de agrosistemas mediterráneos*. Madrid: Universidad de Extremadura y Ediciones Mundi-Prensa. pp. 397-432.

Campos Palacín, P.; Y. Rodríguez; A. Caparrós (2001). Towards the dehesa total income accounting: theory and operative Monfragüe study cases. *Investigación Agraria - Sistemas y Recursos Forestales*, Fuera de Serie, N.º 1, pp. 43-67.

Campos, P.; Caparrós, A. (2002a). Monfragüe Cork Oak Forest Versus Guadarrama Scottish Pine Forest: A Total Sustainable Comparison. In *Bosques, sociedad y cambio climático*. Universidad Internacional Menéndez Pelayo.

Campos, P.; Rodríguez, Y.; Caparrós, A. (2002b). La renta total de los sistemas agroforestales: el caso de las dehesas. In Ministerio de Agricultura, Pesca y Alimentación: *Libro blanco de la agricultura*

y el desarrollo rural: Aspectos Medioambientales de la agricultura. (http\\www.libroblancoagricultura.com)

Caparrós, A., Campos Palacin, P.; Montero, G. (2001). Un sistema de cuentas del uso múltiple de un bosque maderero. Investigación Agraria: Sistemas y Recursos Forestales. Número fuera de serie, N;º 1, págs. 93-110.

Mariscal, P.; P. Campos (2001). *Demandas sociales, interés de los proprietarios e intervención pública en los espacios naturales: el caso de la dehesa de la comarca de Monfragüe*. Madrid: Instituto de Economia y Geografia - CSIC (unpublished).

Rodríguez Luengo, Yolanda; Campos Palacín, Pablo; Caparrós Gass, Alejandro; Martín Barroso, David (2003). *Análisis comparado de rentas comerciales y ambientales de la dehesa*. Paper presented at IV Encuentro de Economia Aplicada, Granada, 5-7 July 2003.

d) Bibliography for indicator 6.5

(1) Of general interest

Blombäck, Peter; Poschen, Peter; Lövgren, Mattias (2003). *Employment Trends and Prospects in the European Forest Sector*. A study prepared for the European Forest Sector Outlook Study (EFSOS). UNECE/FAO Timber and Forest Discussion Paper ECE/TIM/DP/29.

Commission of the European Communities (1987). *Forestry statistics 1980-1984*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1998). *Forestry statistics 1992-1996*. Luxembourg: Office for Official Publications for the Offcial Publications of the European Communities.

Commission of the European Communities (2003). *Forestry Statistics. Data 1990-2002*. Luxembourg: Office for Official Publications for the Offcial Publications of the European Communities.

Eurostat (1997). *An Estimate of Eco-Industries in the European Union 1994*. Eurostat Working Paper Nr. 2/1997/B/1. Commission of the European Communities.

Eurostat (2000a). *Environment industry and Employment in Portugal, 1997*. Eurostat Working Paper 2/2000/B/4. Commission of the European Communities.

Eurostat (2000b). *Environment employment in France, methodology and results 1996-1998*. Eurostat Working Paper 2/2000/B/7. Commission of the European Communities.

FAO/ECE/ILO (2001). *Women in Forestry – Strategies to increase women's participation in the forestry sector in Europe and North America. Proceedings of Seminar held in Viseu, Portugal 2-6 April 2001*.

Forestry Commission (2001). *Forest Employment Survey 1998/9. Employment in Forestry and Primary Wood Processing*. Edinburgh: Forestry Commission.

Hazley C. (2000). *Forest-based and related industries of the European Union-Industrial districts, clusters and agglomerations*. Helsinki: METLA.

ILO (1992). *Social and labour issues in the pulp and paper industry. Report for the tripartite meeting on social and labour issues in the pulp and paper industry*. Geneva: ILO.

ILO (2001). *Social and labour dimensions of the forestry and wood industries on the move. Report for the*

tripartite meeting on Social and labour dimensions of the forestry and wood industries on the move. Geneva: ILO.

ILO and Dresden University of Technology (1999). *Dynamics in the forestry and timber industry in countries of Middle and Eastern Europe. Proceedings of workshop held in Tharandt 4-7 November 1999*.

Johnstone (1996). *Towards a Sustainable Paper Cycle. Labour in the Pulp and Paper Sector*. Sub-Study Series no. 17. International Institute for Environment and Development (IIED).

NRRC (1997). *Analysis of employment in the B. C. forest sector*. (http://www.forestryfutures.bc.ca/research/analysis_of_employment.htm)

OECD/Eurostat (1999). *The Environmental Goods & Services Industry – Manual for data collection and Analysis*. Paris: OECD.

Poschen P. (1997). Forest and employment – much more than meets the eye. In *The economic contribution of forestry to sustainable development. Proceedings of the XI World Forestry Congress 13-22 October 1997. Antalya. Vol. 4*. Ankara: T.C. Orman Bakanligi. pp. 61-79.

Proctor, W.; Ferguson, I.; Conley, K.; Dargavel, J.; Bhati, U. N. (2003). *Direct and Indirect Employment in the Forest Sector*. Australian Government – Forest and Wood Products Research and Development Corporation.

Thompson, J. (1990). *Forest Employment Survey 1988-89*. Occasional Paper 27. Edinburgh: Forestry Commission.

(2) Of specific interest for the Portuguese regions (references for the baseline paper on employment in 1995)

AGRO.GES (1997). *O montado de sobro e a cortiça (Estratégia para a sua defesa e desenvolvimento). Relatório final*. (mimeo)

Associação das Indústrias da Madeira e do Mobiliário de Portugal (1996). *A Floresta Portuguesa e a Indústria de Madeira*. (mimeo)

Baptista, Manuela (1993). Protecção Florestal contra incêndios. *Vida Rural*, N.º 16/93, pp. 6-10.

Eurostat (2000a). *Environment industry and Employment in Portugal, 1997*. Eurostat Working Paper 2/2000/B/4. Commission of the European Communities.

CESE-Conselho para a Cooperação Ensino Superior/Empresa (1996). *O Sector Florestal Português. Documento de Apoio ao Seminário do CESE. Póvoa de Varzim, 4-5 de Outubro de 1996*. [Porto]: CESE-Conselho para a Cooperação Ensino Superior/Empresa. (mimeo).

Ferreira, António Jorge (1995). A indústria de produtos resinosos. *Revista do Agricultor*, Suplemento, N.º 75/76, pp. 29-32.

GAPE-Gabinete de Apoio à Produção de Equipamentos (1992). *Máquinas e Equipamentos para Trabalhar Madeira - Catálogo*. Lisbon: Gabinete de Apoio à Produção de Equipamentos.

IFEN (1999). *Les Comptes de la qualité des cours d'eau*. Études et travaux N.° 25, Orleans.

Instituto do Emprego e Formação Profissional – Delegação Regional do Norte – Núcleo de Apoio ao Artesanato (1991). *Artesanato da Região Norte. Catálogo*. 2.ª ed. Porto: IEFP-Delegação Regional do Norte.

Instituto do Emprego e Formação Profissional – Delegação Regional do Centro (1992). *Artesanato da Região Centro. Catálogo*. Coimbra: IEFP-Delegação Regional do Centro.

Instituto Nacional de Estatística (1995). *Estatísticas das Empresas. Comércio. 1993*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (1996). *Estatísticas das Empresas. Indústria. 1992/1993*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2003) *Recenseamentos Gerais da População e da Habitação. Dados comparativos 1991-2001*. Lisbon: Instituto Nacional de Estatística. (CD-ROM publication).

Jäako Poyry Oy (1990). Restructuring of the Wood Furniture Sector in Portugal. Executive Report. Banco de Fomento Nacional.

Loureiro, Carlos Alberto (1995). Os serviços na fileira florestal. *Revista do Agricultor*, Suplemento, N.º 75/76, pp. 21-24.

Loureiro, Manuel Dias (1995). *A Política de Segurança Interna*. Lisbon: Ministério da Administração Interna.

Mata, Manuel Gil (1990). Produção e Utilização de Fibras Papeleiras Portuguesas. *Ingenium*, Ano IV, N.º 36, Janeiro de 1990, pp. 58-67.

Ministério da Indústria e Energia – Direcção Geral da Indústria 1993(?). *A indústria de máquinas para a cortiça*. Lisbon: Ministério da Indústria e Energia.

(3) Of specific interest for Aquitaine

Auby, Jean François (1998). *Économie du département des Landes*. Sud-Ouest Université.

Eurostat (2000). *Environment employment in France, methodology and results 1996-1998*. Eurostat Working Paper 2/2000/B/7. Commission of the European Communities.

Le Net, Elisabeth (2002). *Suivi de la filière-bois en Aquitaine*. AFOCEL.

Peyron, J. L. ; Colnard, Odile (2001). *Contribution au rapport de la Commission des Comptes et de l'Économie de l'Environnement sur la forêt*. Nancy: Laboratoire d'Économie Forestière UMR ENGREF/INRA Nancy.

e) Bibliography for indicator 6.6

(1) Of general interest

Axelsson S.A. (1995). *Occupational safety and health in the forestry – an international study*. Uppsatser och

resultat nr. 280/1995.

ILO (1998). *Code of practice on safety and health in forestry work*. Geneva: ILO.

f) Bibliography for indicator 6.10

(1) Of general interest

Bateman, I.J. (1996). *An economic comparison of forest recreation, timber and carbon fixing values with agriculture in Wales: a geographical information systems approach*. Ph.D. Thesis, Department of Economics, University of Nottingham.

Bateman, I.J.; Lovett, A.A.; Brainard, J.S. (1999). Developing a methodology for benefit transfers using geographical information systems: modelling demand for woodland recreation. *Regional Studies*, 33(3), pp. 191-205.

Benson, J.F.; Willis, K.G. (1990). *The aggregate value of the non-priced recreation benefits of the Forestry Commission estate*. Report to the Forestry Commission, Department of Town and County Planning, University of Newcastle upon Tyne.

Benson, J.F.; Willis, K.G. (1992). *Valuing informal recreation on the Forestry Commission estate*. Bulletin 104, Forestry Commission, Edinburgh.

Bishop, K.D. (1992). Assessing the benefits of community forests: an evaluation of the recreational use benefits of two urban fringe woodlands. *Journal of Environmental Planning and Management*, 35(1), pp. 63-76.

Bockstael, N.E.; McConnell, K.E.; Strand, I.E. (1991). Recreation. In Braden, J.B.; Kolstad, C.D. (eds.): *Measuring the Demand for Environmental Quality*. Amsterdam: North-Holland,Elsevier Science Publishers.

Brainard, J.S.; Bateman, I.J.; Lovett, A.A. (2001). Modelling demand for recreation in English woodlands. *Forestry*, 74(5), pp. 423-438.

Cesario, F.J. (1976). Value of time in recreation benefit studies. *Land Economics*, 55, pp. 32-41.

Everett, R.D. (1979). The monetary value of the recreational benefits of wildlife. *Journal of Environmental Management*, 8, pp. 203-213.

Fix P.; Loomis J.; Eichhorn R. (2000). Endogenously chosen travel costs and the travel cost model: an application to mountain biking at Moab, Utah. *Applied Economics*, 32(10), pp. 1227-1231.

Forestry Commission (2003a). *Forestry Statistics 2003*. Edinburgh: Forestry Commission.

Forestry Commission (2003b). *Visitor monitoring trends index report. Report on the changes in visitor numbers from 2000 to 2001 for Forest Enterprise sites*. Edinburgh: Forestry Commission.

Gibson, J.G. (1978). Recreation land use. In Pearce, D.W. (ed.): *The Valuation of Social Cost*. London: Allen and Unwin.

Grayson, A.J.; Sidaway, R.M.; Thompson, F.P. (1975). Some aspects of recreation planning in the Forestry Commission. In Searle, G.A.C. (ed.): *Recreational Economics and Analysis: Papers presented at the Symposium on Recreational Economics and Analysis, London Graduate School of Business Studies, January 1972*. Essex: Longman.

Hanley, N.D. (1989). Valuing rural recreation benefits: an empirical comparison of two approaches. *Journal of Agricultural Economics*, 40(3), pp. 361-374.

Hanley, N.D.; Ruffell, R.J. (1991). *Recreational use values of woodland features*. Report to the Forestry Commission, University of Stirling.

Jones, A.P.; Bateman, I.J.; Wright, J. (2000). *Predicting and Valuing Informal Recreation Use of Inland Waterways: Report to British Waterways*. CSERGE, University of East Anglia.

Jones, Andy; Bateman, Ian; Wright, Jan (2003). *Estimating arrival numbers and values for informal recreational use of British woodlands*. Final report to the Forestry Commission. Norwich: CSERGE, School of Environmental Sciences, University of East Anglia.

Liston-Heyes and Heyes, (1999). Recreational benefits from the Dartmoor National Park. *Journal of Environmental Management* 55, pp. 69-80.

Loomis, J.B.; Roach, B.; Ward, F.; Ready, R. (1995). Testing transferability of recreation demand models across regions: A study of Corps of Engineers reservoirs. *Water Resources Research*, 31, pp. 721-730.

Mendelsohn, R.; Hof, J.; Peterson, G.; Johnson, R. (1992). Measuring recreation values with multiple destination trips. *American Journal of Agricultural Economics*, 24(4), pp. 926-933.

Parsons, G.R.; Kealy, M.J. (1994). Benefits transfer in a random utility model of recreation. *Water Resources Research*, 30(8), pp. 2477-2484.

Rosenberger, R.S.; Loomis, J.B. (2000). Using meta-analysis for benefit transfer: In-sample convergent validity tests of an outdoor recreation database. *Water Resources Research*, 36(4), pp. 1097-1107.

Shrestha, R. K.; Loomis, J.B. (2001). Testing a meta-analysis model for benefit transfer in international outdoor recreation. *Ecological Economics*, 39, pp. 67-83.

Smith, V. K.; Kaoru, Y. (1990). Signals or noise? Explaining the variation in recreation benefit estimates. *American Journal of Agricultural Economics*, May 1990. pp. 419-433.

Sturtevant, L.A.; Johnson, F.R.; Desvousges, W.H. (1995). *A meta-analysis of recreational fishing*. Triangle Economic Research, Durham, North Carolina.

Walsh, R. G.; Johnson, D. M.; McKean, J. R. (1990). Nonmarket values from two decades of research on recreation demand. In Link, A.; Smith, V.K. (eds.): *Advances in Applied Micro-Economics*. Vol. 5. Greenwich, CT: JAI Press. pp. 167-193.

Walsh, R. G.; Johnson, D. M.; McKean, J. R. (1992). Benefit transfer of outdoor recreation demand studies, 1968-1988. *Water Resources Research*, 28(3), pp. 707-713.

Willis, K.G.; Benson, J.F. (1989). *Values of user benefits of forest recreation: some further site surveys*. Report to the Forestry Commission. Department of Town and County Planning. University of Newcastle upon Tyne.

Willis K.G.; Benson, J.F.; Whitby, M.C. (1988). *Values of user benefits of forest recreation and wildlife*. Report to the Forestry Commission, Department of Town and County Planning, University of Newcastle upon Tyne.

Willis, K.G.; Garrod, G.D. (1991). An individual travel cost method of evaluating forest recreation. *Journal of Agricultural Economics*, 42(1), pp. 33-41.

Willis, K.G..; Garrod, G.D. (1992). On-Site Recreation Surveys and Selection Effects: Valuing Open Access Recreation on Inland Waterways. In Stratton, J. Van der; Briassoulis, H. (eds.): *Tourism and the Environment: Regional, Economic and Policy Issues*. Kluwer Academic Publishers.

(2) Of specific interest for the Portuguese regions

Mendes, Américo M. S. Carvalho (2004a). Portugal. In Merlo, Maurizio & Croitoru, Lelia (eds.), *Valuing Mediterranean Forests: Towards Total Economic Value*. Wallingford, Oxon (UK): CAB International (forthcoming).

g) Bibliography for indicator 6.4 and for the specific study of Portugal North

(1) Of general interest

Adger, N.; Brown, K.; Cervigni, R.; Moran, D. (1995). Total Economic Value of Forests in Mexico. *Ambio*, Vol. 24, N.º 5.

Alfsen, K.H.; Bye, T.; Lorentsen, L. - Statistics Norway (1987). *Natural Resource Accounting - The Norwegian experience 1978-1986*.

Aguirre, J. (1996). *Environmental accounting: a practical application to the total valuation of the tropical rain forest*. Working Paper, CATIE, Turrialba, Costa Rica.

Ahmad, Y.; El Serafy, S.; Lutz, E. (eds.) (1989). *Environmental Accounting for Sustainable Development*. Washington, D. C., The World Bank.

Anderson, D. (1990). *Carbon-fixing from an Economic Perspective*. Paper presented at the Forestry Commission's First Economic Research Conference, York University, September.

Anielski, Mark (1992a). *Accounting for carbon fixation by Alberta's forests and peatlands*. Paper presented at the Second Meeting of the International Society of Ecological Economics, held in Stockholm on August 3-6, 1992.

Anielski, Mark (1992b). *Resource accounting: indicators of the sustainability of Alberta's forest resources*. Paper presented at the Second Meeting of the International Society of Ecological Economics, held in Stockholm on August 3-6, 1992.

Anielski, Mark (1994). *Resource accounting II: from theory to application—Alberta's timber account in 1991*. Paper presented at the Forestry and Environment Conference: Economic Perspectives II, held in Banff, Alberta on October 12-15, 1994.

Anielski, Mark (1996). *Accounting for the sustainability of Alberta's forests: the 1995 timber resource account*. Unpublished manuscript.

Bartelmus, Peter (1994). Green accounting for a national strategy of sustainable development—the case of Papua New Guinea. *Ambio* 23(8), pp. 509-514.

Bartelmus, Peter; Lutz, Ernst; Schweinfest, Stefan (1992). *Integrated environmental and economic accounting: a case study for Papua New Guinea*. Environment Working Paper N.º 54. Environment Department, The World Bank, Washington, D.C.

Bartelmus, Peter; Tongeren, Jan van (1994). *Environmental accounting: an operational perspective*. Working Paper Series N.º 1. Department for Economic and Social Information and Policy Analysis, United Nations, New York.

Bateman, I.J. (1996). *An economic comparison of forest recreation, timber and carbon fixing values with agriculture in Wales: a geographical information systems approach*. Ph.D. Thesis, Department of Economics, University of Nottingham.

Bateman, I.J.; Carson, R.T.; Day, B.; Hanemann, W.M.; Hanley, N.; Hett, T.; Jones-Lee, M.; Loomes, G.; Mourato, S.; Ozdemirogla, E.; Pearce, D.W.; Sugden, R.; Swanson, J. (2002). *Guidelines for the Use of Expressed Preference Methods for the Valuation of Preferences for Non-market Goods*. Edward Elgar Publishing.

Bateman, I.J.; Jones, A.P.; Nishikawa, N.; Brouwer, R. (2000). *Benefits transfer in theory and practice: A review*. CSERGE Global Environmental Change Working Paper GEC2000-25, Centre for Social and Economic Research on the Global Environment, University of East Anglia and University College London.

Bateman, I.J.; Willis K.G. (eds.) (1999). *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation method in the US, EU and Developing Countries*.Oxford University Press.

Baumgarten, Cynthia (1996). Modelling a physical timber resource account for Canada. In *Third Meeting of the London Group on Natural Resource and Environmental Accounting. Proceedings of meeting held in Stockholm on May 28-31, 1996*. Stockholm: Statistics Sweden.

Bergen, V. (2001) Forest Public Goods in National Accounts. *Investigación Agraria - Sistemas y Recursos Forestales*, Fuera de Serie, N.º 1, pp. 27-42.

Bergen, V.; Gutow, S.; Schröder, H. (1997). *Preparation and Development of Forest Balances within the System of National Accounts*. Georg August-University Göttingen. A pilot study for Eurostat and DGXI.

Bergen, V.; Gutow, S.; Schröder, H. (1999). *Consideration and Consequences of an Extended Definition of Forestry Production within the System of National Accounts*. Georg August-University Göttingen. A pilot study for Eurostat and DGXI.

Bergland, O.; Magnussen, K.; Navrud, S. (1995). *Benefit transfer: testing for accuracy and reliability*. Discussion Paper #D-03/1995, Agricultural University of Norway.

Bigsby, Hugh (1995). Accounting for plantations: national accounts and forestry. *New Zealand Forestry* (May), pp. 15-18.

Bowes, M. D.; Krutilla, J. V. (1989). *The Multiple-Use Economics of Public Forest lands*. Washington. D. C.: Resources for the Future. 357 p.

Boyle, K. J. (n.d.). *The practical implications of accomplishing an ideal benefits transfer with limited data availability*. Department of Resource Economics and Policy, University of Maine, Orono.

Boyle, K. J.; Bergstrom, J. C. (1992). Benefit transfer studies: myths, pragmatism, and idealism, *Water Resources Research*, 28(3), pp. 657-663.

Boyle, K.J.; Poe, G.L.; Bergstrom, J. (1994). What do we know about groundwater values?: Preliminary implications from a meta-analysis of contingent valuation studies. *American Journal of Agricultural Economics*, 76(5), pp. 1055-1061.

Brookshire, D. S.; Neill, H. R. (1992). Benefit transfers: conceptual and empirical issues. *Water Resources Research*, 28(3), pp. 651-655.

Brouwer, R.; Spaninks, F.A. (1999). The validity of environmental benefits transfer: further empirical testing. *Environmental and Resource Economics*, 14(1), pp. 95-117.

Brown, T. (1999). *Notes on the Economic Value of Water from National Forests*. Unpublished report. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Campos Palacín, P. (1994). The total economic value of agroforestry systems. In Koch, N. E. (ed.): *The scientific basis for sustainable multiple-use forestry in the European Community*. European Commission/Directorate General for Agriculture, VI/4135/94-EN, Brussels, pp. 33-47.

Campos Palacín, P. (1999a). Un sistema de cuentas microeconómicas del uso múltiple de un espacio natural de interés ambiental. In Casado, J.M.; Azqueta D. (comps.): *Lecturas de economía y medio ambiente*. Madrid: Consejo General de Colegios de Economistas de España. pp. 71-98.

Campos Palacín, P. (1999b). Hacia la medición de la renta de bienestar del uso múltiple de un bosque. *Investigación Agraria: Sistemas y Recursos Forestales*, Vol. 8 (2), págs. 407-422.

Campos Palacín, Pablo (2000). An agroforestry economic accounting system. Towards the Measurement of Social Income. In Jöbstl, Hans; Merlo, Maurizio; Venzi, Lorenzo (eds.): *Proceedings of the International Symposium on Institutional Aspects of Managerial Economics and Accounting in Forestry, 15-18 April, 1998, Roma, Ostia*. Viterbo: Stabilimento Tipolitografico Agnesotti. pp. 9-19.

Campos Palacín, P. (2000). Las nuevas cuentas del bosque europeo. *Fuentes estadísticas* Nº. 41, pp. 14-15.

Campos Palacín, P. (2001). Medición de la renta de bienestar en sistemas agroforestales mediterráneos. In Labrador, J.; Altieri, M. (coords.): *Agroecología y desarrollo: Aproximación a los fundamentos agroecológicos para la gestión sustentable de agrosistemas mediterráneos*. Madrid: Universidad de Extremadura y Ediciones Mundi-Prensa. pp. 397-432.

Campos Palacín, P.; Y. Rodríguez; A. Caparrós (2001). Towards the dehesa total income accounting: theory and operative Monfragüe study cases. *Investigación Agraria - Sistemas y Recursos Forestales*, Fuera de Serie, N.º 1, pp. 43-67.

Caparrós, A.; Campos Palacin, P.; Montero, G. (2002). An operative framework for total hicksian income measurement: application to a multiple use forest. *Environmental and Resource Economics*.

Carson, et al.; Flores, N. E.; Martin, K. M.; Wright, J. L. (1996). Contingent valuation and revealed preference methodologies: comparing the estimates for quasi-public goods. *Land Economics*, 72, pp. 80-99.

Carson, R.T.; Groves, T.; Machina, M.J. (1999). *Incentive and informational properties of preference questions*. Plenary Address, Ninth Annual Conference of the European Association of Environmental and Resource Economists (EAERE), Oslo, Norway, June 1999.

Clough, Peter (1992). *Natural resource accounting for New Zealand's indigenous forests*. Report to the Ministry for the Environment, under contract N.º 343. New Zealand Institute of Economic Research, Wellington.

Commission of the European Communities (1987). *Forestry statistics 1980-1984*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1992). *Manual on Economic Accounts for Agriculture and Forestry*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1994a). *Communication from the Commission to the Council and European Parliament on 'Directions for the EU on Environmental Indicators and Green National Accounting', COM (94) 670, December 1994*.

Commission of the European Communities (1994b). *The European System for the Collection of Economic Information on the Environment – SERIEE 1994 Version*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1996). *European System of Accounts – ESA 1995*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1997). *Manual on the Economic Accounts for Agriculture and Forestry (Rev. 1)*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1998a). *Economic Accounts for Agriculture and Forestry 1992-1997*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1998b). *Forestry statistics 1992-1996*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1999a). *The European Framework for Integrated Environmental and Economic Accounting for Forests: Results of pilot applications*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (1999b). *The European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF)*. Luxembourg: Office for Official Publications of the European Communities.

Commission of the European Communities (2002). *The European Framework for Integrated Environmental and Economic Accounting for Forests (IEEAF). 2002 Edition*. Luxembourg: Office for Official Publications of the European Communities.

Crowards, Tom M. (1996). Natural resource accounting: a case study of Zimbabwe. *Environmental and Resource Economics* 7, pp. 213-241.

Dasgupta, P.; B. Kriström; K.-G. Mäler (1995). Current issues in resource accounting. In Johansson, P.-O.; Kriström, B.; Mäler, K.-G.: *Current Issues in Environmental Economics*. Manchester: Manchester University Press.

De Haan, M.; Keuning S.J.; Bosch, P.R. (1993). *Integrating indicators in a National Accounting Matrix including Environmental Accounts National Accounts*. Occasional papers N.º 60, Statistics Netherlands.

Desvousges, W. H.; Johnson, F.R.; Banzaf, H.S. (1998). *Environmental Policy Analysis With Limited Information: Principles and Applications of the Transfer Method*. Edward Elgar, Northampton, Mass.

Desvousges, W. H.; Naughton, M. C.; Parsons, G. R. (1992). Benefit transfer: conceptual problems in estimating water quality benefits using existing studies. *Water Resources Research*, 28(3), pp. 675-683.

Downing, M.; Ozuna, T. (1996). Testing the reliability of the benefit function transfer approach. *Journal of Environmental Economics and Management*, 30, pp. 316-322.

Dube, Y. C.; Jackson, H.; Narain, P. (1998). *Accounting for the Benefits of Forest Resources: A Progress Report on FAO Activities*. Presented at International Symposium International Aspects of Managerial Accounting in Forestry. Rome, Italy. April, 15-18.

Eliasson, P. (1996). *Evaluation of carbon fixation in the context of national accounts*. Working Paper, Institutionen för skogsekonomi, Lantbruks Universitet, Sweden.

Englert, H.; Küppers, J.G.; Thoroe C. (1999). *Valuation of standing timber volumes by stumpage prices in Germany, Institute for Economics of the German Federal Research Centre for Forestry and Forest products. A pilot study for Eurostat and DG Environment*.

Eriksson, M. and Wolf, M.- Statistics Sweden (1998). *Forest Economic and Environmental Accounting. A pilot study for Eurostat and DGXI.*

Eurostat (1996). *Nordic Natural Resource and Environmental Accounting: a joint report from the statistical offices in Denmark, Finland, Iceland, Norway and Sweden*. (Working Paper internally produced by Eurostat – March 1996).

Eurostat (1997). *An Estimate of Eco-Industries in the European Union 1994*. Eurostat Working Paper Nr. 2/1997/B/1. Commission of the European Communities.

Eurostat (1999a). *Eurostat Task Force on Forest Economic and Environmental Accounting. Minutes of the 8 March 1999 meeting. Eurostat B1*. Luxembourg: Eurostat.

Eurostat (1999b). *Eurostat Task Force on Forest Economic and Environmental Accounting. Summary of the 20-21 May 1999 meeting on the Valuation of non-ESA/SNA functions of forests. Eurostat B1*. Luxembourg: Eurostat.

Eurostat (1999c). *Physical description of non-ESA/SNA functions of forests, 9/10 September 1999 meeting of the Task Force on Forest Accounting, Luxembourg, August 1999.*

Eurostat (1999d). *Report of the 9-10 September 1999 meeting of the Eurostat Task Force on Forest Accounting, Doc. ACCT-ENV/99/7.3.1c, 16/17 September 1999 meeting of the Working Party 'Economic accounts for the environment'.*

Eurostat (1999e). *Statistics on Environmental taxes and other economic instruments for environmental protection in EU Member States*. Luxembourg (internally produced by Eurostat – November 1999).

Eurostat (2000a). *Valuation of European forests. Results of IEEAF test applications*. Luxembourg: Office for Official Publications of the European Communities.

Eurostat (2000b). *The European Handbook for Integrated Environmental and Economic Accounting for Forests – IEEAF*. Luxembourg: Office for Official Publications of the European Communities.

Fankhauser, S. (1995). *Valuing Climate Change. The Economics of the Greenhouse*. London: Earthscan.

Freeman, A. M. III (1979). The benefits of environmental improvement: theory and practice. Baltimore and London: Resources for the Future and John Hopkins University Press.

Freeman, A. Myrick III (1993). *The Measurement of Environmental and Resource Values*. Washington, D.C.: Resources for the Future.

FAO (1998). *Economic and environmental accounting for forestry: status and current efforts, draft 20/08/98.* FAO: Rome (http://www.fao.org/forestry/fon/fonp/fao-eeac.pdf).

Grayson, A. J. (1989). *Carbon Dioxide, Global Warming and Forestry*. Research Information Note 146. Edinburgh: Forestry Commission.

Green, D.; Jacowitz, K.E.; Kahneman, D.; McFadden, D. (1998). Referendum contingent valuation, anchoring, and willingness to pay for public goods. *Resource and Energy Economics*, 20 (2), pp. 85-116.

Gregersen, H. M.; Arnold, J. E. M.; Lundgren, A. L.; Contreras-Hermosilla, A. (1995). *Valuing Forests: Issues, Contexts, and Guidelines*. Rome: UN-FAO Environment Program. 53p.

Gregersen, H. M.; Lundgren, A; Kengen, S.; Byron, N.. *Measuring and capturing forest values: issues for the decision-maker*. Proceedings of the XI World Forestry Congress. Vol. 4, pp. 197-207.

Grobecker, C. - Statistisches Bundesamt (1998). *Forest Accounting: Flow Accounts for Wood and Residuals. A pilot study for Eurostat and DG Environment*.

Hamilton, Kirk (1997). *Forest resources and national income*. Unpublished manuscript. The World Bank, Washington, D.C.

Hamilton, Kirk; Lutz, Ernst (1996). *Green national accounts: policy uses and empirical experience*. Working Paper, Environment Department, World Bank, Washington, D.C..

Hanley and Spash (1994). *Cost-Benefit Analysis and the Environment*. Edward Elgar.

Hartwick, John M. (1997). *Notes on valuation in forestry and deforestation*. Unpublished manuscript, Department of Economics, Queen's University, Kingston, Ontario.

Heal, G.; B. Kriström (2001). National income and the environment. In Mäler, K.-G.; Vincent, J. (eds.), *Handbook of Environmental Economics*. Amsterdam: North Holland.

Herriges, J.A.; Kling C.L. (eds.) (1999). Valuing Recreation and the Environment: Revealed Preference Methods in Theory and Practice. Cheltenham: Edward Elgar Publishing.

H.M. Treasury (1972). *Forestry in Great Britain: An Interdepartmental Cost/Benefit Study*. HMSO, London.

Hoen, Hans Friedrik (1993). Forestry and national accounting—a comment. *Scandinavian Forest Economics* 34, pp. 136-146.

Hoffrén, J. (1996). *Measuring the ecological quality of Finnish forest resources*. Research Report N.º 220, Statistics Finland, Helsinki.

Hoffrén, J. – Statistics Finland (1997). *Finnish forest resource accounting and ecological sustainability*. Tutkimuksia Forskningsrapporter Research Report 224, Helsinki, Finland.

Howell, Stephanie L. (1996). A review of conceptual and methodological issues in accounting for forests, In *Third Meeting of the London Group on Natural Resource and Environmental Accounting*. Stockholm: Statistics Sweden.

Hufschmidt, M.; James, D.; Meister, A.; Bower, B.; Dixon, J. (1983). *Environment, Natural Systems, and Development: an Economic Valuation Guide*. Baltimore: Johns Hopkins University Press.

Hultkrantz, L. (1992). National accounts of timber and forest environmental resources in Sweden. *Environmental and Resource Economics*, 2(1), pp. 283-305.

IIED Forestry and Land Use Programme and The World Conservation Monitoring Centre (1994). *Forest Resource Accounting: Stock-Taking for Sustainable Forest Management*. IIED Forestry and Land Use Series N.º 1, IIED, London.

INSEE (1985). *Natural Patrimony Accounts*.

Inter-Secretariat Working Group on National Accounts (1993). *System of National Accounts 1993*. Brussels/Luxemburg, New York, Paris & Washington: Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations and World Bank.

Jöbstl, H.; Hogg, J. (1998). On the state of forest accounting in some European countries. In Recent Developments In *Accounting And Managerial Economics For An Environmentally-Friendly Forestry. International IUFRO - INRA Symposium, Nancy, 21 - 23 April 1997*.

Joisce, John (1996). Valuation of forests: some issues. In *Third Meeting of the London Group on Natural Resource and Environmental Accounting. Proceedings of meeting held in Stockholm on May 28-31, 1996*. Stockholm: Statistics Sweden.

Kellenberg, John V. (1995). *Accounting for natural resources: Ecuador, 1971-1990*. Ph.D. dissertation, Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland.

Kengen, Sebastião (1997). *Forest Valuation for Decision-making: Lessons of experience and proposals for Improvement*. Rome: FAO. 134 pp.

Kirchhoff, S.; Colby, B. G.; LaFrance, J. T. (1997). Evaluating the performance of benefit transfer: an empirical inquiry. *Journal of Environmental Economics and Management*, 33, pp. 75-93.

Kolttola, L.; Mukkonen, J. (1996). Forests and the national accounts. In *Third Meeting of the London Group on Natural Resource and Environmental Accounting. Proceedings of meeting held in Stockholm on May 28-31, 1996*. Stockholm: Statistics Sweden.

Kong, F.; Naihui, H. *Accounting of Forest Resources and Accounting System of National Economy*. People China Press.

Kong, F.; Guangcui, D.; Naihui, H. (1994). *Forest Environmental Resource Accounting and Economic Compensation Policy*. China Environmental Science Press.

Kopp, R. J.; Smith, V. K. (eds.). *Valuing natural assets. The economics of natural resource damage assessment*. Washington, D. C.: Resource for the Future.

Kriström, B. (2001). Valuing forests. In Holliwell, V. G.; Raven, P.: *Managing Human-Dominated Ecosystems*. St. Louis: MGB Press.

Kriström, B.; Skanberg, K. (2001). Monetary forestry accounting including environmental goods and services. *Investigación Agraria - Sistemas y Recursos Forestales*, Fuera de Serie, N.º 1, pp. 7-26.

Krutilla, J.V.; Fisher, A.C. (1975). *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources*. Baltimore, MD: Johns Hopkins University Press (for Resources for the Future).

Kula, E. (1986). The Developing Framework for the Economic Evaluation of Forestry in the United Kingdom. *Journal of Agricultural Economics*, Vol. 37, N.º 3.

Kumari, Kanta (1995). *An environmental and economic assessment of forest management options: a case study of Malaysia*. Environmental Economics Series. The World Bank..49 p.

London Group on Natural Resource and Environmental Accounting (1995). Conference papers of the second meeting, published by the U.S. BEA.

London Group on Natural Resource and Environmental Accounting (1996). Proceedings volume of the third meeting, published by Statistics Sweden.

London Group on Natural Resource and Environmental Accounting (1998). Papers and proceedings of the fourth meeting, published by Statistics Canada.

London Group on Natural Resource and Environmental Accounting (1999). Proceedings and papers of the fifth meeting, published by IFEN.

Loomis, J. B. (1992). The evolution of a more rigorous approach to benefit transfer: benefit function transfer. *Water Resources Research*, 28(3), pp. 701-705.

Loomis, J.B.; White, D.S. (1996). Economic benefits of rare and endangered species: Summary and meta-analysis. *Ecological Economics*, 18 (3), pp. 197-206.

Lovett, A.A.; Brainard, J.S.; Bateman, I.J. (1997). Improving benefit transfer demand functions: a GIS approach. *Journal of Environmental Management*, 51, pp. 373-389.

Lutz, E. (ed.) (1993). *Toward Improved Accounting for the Environment*. Washington, D. C.: The World Bank.

Lutz, E.; El Serafy, S. (1988). *Environmental and resource accounting : an overview*. Policy Planning and Research Staff, World Bank Environment Department Working Paper N.º 6. Washington, D.C.

Mäler, Karl-Göran (1991). National accounts and environmental resources. *Environmental and Resource Economics* 1, pp. 1-15.

Mariscal, P.; Campos Palacin, P. (2001). *Demandas sociales, interés de los proprietarios e intervención pública en los espacios naturales: el caso de la dehesa de la comarca de Monfragüe*. Madrid: Instituto de Economia y Geografia - CSIC (unpublished).

Mattsson, L. (1989). The Economic Value of Wildlife for Hunting. In Mattsson, L.; Sodal, D. P. (eds.): Multiple Use of Forest – Economics and Policy. Proceedings of a Conference held in Oslo, May 1988, *Scandinavian Forest Economics*, N.º 30.

Merlo, Maurizio; Croitoru, Lelia (eds.) (2004). *Valuing Mediterranean Forests: Towards Total Economic Value*. Wallingford, Oxon (UK): CAB International (forthcoming).

Mitchell, R.C.; Carson, R.T. (1989). *Using Surveys To Value Public Goods: The Contingent Valuation Method*. Washington D.C.: Resources for the future.

Motta, Ronaldo Serôa da (1993). *Measuring sustainable income: the case of mineral and forest depletion in Brazil*. Paper presented at OAS Seminar on Natural Resource and Environmental Accounts for Development Policy in Washington, D.C. on April 13-14, 1993.

Muukkonen, J. - Statistics Finland (1997). *Wood material accounting in Finland and its applications in linking materials/energy balances data to economic and environmental data, in Eurostat: Material Flow Accounting – Experience of Statistical Institutes in Europe*. Luxembourg, December 1997.

Muukkonen, J. - Statistics Finland (1998). *European Forest Accounting: Pilot accounts of forest accounting in Finland. A pilot study for Eurostat and DGXI*.

Muukkonen, J. - Statistics Finland (1999). *Valuation of forests. A pilot study for Eurostat and DG Environment*.

Newson, B.; Gie, G. (1996). Forest economic and environmental accounting. In *Third Meeting of the London Group on Natural Resource and Environmental Accounting. Proceedings of meeting held in Stockholm on May 28-31, 1996*. Stockholm: Statistics Sweden.

Nordhaus, W. D. (1990). *To Slow or Not to Slow: The Economics of the Greenhouse Effect*. National Science Foundation.

Nordhaus, W. D.; Kokkelenberg, E. C. (1999). *Nature's numbers: expanding the national economic accounts to include the environment*. Washington D. C.: National Academy Press.

Oosterhuis, F. H.; van der Linden, J. W. (1987). *Benefits of Preventing Damage to Dutch Forests: An Application of the Contingent Valation Method*. Paper presented to the Conference "Environemental Policy in a Market Economy", September, Wageningen, The Netherlands.

OECD (1988). *The Environmental Effects of Market and Intervention Failures in the Management of Forests*. Paper ENV/ECO/88.12. Paris: OECD.

OECD (1994a). *Natural resource accounts: taking stock in OECD countries*. OECD Environment Monograph N.º 84. OECD, Paris.

OECD (1994b). *Core set of environmental indicators - Forest resources: measurement issues*. ENV/EPOC/SE(94)5, Working Paper drafted by the Canadian Delegation.

OECD (1994c). *Indicators for the integration of environmental concerns into forestry policies*. ENV/EPOC/SE(94)1.

OECD (1995). *Environmental accounting for decision-making: summary report of an OECD seminar*. OECD Environment Monograph N.º 113. OECD, Paris.

OECD/Eurostat (1999). *The Environmental Goods & Services Industry – Manual for data collection and Analysis*. Paris: OECD.

Pearce, D. W. (1990). Assessing the Returns to the Economy and to the Society from Investments in Forestry. In Whiteman, A. (ed.): *Forestry Expansion*. Edinburgh: Forestry Commission.

Pearce, D.W.; Moran, D. (1994). *The Economic Value of Biodiversity*. London: Earthscan.

Peskin, H. M. (1989). *Accounting for natural resource depletion and degradation in developing countries*. Working Paper, Environment Department, World Bank, Washington, D.C.

Peskin, H. M. (1996). *Alternative resource and environmental accounting approaches and their contribution to policy*. Paper prepared for the Fondazione Eni Enrico Mattei and presented in Beijing, China and Tokyo, Japan. Published as Nota di Lavoro 77.96, Fondazione Eni Enrico Matte, Milan, Italy..

Peskin, H. M.; Lutz, E. (1990). *A survey of resource and environmental accounting in industrialized countries*. Environment Working Paper Number 37, The World Bank, Washington, D.C.

Poe, G.L.; Boyle, K.J.; Bergstrom, J.C. (2001). A preliminary meta analysis of contingent values for ground water revisited. In Bergstrom, J.C.; Boyle, K.J.; Poe, G.L. (eds.): *The Economic Value of Water Quality*. Northampton, MA: Edward Elgar.

Prudham, W. S.; Lonergan, S. (1993). Natural resource accounting (I): a review of existing frameworks. *Canadian Journal of Regional Science* 16(3), pp. 363-386.

Prudham, W. S.; Lonergan, S. (1999). Natural Resource Accounting (II): Toward the development of a Regional Model. *Canadian Journal. of Regional Science*. 16(3), pp. 387-412.

Rego, F. (1991). A silvopastorícia na sua relação com os incêndios florestais em Portugal. *Ingenium*, Year VI, N.º 53, September/October 1991, pp. 67-72.

Repetto, R.; Magrath, W.; Wells, M.; Beer, C.; Rossini, F. (1989). *Wasting Assets: Natural Resources in the National Income Accounts*. Washington, D. C.: World Resources Institute.

Rodríguez Luengo, Yolanda; Campos Palacín, Pablo; Caparrós Gass, Alejandro; Martín Barroso, David (2003). *Análisis comparado de rentas comerciales y ambientales de la dehesa*. Paper presented at IV Encuentro de Economia Aplicada, Granada, 5-7 July 2003.

Roper, C. S.; Park, A. (eds.) (1999). *The living forest: non-market benefits of forestry*. London: Forestry Commission.

Rylander, J. C. (1996). Accounting for nature: a look at attempts to fashion a green GDP. *Renewable Resources Journal* 14 (2), pp. 8-13.

Sadoff, Claudia W. *Natural resource accounting: a case study of Thailand's forest management*. Ph.D. dissertation, Department of Economics, University of California at Berkeley.

Sadoff, Claudia W. Natural resource accounting: a practical comparison of methodologies and applications to Thailand's logging ban. In Shen, Susan; Contreras-Hermosilla, Arnoldo (eds.): *Environmental and Economic Issues in Forestry: Selected Case Studies in Asia*. World Bank Technical Paper No. 281, Asia Technical Department Series. The World Bank, Washington, D.C.

Sekot, W. (1999). *Comparing results of alternative methods for the valuation of forest assets*. Universität für Bodenkultur Wien. A pilot study for Eurostat and DG Environment.

Sekot, W.; Gerhold, S.; Knieling, A. (1996). Valuing the forestry asset—methodological considerations from an Austrian perspective. In *Third Meeting of the London Group on Natural Resource and Environmental Accounting. Proceedings of meeting held in Stockholm on May 28-31, 1996*. Stockholm: Statistics Sweden.

Sistema de Informação de Cotações de Produtos Florestais na Produção (2003a). *Indicadores de Mercado 2000-2003*. Lisbon: Direcção Geral das Florestas-Divisão de Inventário e Estatísticas Florestais. Leaflet.

Sistema de Informação de Cotações de Produtos Florestais na Produção (2003b). Website: http://cryptomeria.dgf.min-agricultura.pt, updated as of April 12, 2004.

Smith, V. Kerry (1996). *Estimating Economic Values for Nature*. Cheltenham, U.K.: Edward Elgar.

Solberg, Birger; Svendsrud, A. (1992). *Environmental factors and national account of forestry—some findings from Norway*. Paper presented at IUFRO Centennial Meeting, held August 31-September 4, 1992, in Berlin.

Statistics Canada (1995). *Valuing Ontario's Timber resources stock, Environmental Perspectives*.

Statistics Canada (1997). *Econnections: Linking the Environment and the Economy; Concepts, Sources and Methods of the Canadian System of Environmental and Resource Accounts*. Catalogue N.º 16-505-GPE., Ontario.

Statistics Norway (1998). *Norwegian Economic and Environmental Accounts Project (NOREEA)*. p.20.

Steurer, Anton (2000). *Towards an Environmental Accounting Framework for the EU*. Nota di Lavoro 96.2000, Fondazione Eni Enrico Mattei, Milan, Italy.

Tessier, A.; Peyron, J.-L. - IFEN and ENGREF (1998). *Faisabilité de comptes de la forêt en France. A pilot study for Eurostat and DGXI.*

Tessier, A.; Peyron J.-L. - IFEN and ENGREF (1999). *A comparison of valuation methods for the French forests*. A pilot study for Eurostat and DG Environment.

UN Commission on Sustainable Development (1996). *Measuring and capturing forest values: issues policies and challenges. Program Element III.1 (b), Scientific Research, Forest Assessment and Development of Criteria and Indicators for Sustainable Forest Management. Ad Hoc Intergovernmental Panel on Forests Third Session, September 9-20, 1996*.

United Nations (1984). *Framework for the development of environment statistics*. Statistics Paper, Series M, N.º 78. New York: United Nations. 28 p.

United Nations (1991). *Concepts and methods of environment statistics: statistics of the natural environment*. Studies in methods, Series F, N.º 57. New York: United Nations. 159 p.

United Nations (1993). *Integrated Environmental and Economic Accounting. Handbook of National Accounting*. New York: United Nations. Series F, N.º 61.

United Nations – Economic and Social Council – Statistical Commission and Economic Commission for Europe (1994). *Single European Standard Classification of Environmental Protection Activities and Facilities*. Note prepared by the Secretariat of the Forty-second plenary session of the Conference of European Statisticians, Paris, 13-17 June 1994.

United Nations (1996). *Integrated Environmental and Economic Accounting: Interim Version*. New York: United Nations.

United Nations Economic Commission for Europe & FAO (2000). *Forest Resources of Europe, CIS, North America, Australia, Japan and New Zealand (Industrialized temperate/boreal countries). UN-ECE/FAO Contribution for the Global Forest Resources Assessment 2000. Main Report.* Geneva Timber and Forest Study Papers, N.º 17. Geneva and New York: United Nations [referred in the text as TBFRA-2000].

Uno, K.; Bartelmus, P. (1998). *Environmental Accounting in Theory and Practice*. Dordrecht: Kluwer Academic Publishers. 459 pp.

U. S. Forest Service (2000). *Water and the Forest Service*. Washington, D.C.: U. S. Forest Service, U. S. Departement of Agriculture.

Van den Bergh, J. C. J. M.; Button, K. J.; Nijkamp, P.; Pepping, G. C. (1997). *Meta-Analysis in Environmental Economics*. AH Dordrecht, The Netherlands: Kluwer Academic Publishers.

Van Houtven, G.L.; Pattanayak, S.K.; Pringle, C.; Yang, J-C. (2001). *Review and metaanalysis of water quality valuation studies*. Draft Report, prepared for U.S. Environmental Protection Agency, Office of Water and Office of Policy, Economics, and Innovation, Washington, D.C.

Vincent, J. (1998). *Theoretical Aspects of Forest Accounting*. Development Discussion Paper N.º 625, Harvard Institute for International Development.

Vincent, J. (1999a). Net accumulation of timber reserves. *The Review of Income and Wealth*, 45, pp. 251-262.

Vincent, J. (1999b). A framework for forest accounting. *Forest Science*, 45(4), pp. 552-561.

Vincent, J.; Hartwick, M. (1997). *Accounting for the benefits of forest resources: concepts and experience*. Rome: FAO.

Walsh, R. G.; Bjonback, R. D.; Aiken, R. A.; Rosenthal, D. H. (1990). Estimating the Public Benefits of Protecting Forest Quality. *Journal of Environmental Management*, Vol. 30, pp. 175-89.

Ward, M. (1982). *Accounting for the Depletion of Natural Resources in the National Accounts of Developing Countries*. OECD: Paris.

Weitzman, M. L. (1976). On the welfare significance of national product in a dynamic economy, *Quarterly Journal of Economics* 90(1), pp. 156-162.

Weitzman, M. L.; Löfgren, K.-G. (1997). On the welfare significance of green accounting as taught by Parable. *Journal of Environmental Economics and Management*, 32(2), pp. 139-153.

Wibe, S. (1994). *Non-wood benefits in forestry - survey of valuation studies*. Working paper 199, Department of Forest Economics, SLU-Umea, Sweden.

Wibe, S.; Jones, T. (ed.) (1992). *Forests: Markets and Intervention Failures. Five Case Studies*. London: Earthscan.

Whiteman, A.; Sinclair, J. (1994). *The Costs and Benefits of Planting Three Community Forests: Forest of Mercia, Thames Chase and Great North Forest*. Policy Studies Division, Forestry Commission, Edinburgh.

Willis, K.; Garrod, G. (1994). Transferability of benefit estimates. In Willis, K. G.; Corkindale, J. T. (eds.): *Environmental Valuation: New Perspectives*. CAB International.

World Bank (1995). *Monitoring Environmental Progress: A Report on Work in Progress*. Indicators and Environmental Valuation Unit, Environment Department. Washington, D.C.

World Bank (1997). *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*. Indicators and Environmental Valuation Unit, Environment Department. Washington, D.C.

Xu, Zhi; Bradley D.P.; Jakes, P.J. (1995). Measuring forest ecosystem sustainability: a resource accounting approach. *Environmental Management* 19 (5), pp. 685-692.

(2) Of specific interest for the Portuguese regions

Alpuim, M.; Carneiro, M.; Vacas de Carvalho, M. A.; Rocha, M. E. (1998) *Pinheiro Manso. 1.ª parte - O pinheiro manso e a produção de pinhão*. UTAD, Vila Real, 28-29 September. (unpublished manuscript).

Bugalho, J.; Carvalho, J. (2001) *O associativismo cinegético em Portugal: a importância do associativismo cinegético para a conservação dos recursos naturais e o seu reflexo no desenvolvimento rural*. Lisbon: Ministério da Agricultura, do Desenvolvimento Rural e das Pescas, Direcção Geral do Desenvolvimento Rural, Série Estudos e Análises.

Campos Palacín, Pablo (1996). *Análisis técnico y económico de sistemas de dehesas y de montados. Informe final*. Madrid: CSIC/UTL (Lisboa)/SDIT (Badajoz)/UNEX(Cáceres).

Cipriano, R.J.R. (1999). *Análise do Panorama Cinegético em Portugal a Partir de Um Questionário aos Caçadores*. Report submitted in fulfillment of the Bachelor's degree in Forest Engineering. Lisbon: Instituto Superior de Agronomia (mimeo).

CELPA (Associação da Indústria Papeleira) (2002). *Indústria Papeleira Portuguesa. Boletim Estatístico 2001*. Lisbon: CELPA.

CELPA (Associação da Indústria Papeleira) (2003). *Indústria Papeleira Portuguesa. Boletim Estatístico 2002*. Lisbon: CELPA.

CESE-Conselho para a Cooperação Ensino Superior/Empresa (1996). *O Sector Florestal Português. Documento de Apoio ao Seminário do CESE. Póvoa de Varzim, 4-5 de Outubro de 1996*. [Porto]: CESE-Conselho para a Cooperação Ensino Superior/Empresa. (mimeo).

Comissão Nacional Especializada de Fogos Florestais (2001). *Contribuição da prevenção dos incêndios florestais e da valorização energética dos resíduos florestais para a redução das emissões de CO2*. (Documento apresentado no âmbito da discussão pública do PNAC(2001).

Direcção Geral das Florestas (1992). *Portugal, País de Florestas*. Lisbon: Direcção Geral das Florestas.

Direcção Geral das Florestas (1998). *The Portuguese Forest by Numbers*. Lisbon: Direcção Geral das Florestas.

Direcção Geral das Florestas (1999). *Anuário Florestal 1999*. Lisbon: Direcção Geral das Florestas.

Direcção Geral das Florestas (2001). *Inventário Florestal Nacional. Portugal Continental. 3.ª Revisão, 1995-1998. Relatório Final*. Lisbon: Direcção Geral das Florestas.

Direcção Geral das Florestas (2002a). *Revisão dos dados a utilizar no PNAC 2002 - Floresta e Produtos Florestais - Cenário de referência*. Direcção Geral das Florestas, Novembro 2002, versão 2.

Direcção Geral das Florestas (2002b). *Actualização de informação dos recursos florestais para o cálculo do balanço de carbono do sector florestal*. Direcção Geral das Florestas, Junho 2002.

Direcção Geral das Florestas-Corpo Nacional da Guarda Florestal (2003). *Determinação das causas dos incêndios florestais em 2002 (Resumo técnico)*. Lisbon: Direcção Geral das Florestas.

Direcção Geral do Ambiente (coord.) (2001). *Programa Nacional para as Alterações Climáticas. Estudos de Base para a Fundamentação do Programa. Versão 2001 para Discussão Pública*. Lisbon: Direcção-Geral do Ambiente.

Departamento de Ciências e Engenharia do Ambiente - Faculdade de Ciências e Tecnologia – Universidade Nova de Lisboa (2000). *Avaliação das Emissões e Controlo de Gases com Efeito de Estufa em Portugal*.

Instituto da Conservação da Natureza; Centro de Micologia da Universidade de Lisboa; Direcção-Geral das Florestas; Direcção-Geral de Fiscalização e Qualidade Alimentar; Universidade de Trás-os-Montes e Alto Douro; Universidade de Évora; Forestis (2001). *Conservação, Valorização e Comercialização de Cogumelos Silvestres. Relatório*. (mimeo).

Instituto do Ambiente (2002). *Relatório da Consulta Pública do Programa Nacional para as Alterações Climáticas. Versão 2001*. Lisbon: Instituto do Ambiente.

Instituto do Ambiente (coord.) (2003a). *Plano Nacional para as Alterações Climáticas. Síntese. Cenários e Esforço de Redução*. Lisbon: Instituto do Ambiente.

Instituto do Ambiente (coord.) (2003b). *Plano Nacional para as Alterações Climáticas. Volume 8. Floresta e Produtos Florestais. Cenário de Referência.* Lisbon: Instituto do Ambiente.

Instituto do Ambiente (coord.) (2003c). *Programa Nacional para as Alterações Climáticas. Medidas adicionais no sector da Floresta e Indústria de Produtos Florestais para Discussão Pública.* Lisbon: Instituto do Ambiente.

Instituto Nacional da Água (2000). *Planos das bacias hidrográficas dos rios luso-espanhóis - síntese*. Lisbon: INAG. (mimeo)

Instituto Nacional de Estatística (2001). *Agricultura em números*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2002a). *Estatísticas Agrícolas 2001*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2002b). *Estatísticas do Turismo 2002*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2003a). *Recenseamentos Gerais da População e da Habitação. Dados comparativos 1991-2001*. Lisbon: Instituto Nacional de Estatística. (CD-ROM publication).

Instituto Nacional de Estatística (2003b). *Estatísticas Agrícolas 2002*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2003c). *Estatísticas do Turismo 2002*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2003d). *Estatísticas do Ambiente 2001*. Lisbon: Instituto Nacional de Estatística.

Instituto Nacional de Estatística (2003e). *Contas Económicas da Agricultura 2002*. Lisbon: Instituto Nacional de Estatística.

Leite, A.; Martins, L. (2000a). Recursos florestais. In *Florestas de Portugal. Forests of Portugal*. Lisbon: Direcção-Geral das Florestas. pp. 139-143.

Leite, A.; Martins, L. (2000b). Funções produtivas. In *Florestas de Portugal. Forests of Portugal*. Lisbon: Direcção-Geral das Florestas. pp. 157-159.

Loureiro, M. C.; Albiac, J. (1996). *Aplicação da metodologia de valorização contingente para determinação do valor de uso recreativo anual da Reserva Florestal de recreio do Monte Brasil*. (mimeo).

Mendes, Américo M. S. Carvalho (1997). Estimativa do valor económico da floresta portuguesa. In: Puertas Tricas, Fernando; Rivas, Martin (eds.): *I Congreso Forestal Hispano Luso - II Congreso Forestal Español, Pamplona 23-27 de Junio de 1997, Libro de Actas, Tomo VI*. Pamplona: Gobierno de Navarra. pp. 135-140.

Mendes, Américo M. S. Carvalho (2004a). Portugal. In Merlo, Maurizio & Croitoru, Lelia (eds.), *Valuing Mediterranean Forests: Towards Total Economic Value*. Wallingford, Oxon (UK): CAB International (forthcoming).

Mendes, Américo M. S. Carvalho (2004b). *Cost Action E 30. Country Report for the Phase One of the Action. 'State of the Art'. Portugal*. April 2004. (unpublished manuscript delivered to the action coordinators).

Ministério da Administração Interna (2002). *Relatório Anual de Segurança Interna – 2001*. Lisbon: Ministério da Administração Interna.

Ministério da Administração Interna-Gabinete do Ministro (2003). *Livro Branco dos Incêndios Florestais Ocorridos no Verão de 2003*. Lisbon: Ministério da Administração Interna.

Ministério da Agricultura, do Desenvolvimento Rural e das Pescas - Gabinete de Planeamento e Política Agro-Alimentar (2001). *Apoios à Agricultura 2000*. Lisbon: Ministério da Agricultura, do Desenvolvimento Rural e das Pescas.

Moreira, M. B.; Coelho I. S.; Reis, P. S. (1995) *Análise Técnico Económica de Sistemas de Dehesa/Montado. Relatório Final (UE-DGVI-Programa CAMAR: CT90-0028)*. Lisbon: Instituto Superior de Agronomia. (unpublished manuscript).

Moreira, Nuno (1980). *Cultura de forragens e pastagens*. Vila Real: Instituto Universitário de Trás-os-Montes e Alto Douro. (mimeo).

Natividade, J. Vieira (1950). *Subericultura*. Lisbon: Imprensa Nacional.

Oliveira, V. (2004). *Evolução dos produtos tradicionais com nomes protegidos (Produção, Valor da Produção, Índices de Quantidades, Preços e Valores). 1997 a 2001*. Lisbon: Instituto de Desenvolvimento Rural e Hidráulica-Direcção de Serviços de Planeamento-Divisão de Estudos Planeamento e Prospectiva.

Paulino, A. (2000). Preservação de cogumelos corre perigo. *Jornal Expresso*, October 30, 2000.

Pereira, J. Santos; Lima, M. J.; Correia, A. C. (2002). *Quantificação dos Sumidouros Terrestres de Carbono em Portugal Continental*. Lisbon, Instituto Superior de Agronomia, Abril 2002, Documento de Trabalho.

Poeira, M.; Eliseu, J.; Ramalho, J. (1990). Erosão e Gestão do Solo. Reflexões sobre o caso português. *DGF Informação*, Ano 1, N.º 4, pp. 28-33.

Rego, F. (1991). A silvopastorícia na sua relação com os incêndios florestais em Portugal. *Ingenium*, Year VI, N.º 53, September/October 1991, pp. 67-72.

Rocha, J.; Botelho, O.; Maló, T.; Nunes, N.; Monteiro, C. (1986). A floresta e a erosão do solo. In *Comunicações - 1.º Congresso Florestal Nacional, Fundação Calouste Gulbenkian, Lisboa, 2-6 December 1986*. pp. 374-378.

Sá, Fernando Vieira. (1978). *A cabra*. Lisbon: Livraria Clássica Editora.

Santos, J. Lima (1997). *Valuation and cost-benefit analysis of multi-attribute environmental changes. Upland agricultural landscapes in England and Portugal*. Thesis submitted in fulfillment of the degree of Doctor of Philosophy. Department of Town and Country Planning, University of Newcastle upon Tyne. (mimeo).

Sistema de Informação de Cotações de Produtos Florestais na Produção (2003a). *Indicadores de Mercado 2000-2003*. Lisbon: Direcção Geral das Florestas-Divisão de Inventário e Estatísticas Florestais. Leaflet.

Sistema de Informação de Cotações de Produtos Florestais na Produção (2003b). Website: http://cryptomeria.dgf.min-agricultura.pt, updated as of April 12, 2004.

E. Project Partnership

1. Organisations and budgets

Budget par partenaire		
	Nom	*Recettes*
Chef de file	*IEFC*	*404 700,00 €*
Partn. 1	*CRPF*	*242 425,04 €*
Partn. 2	*USSE*	*90 000,00 €*
Partn. 3	*westernforestrycoop*	*235 538,57 €*
Partn. 4	*INRA*	*150 000,00 €*
Partn. 5	*Bordeaux4 - CAPC*	*30 000,00 €*
Partn. 6	*Gestión Ambiental, Viveros y Repoblaciones de Navarra, SA*	*275 478,58 €*
Partn. 7	*FORESNA*	*20 000,00 €*
Partn. 8	*IKT*	*205 074,76 €*
Partn. 9	*NEIKER*	*177 475,42 €*
Partn. 10	*Confederación de Forestalistas del País Vasco*	*20 000,00 €*
Partn. 11	*Universidad del País Vasco*	*33 675,17 €*
Partn. 12	*A.F.C.*	*100 146,21 €*
Partn. 13	*Fundacion general de la Universidad de Valladolid*	*225 275,90 €*
Partn. 14	*FAFCYLE : Federacion Asociaciónes Forestales de Castilla y León*	*24 073,08 €*
Partn. 15	*Confederación Hidrográfica del Duero*	*8 822,63 €*
Partn. 16	*Universitad de santiago - Lugo*	*249 538,58 €*
Partn. 17	*Association Forestière de Galice*	*23 431,06 €*
Partn. 18	*Université Catholique Portugaise*	*156 025,32 €*
Partn. 19	*Institut Supérieur d'Agronomie*	*117 667,35 €*
Partn. 20	*Ecole Supérieure d'Agronomie de Coimbra*	*87 870,42 €*
Partn. 21	*EFN*	*111 670,24 €*
Partn. 22	*Confédération d'Agriculteurs du Portugal*	*7 902,02 €*
Partn. 23	*CELPA*	*36 000,00 €*
Partn. 24	*Xunta Galicia, direccion general de montes*	*54 000,00 €*
		3 086 790,35 €

2. Region and participants

Region	Title	First Name	Name	Organisation
Galicia	M.	Jacobo	Aboal Viñas	Xunta de Galicia - San Lazaro
Portugal Norte	M.	Nuno	Afonso	Universidade Catolica Portuguesa
Galicia	M.	Pedro	Alvarez Alvarez	Universidad de Santiago de Compostella
Galicia	M.	Juan Gabriel	Alvarez Gonzalez	Universidad de Santiago de Compostella
Euskadi	Mme.	Ibone	Amezaga	Université du Pays Basque
Euskadi	Mr.	Asier	Arrese	Nekazal Ikerketa eta Teknologia
Euskadi	Mlle.	Eider	Arrieta	Nekazal Ikerketa eta Teknologia
Euskadi	M.	Martin	Ascacibar Gregorio	Gobierno del Pais Vasco
Aquitaine	M.	Laurent	Augusto	Institut National de la Recherche Agronomique
Euskadi	M.	Josu	Azpitarte	Confederacion de Forestalistas del Pais Vasco
Aquitaine	M.	Mark	Bakker	Institut National de la Recherche Agronomique
Euskadi	Mme.	Yolanda	Barredo	Instituto Vasco de Investigacion y Desarollo Agrario - NEIKER
Euskadi	M.	Oscar	Barreiro Mouriz	Union des Sylviculteurs du Sud de l'Europe

Region	Title	First Name	Name	Organisation
Portugal Centro	Mme.	Sonia	Beito	Escola Superior Agraria de Coimbra
Portugal Norte	M.	João	Bento	Universidade de Tràs os montes e Alto Douro
Aquitaine	M.	Michel	Berges	Université Bordeaux IV
	M.	Henri	Beuffe	
	M.	Armando	Bilbao Sargarduy	
Portugal Centro	Pr.	José Guilherme	Borges	Instituto Superior de Agronomia
Portugal Norte	M.	Herminio	Botelho	Universidade de Tràs os montes e Alto Douro
Castilla y Léon	M.	Felipe	Bravo	Universidad de Valladolid
Cantabria	M.	Aitor	Calleja Uraca	Asociacion Forestal de Cantabria
Castilla y Léon	Mlle.	Yolanda	Calvo	Fundacion General de la Universidad de Valladolid
Portugal Centro	M.	Paulo	Canaveira	Ministerio da Agricultura
Euskadi	M.	Alejandro	Cantero	Nekazal Ikerketa eta Teknologia
Aquitaine	M.	Jean-Michel	Carnus	Institut National de la Recherche Agronomique
Portugal Centro	M.	Pedro	Carvalho	Instituto Superior de Agronomia
Portugal Norte	M.	Américo M. S.	Carvalho Mendes	Universidade Catolica Portuguesa
Aquitaine	Mme.	Amélie	Castro	Centre Régional de la Propriété Forestière Aquitaine
Galicia	M.	José Luis	Chan Rodriguez	Xunta de Galicia - San Lazaro
Aquitaine	M.	Guillaume	Chantre	Association Forêt Cellulose
Aquitaine	M.	Antoine	Colin	Inventaire Forestier National
Madrid	Mlle.	Ana Bélen	Conde Martinez	Universidad Politécnica de Madrid
Ireland	Mme.	Marina	Conway	Western Forestry Co-operative Society Ltd
Euskadi	M.	Nekane	Cortabarria	Instituto Vasco de Investigacion y Desarollo Agrario
Portugal Centro	Mlle.	ana	corticada	Instituto Superior de Agronomia
Portugal Norte	M.	João	Couthino	Universidade de Tràs os montes e Alto Douro
Galicia	Dr	Rafael	Crecente Maseda	Universidad de Santiago de Compostella
Aquitaine	M.	Dominique	D´Antin de Vaillac	Université Bordeaux IV
Galicia	M.	Francisco	Dans del valle	Associacion Forestal de Galicia
Portugal Centro	Mlle.	Suzana	Dias	Instituto Superior de Agronomia
Euskadi	M.	José Ramon	Diez	Nekazal Ikerketa eta Teknologia
Castilla y Léon	Dr.	Julio	Diez Casero	Universidad de Valladolid
Catalogne	Mlle.	Gloria	Dominguez Torrez	Centre Tecnològic Forestal de Catalunya
Aquitaine	M.	Sébastien	Drouineau	Centre Régional de la Propriété Forestière Aquitaine
Navarra	M.	Enrique	Eraso Centelles	Gobierno de Navarra
Portugal Centro	Mme.	Sonia	Faias	Instituto Superior de Agronomia
Ireland	M.	Edward (Ted)	Farrell	University College Dublin - Faculty of Agriculture

Region	Title	First Name	Name	Organisation
Portugal Norte	Mlle.	Diana	Feliciano	Universidade Catolica Portuguesa
Castilla y Léon	Mme.	Mercedes	Fernandez	Universidad de Valladolid
Galicia	Dr.	Francisco	Fernandez de Ana Magan	Centro de Investigacions Florestais e Ambientais de Lourizan
Portugal Norte	Mlle.	Teresa	Fonseca	Universidade de Tràs os montes e Alto Douro
Ireland	M.	Raymond	Gallagher	Western Forestry Co-operative Society Ltd
Euskadi	M.	Pedro José	Garai	Confederacion de Forestalistas del Pais Vasco
Castilla Y Léon	M.	Nati	Gómez Corral	Federacion de Asociaciones Forestales de catilla y Leon
Portugal Norte	M.	Marinho	Gonçalves	Universidade de Tràs os montes e Alto Douro
Euskadi	M.	Ander	Gonzalez Arias	Instituto Vasco de Investigacion y Desarollo Agrario
Ireland	Mlle.	Carly	Green	University College Dublin - Faculty of Agriculture
Euskadi	M.	Juan Andréas	Gutierrez	Nekazal Ikerketa eta Teknologia
Euskadi	M.	Iñaki	Isasi Pérez	Union des Sylviculteurs du Sud de l'Europe
Aquitaine	M.	Hervé	Jactel	Institut National de la Recherche Agronomique
Castilla-Leon	M.	José Carlos	Jimenéz Hernandéz	Confederacion Hidrografica del Duero
	Mme.	lydie	kuus	
Aquitaine	M.	Michel	Lacan	Office National des Forêts - Direction Territoriale Sud-Ouest
	M.	Francisco	Lario Leza	Empresa de Transformacion Agraria
Portugal Centro	M.	Luis	Leal	Associação da Industria Papeleira
Aquitaine	M.	Yves	Lesgourgues	Centre Régional de la Propriété Forestière Aquitaine
Galicia	M.	Tomas	Lesgourgues	Xunta de Galicia - San Lazaro
Aquitaine	M.	Denis	Loustau	Institut National de la Recherche Agronomique
Centre Portugal	M.	João A.	Maciel de Soveral	Confederação dos Agricultores de Portugal
Portugal Centro	M.	Manuel	Madeira	Instituto Superior de Agronomia
Castilla y Léon	M.	Jorge	Martin	Fundacion General de la Universidad de Valladolid
	M.	Marcos	Martin Larrañaga	Cesefor
Euskadi	M.	Inazio	Martinez De Araño	Instituto Vasco de Investigacion y Desarollo Agrario
Portugal Centro	M.	Abel	Martins Rodrigues	Instituto Nacional de Investigação Agraria - Estação Florestal Nacional
Aquitaine	M.	Jean-Louis	Martres	Centre de Productivité et d'Action Forestière
Aquitaine	M.	Jean-Louis	Martres	Centre Régional de la Propriété Forestière Aquitaine
Aquitaine	M.	Jean-Louis	Martres	Conseil Interprofessionnel des Bois d'Aquitaine
Aquitaine	M.	Jean-Louis	Martres	Union des Sylviculteurs du Sud de l'Europe
Aquitaine	M.	Jean-Louis	Martres	Université Bordeaux IV
Aquitaine	M.	Alain	Maurette	GEIE FORESPIR
Aquitaine	M.	Thierry	Mazet	Conseil Régional d'Aquitaine
Galicia	M.	Agustin	Merino	Universidad de Santiago de Compostella
	Mlle.	Sofia	Miranda	

Region	Title	First Name	Name	Organisation
Castilla-Leon	M.	Alfonso Fernandez	Molowny	Confederacion Hidrografica del Duero
	Mme.	Olga	Moro Coco	Cesefor
Portugal Centro	Mr.	Pedro	Ochoa	Instituto Superior de Agronomia
Euskadi	Dr.	Miren	Onaindia	Université du Pays Basque
Aquitaine	M.	Christophe	Orazio	Institut Européen de la Forêt Cultivée
Portugal Centro	M.	Fernando	Pascoa	Escola Superior Agraria de Coimbra
Galicia	M.	Manuel	Pérez	Universidad de Santiago de Compostela, Oficina de Investigacion e Tecnoloxia
Castilla-Leon	M.	Alavaro	Picardo Nieto	Gobierno de Castilla y Leon
Aquitaine	M.	Christian	Pinaudeau	Syndicat des Sylviculteurs du Sud-Ouest
Aquitaine	M.	Christian	Pinaudeau	Union des Sylviculteurs du Sud de l'Europe
Aquitaine	M.	Dominique	Piou	Institut National de la Recherche Agronomique
Navarra	Mlle.	Irantzu	Primicia	Gestion ambiental viveros y repoblaciones de Navarra
Navarra	M.	Fernando	Puertas Tricas	Gobierno de Navarra
Portugal Centro	Prof.	Francisco	Rego	Instituto Superior de Agronomia
Portugal Centro	M.	Edmundo Manuel	Rodrigues de Sousa	Instituto Nacional de Investigação Agraria - Estação Florestal Nacional
Galicia	M.	Roque	Rodriguez Soaillero	Universidad de Santiago de Compostella
Aquitaine	M.	Alain	Rousset	Conseil Régional d'Aquitaine
Cantabria	Doña	Concepcion	Royano Fernandez	Asociacion Forestal de Cantabria
Euskadi	M.	Daniel	Saenz Garcia	Nekazal Ikerketa eta Teknologia
Cantabria	M.	Máximo	Sainz Cobo	Gobierno de Cantabria
Ireland	M.	Gustavo	Saiz	University College Dublin - Faculty of Agriculture
Portugal Centro	M.	Raul	Salas	Escola Superior Agraria de Coimbra
Aquitaine	M.	Jean-Charles	Samalens	Institut National de la Recherche Agronomique
Euskadi	M.	Mikel	San Sebastian	Université du Pays Basque
Portugal Centro	M.	Rui	Silva	Instituto Nacional de Investigação Agraria - Estação Florestal Nacional
Galicia	M.	Fernando	Solla	Universidad de Santiago de Compostella
Aquitaine	M.	Rémi	Teissier du Cros	Inventaire Forestier National
Portugal Centro	Mme.	Margarida	Tomé	Instituto Superior de Agronomia
Navarra	Mme.	Carmen	Traver	Gestion ambiental viveros y repoblaciones de Navarra
Aquitaine	Mme.	Inge	Van Halder	Institut National de la Recherche Agronomique
Galicia	Mme.	Maria Dolores	Vega Fernandez	Universidad de Santiago de Compostella
Aquitaine	Mme.	Françoise	Vernier	Institut de Recherche pour l'Ingénierie de l'Agriculture et de l'Environnement-Bordeaux
Navarra	M.	Juan miguel	Villaroel	Asociacion Forestal de Navarra - Foresna Zurgaia