FORSEE Project
A network of pilot zones to test and improve the indicators of Sustainable Forest Management at the regional level in the European Atlantic Arc

Final Regional Report – *North Portugal*

1st PART: SYNTHESIS

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The foresters from the pulp and paper industries;

The foresters from the technical forest offices of the 6 municipalities of Sousa Valley;

The colleagues from the region Portugal Centre;

The forest owners from Sousa Valley.

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ABBREVIATIONS

AFVS – Associação Florestal do Vale do Sousa (*Portuguese initials*)

DGEEP – Direcção-Geral de Estudos, Estatística e Planeamento (Portuguese initials)

DGRF – Direcção Geral dos Recursos Florestais (*Portuguese initials*)

DRABL – Direcção Regional Agricultura da Beira Litoral (*Portuguese initials*)

DRAEM – Direcção geral de Agricultura do Entre Douro e Minho (*Portuguese initials*)

ESAC – Escola Superior Agrária de Coimbra (*Portuguese initials*)

IDARN – Instituto para o Desenvolvimento Agrícola da Região Norte (*Portuguese initials*)

IEFP – Instituto do Emprego e Formação Profissional (*Portuguese initials*)

ISA – Instituto Superior de Agronomia (*Portuguese initials*)

MCPFE - Ministerial Conference on the Protection of Forests in Europe

SFM – Sustainable Forest Management

UTAD – Universidade de Trás-os-Montes e Alto Douro

ZIF – Zona de Intervenção Florestal (*Portuguese initials*)

ZIF EDS – Zona de Intervenção Florestal de Entre Douro e Sousa (*Portuguese initials*)

INE – Instituto Nacional de Estatística (*Portuguese initials*)

NFI – National Forest Inventory

I The project

1. FORSEE project

FORSEE is a project financed by the European Funds of Regional Development INTERREG IIIB and engages 8 regions from 4 countries of the Atlantic Arc, Portugal, Spain France and Ireland and 10 pilot zones. In Portugal there are two pilot zones, *Vale do Sousa* for North Portugal and *Concelho da Lousã* for Portugal. The coordination of FORSEE project is in charge of IEFC - Institute European of Cultivated Forest (www.iefc.net).

The objectives of this project are to test the indicators of the 6 Criteria of sustainable forest management at sub-regional level in 9 representative sites, to evaluate its the relevance, feasibility and cost, to build a recognized network of experts or organisations and to contribute to the popularity of the indicator concept in the forest areas with the organisations of development. Portuguese Catholic University is the institution which coordinates the site North Portugal being the project developed with the collaboration of *Universidade de Trás-os-Montes e Alto Douro* (UTAD) and *Associação Florestal do Vale do Sousa* (AFVS).

The 6 Criteria of Sustainable Forest Management covered by FORSEE are:
C1 – Carbon sequestration;
C2 – Forest health;
C3 – Forest products;
C4 – Biodiversity;
C5 – Forest soils;
C6 – Maintenance of other socio-economic and cultural functions and conditions of forests.

2. Criteria and Indicators evaluated for North Portugal

To evaluate the indicators of sustainable forest management it was applied the evaluation protocols established by the expert groups, formerly defined in FORSEE project.
The indicators considered and assessed by North Portugal team are:

Criterion 1 – Carbon Sequestration

C1.1 – Forest area
C1.2 – Growing stock

C1.4 – Carbon stock

C1.4.1- Carbon stock in the woody biomass

C1.4.2 – Carbon stock in the soils (common to C5.3.1)

C1.4.3 – Carbon in the dead wood stock

C1.4.4 – Carbon in the litter stock

C1.4.5 – Carbon in the under storey

Criterion 2 – Forest Health

C2.4 – Damages

C2.4a – Key factors for damages

Criterion 3 – Forest Products

C3.1 – Increment and fellings

C3.2 – Roundwood harvested (value and volume)

C3.3 – Non Wood Products

C3.5 – Forest under management plans

C3.6 – Accessibility

C3.7 - Harvestability

Criterion 4 – Biodiversity

C4.1 – Trees species composition

C4.2 – Regeneration

C4.3 – Naturalness

C4.4 – Introduced tree species

C4.5 – Deadwood

Criterion 5 – Forest soils

C5.3.1 – Carbon soil stock and Water holding capacity

C5.3.2 – Nutritive status

Criterion 6 - Maintenance of other socio-economic and cultural functions and conditions of forests

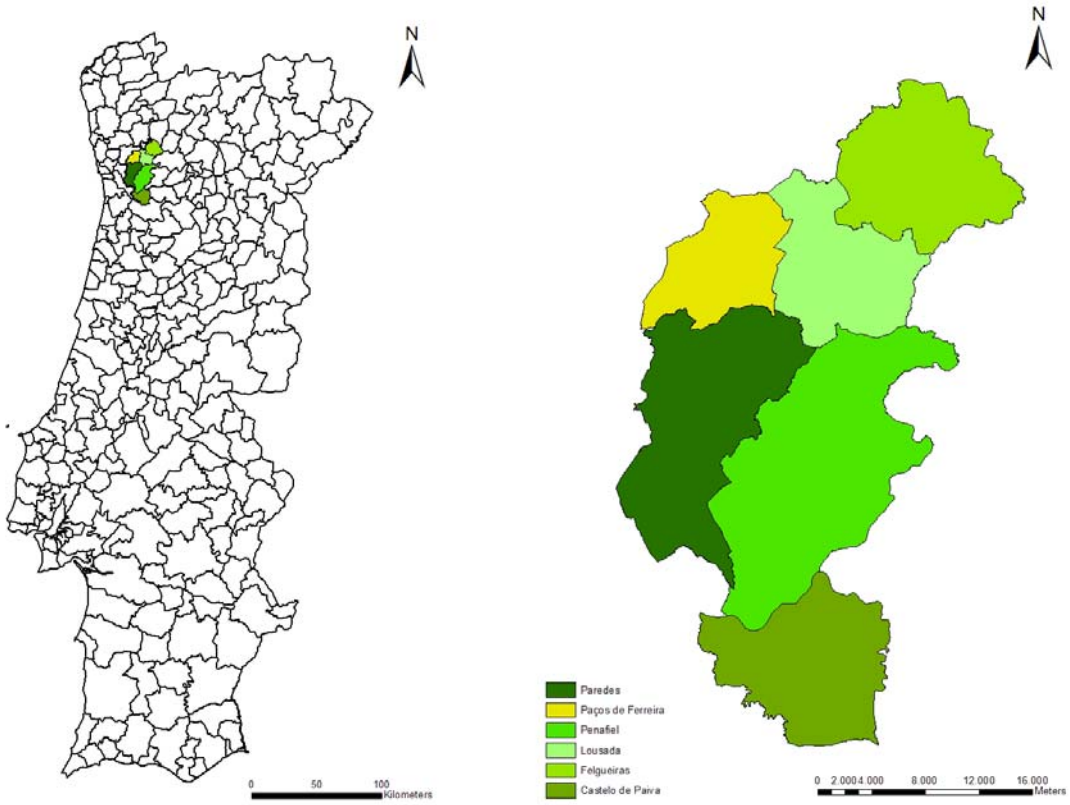
C6.01 – Forest holdings
C6.03 – Net revenue
C6.04 - Expenditure for services
C6.05 – Forest sector workforce
C6.06 – Occupational safety and health
C6.10 – Accessibility for recreation
C6.12 – Total economic value of forest production

3. North Portugal pilot zone

a) Location

The site chosen for pilot zone in North Portugal is the region of Sousa Valley, corresponding to the municipalities of Felgueiras, Lousada, Paços de Ferreira, Paredes, Penafiel and Castelo de Paiva. This region is located at about 40 Km East from Porto and have a total area of 77 620 hectares.
In terms of institutional territory, Sousa Valley belongs to *DRAEM – Direcção Regional de Agricultura de Entre Douro e Minho* (General Direction of Agriculture of Entre Douro e Minho), supervised by the group *Zonas Agrárias de Sousa e Ribadouro* (Agrarian Regions of Sousa and Ribadouro) included in Sousa Valley.

Figure 1: Sousa Valley



b) Ecological characterization of Sousa Valley

According to Ecological Map of Portugal (*Carta Ecológica de Portugal*), worked out by Pina Manique e Albuquerque, the different ecological zones of Portugal and the correspondent trees species are defined concerning 5 poles of ecological differentiation: Atlantic, Thermo-Atlantic, Oro-Atlantic, EuMediterranean and Iberian. In what concerns to this type of classification Sousa Valley is inserted in the following ecological zones:

Region *Basal Atlantica Galaico-Portuguesa* (A.MA)

Altitude: 0 – 400 meters

Clime: The region is under a clime of Atlantic influence (high rainfall, slight winter and meso thermic summer) with some evidences of Mediterranean influence (about 30 %) due to latitude effect that gives a smooth temperature.

Observations: Important region for agriculture;

Location: Covers almost all Sousa Valley;

Forest Species: This region presents good natural conditions for the growing of the coniferous *Pinus pinaster, Pinus radiata* and the broadleaves *Eucalyptus globulus* and *Quercus robur*. Other coniferous with good adaptation here is *Cupressus lusitanica*. Besides the pure stands of the referred species, it can be constituted mixed stands of coniferous and broadleaves (e.g. *Pinus* x *Eucalyptus*) or coniferous and coniferous (*Pinus x Cupressus*). In landscape division broadleaves such as *Salix alba*, *Alnus glutinosa*, *Populus sp*. and *Platanus hybrida* can be planted.

Region *Submontana Subatlântica* (SAxMA)

Altitude: 400 – 700 meters

Clime: The region is under a clime of atlantic influence (medium rainfall, mild winter and dry and macrothermic summer) attenuated by the transition and by the distance from the shores.

Location: represents a small part of the region corresponding to some parishes belonging to the municipalities of Castelo de Paiva, Penafiel, Felgueiras, Paços de Ferreira and Paredes.

Forest Species: The main specie is *Pinus pinaster*. Other species with good adaptation are *Pseudotsuga mensiensii*, *Castanea sativa* (production of nuts and valuable timber) and *Quercus suber*. These species can be used as pure stands or mixed stands of coniferous and broadleaves, coniferous and coniferous or broadleaves and broadleaves. In landscape division broadleaves as *Salix alba*, *Ulmus procera*, *Alnus glutinosa*, *Populus sp*. and *Platanus hybrida* can be planted.

c) Population

From the demographic point of view, Sousa Valley has evidenced high population dynamism during the last two decades, assuming progressively higher relevance in the regional and national context.

Even though the strong rural migration and the decrease of the birth rates, the population has been growing in Sousa Valley since 1940. According to the census published by INE (National Institute of Statistics) the population increased 13% between 1991 and 2001, from 289497 to 327806 inhabitants. Paços de Ferreira (19, 9%), Felgueiras (17, 2%), Lousada (17%) and Paredes (14, 2%) were the municipalities with higher growth rates while Castelo de Paiva (5%) and Penafiel (4, 9%) were the municipalities with lower growth rates.

The municipalities of Penafiel and Paredes represent almost half of the total population of Sousa

Valley (47, 3 %) assuming a role of urban centrality in the region. Their relative proximity of Porto metropolitan area and the good accessibilities could have been contributed to this situation.

As a consequence of the population growth, in 2001, Sousa Valley presented high population density, 427,3 inhabitants/Km^2. The entire North region presented a population density of 171, 8 inhabitants/Km^2.

In the 6 municipalities of Sousa Valley, the most frequent age group is the 25-64 years, followed by the age groups 0-14 years and 65-85 years or above. These elements give evidence about the weight of the working force within the local population.

Table 1: Population in Sousa Valley in 2001

Municipality	Total population	Men	Women
Castelo de Paiva	17338	8534	8804
Felgueiras	57595	28099	29496
Lousada	44712	22088	22624
Paços de Ferreira	52985	26656	26329
Paredes	83376	41310	42066
Penafiel	71800	35471	36329
Total	**327806**	**162158**	**165648**

Source: INE (2001)

d) Forest resources

In 2005, there were 29274, 16 hectares of forest stands in Sousa Valley (IFN, 2005) and the rate of forest cover was 38, 1 %. This rate of forest cover is lower than the rate of forest cover in 1981 (47, 3 %) and the rate of forest cover in 1995 (45, 2 %). The forest holdings in Sousa Valley are essentially private and the forest stands are often divided in small forest holdings usually belonging to several forest owners.

In almost all the municipalities of Sousa Valley, pulp and paper industries own or rent forest stands to plant *Eucalyptus globulus*.

Table 2: Forest area per municipality in 1981, 1995 and 2005

Municipalities	Total area (1)	Forest area in 1981 (2)	% (2/1)	Forest area in 1995 (3)	% (3/1)	Forest area in 2005 (4)	% (4/1)
Castelo de	11468	6114	53,3	7215	62,9	n.a	n.a

Paiva							
Felgueiras	11559	5312	46,0	3894	33,7	n.a	n.a
Lousada	9480	3912	41,3	3886	41,0	n.a	n.a
Paços de Ferreira	7268	3671	50,5	2905	40,0	n.a	n.a
Penafiel	15655	8707	55,6	7130	45,5	n.a	n.a
Paredes	21276	8533	40,1	9638	45,3	n.a	n.a
Total	**76706**	**36249**	**47,3**	**34668**	**45,2**	**29274,16**	**38,1**

Sources:

Forest Area in 1981: Cary, F. (1985). Enquadramento e Perfis do Investimento Agrícola no Continente Português. 1º Volume, Lisboa.

Forest Area in 1995: AreaStat (data not published)

Forest Area in 2005: IFN 2005

The main forest species occurring in Sousa Valley are *Eucalyptus globulus* Labill and *Pinus pinaster* Aiton. The area filled by these species in Sousa Valley in 1981 and in 1995 is presented at the following table:

Table 3: Evolution of the main forest species between 1981 and 1995

Municipalities	***Eucalyptus globulus*** (ha)			***Pinus pinaster*** **(ha)**		
	1981	**1995**	**2005**	**1981**	**1995**	**2005**
Castelo de Paiva	1583	4717	n.a.	4462	1689	n.a.
Felgueiras	381	2084	n.a	4824	698	n.a
Lousada	712	2386	n.a	3180	751	n.a
Paços de Ferreira	662	2144	n.a.	3003	346	n.a.
Penafiel	705	5022	n.a	7987	1875	n.a
Paredes	2426	2795	n.a	6022	2068	n.a
Total	**6469**	**19148**	**17099,5**	**29478**	**7427**	**3449,91**

Sources:

Area of *Eucalyptus globulus* and *Pinus pinaster* in 1981: Cary, F. (1985). *Enquadramento e Perfis do Investimento Agrícola no Continente Português*. 1º Volume. Lisboa.

Area of *Eucalyptus globulus* and *Pinus pinaster* in 1995: AreaStat (non published data)

Table 4: Variation in the area of *Eucalyptus globulus* and *Pinus pinaster* between 1981 and 2005

Eucalyptus globulus **(ha)**	***Pinus pinaster*** **(ha)**

Variation (1981-2005)	Variation (1981-2005)
n.a.	n.a.
n.a	n.a
n.a	n.a
n.a.	n.a.
n.a	n.a
n.a	n.a
10630,5	**-26028,1**

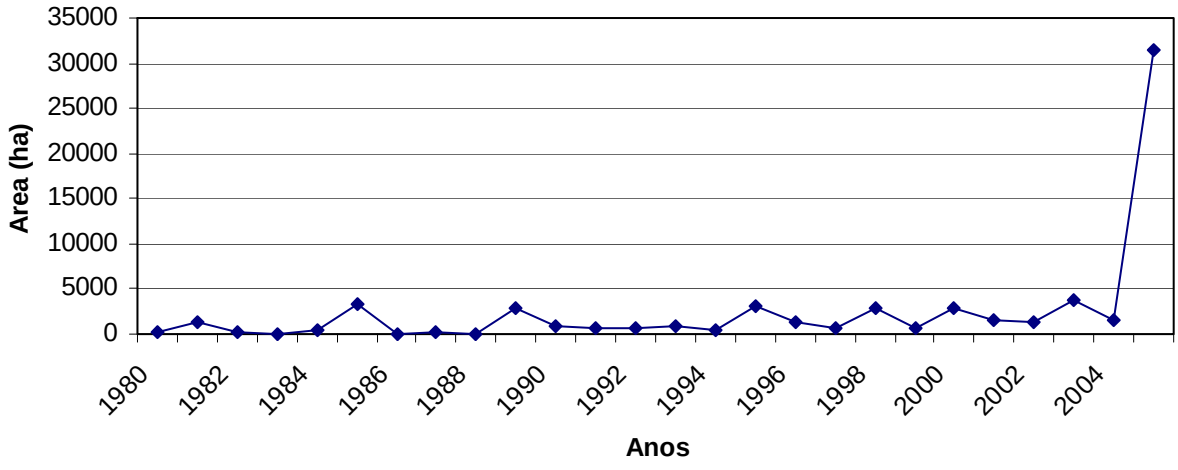
According to the table above, in 24 years the area of *Eucalyptus globulus* increased 10630 hectares and the area of *Pinus pinaster* decreased 26028 hectares. Forest fires are the main reason for the decreasing of the area of *Pinus pinaster* in Sousa Valley.

e) Forest fires

Even though the economic importance of forest and the efforts for associative management forest fires are very frequent in Sousa Valley. This is a consequence of the lack of active management from some forest owners, the negligent behaviours of the inhabitants and the natural risk of forest fires of this region.

According to the following figure the situation has becoming worse in the last years reaching an area of 3000 hectares of forests stands burnt in 2004 which corresponds to about 10,2 % of the total area of forest in 2005.

Graphic 1: Area of forest stands burnt in Sousa Valley between 1980 and 2005



Source: INE (2004). O país em números, Versão 2**,** 2004

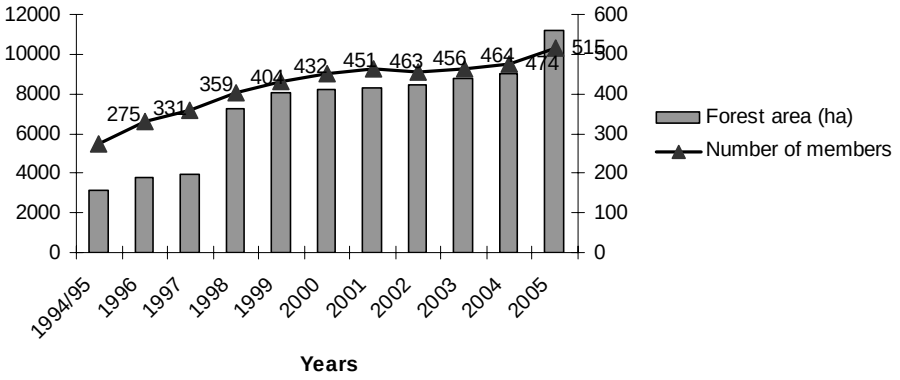
f) Forest Owners' Association of Sousa Valley – AFVS

If well managed and protected from the high risk of forest fires the forest can be a source of income to the forest owners. In 1994 it was implemented the Forest Owners' Association of Sousa Valley (AFVS in Portuguese initials) to support the forest owners of Sousa Valley in the management of their forests. AFVS is a non profit organisation providing services to the forest owners of the 6 municipalities of Sousa Valley and it was the first forest owners' organisation (FOA) at sub-regional level promoted by FORESTIS – *Associação Florestal de Portugal*, a national federation which encloses 26 Forest Owners Organisations in Continental Portugal.

AFVS is implemented in a region where small scale forest holdings are predominant and has been promoting several initiatives in order to aware the forest owners to the active forest management and to the importance of its collective action. In these initiatives AFVS tries to enrol other entities which can give important contributes in the development of the forest sector.

In terms of membership, AFVS admits as members not only forest owners but also whoever desires to become a member. The positive evolution of the number of members has also contributed to the increase of forest area covered by this FOA. In 2005, AFVS had a membership of more than 500 members and covering a forest area of about 11000 hectares. This area represents 32 % of the total forest area of Sousa Valley.

Graphic 2: Evolution of the number of members and area covered by the Forest Owners Association of Sousa Valley



AFVS provides forest services directly to 32 % of the total forest area of the region (in 2005). These services also affect the remaining forest area since the forest services provided in a given area can also have results in the adjacent areas (e.g. forest services held in a forest holding in order to reduce the risk of forest fires can protect also the adjoining areas from that risk).

The forest services provided by AFVS to the forest owners are:

a) Technical advice;

b) Forest works in order to reduce the risk of forest fires;
c) Wood quantification;
d) Preparation of forest management plans;
e) Training actions to the forest owners;
f) Certification of forest products;
g) Information about forest policies;
h) Representation and defence of the collective interests of their members;
i) Information about the best forest practises.

In 2005, AFVS was working with 5 foresters, 2 brigades of forest sappers and two office clerks.

Apart from the forest services provided to the members and to other entities with interests in Sousa Valley forest sector (eg. municipalities/town councils), AFVS has been working with research entities (forest departments of universities UTAD, ISA, ESAC) in the development of R&D projects. The results coming out from these projects are important contributions to increase the knowledge about the social and natural resources of Sousa Valley.

The existence of the local Forest Owners' Organization (AFVS) with 13 years of experience in the field and a with an important knowledge about the natural and social mean together with the exchange information between the AFVS staff and the research team working in FORSEE was fundamental for the development of the project.

g) Previous work in Sustainable Forest Management in Sousa Valley

Pilot Project of Sustainable Forest Management of Sousa Valley[1]

The Pilot Project was developed by the Forest Owners Association of Sousa Valley in partnership with the Forest Department of the High Institute of Agronomy (*Instituto Superior de Agronomia*) between the years 2001 and 2004.
The general objective of this project was to create a base of knowledge to the accomplishment of projects of sustainable forest management, if possible in a collective way.

The specific objectives of the Pilot Project were (1):

1) To identify the resources and forest potentialities in Sousa Valley according to the criteria and indicators of sustainable forest management;

2) To create a digital database about the resources and potentialities to support the future options of forest improvement in forest management;

3) To disseminate the results of the project to the forest owners and to other entities with interests in forest sector in order to aware them to the implementation of a system of sustainable forest management and the grounding for the certification of the forest products in a collective way.

The objectives of this project were framed in the Plan of Activity of AFVS for 1999 proposed by the association's board and were accepted by the members of the General Assembly. With this project the board attempted to meet the objective of planning and organising the sustainable development of the Association through the improvement of the information system about the forest area and the identification of places with best improvement conditions.

The **Pilot Project of Sustainable Forest Management** started after the approval of the Resolution L2, adopted in the 3rd edition of the Ministerial Conference on the Protection of Forests in Europe (MCPFE), in a period where there was little technical work done in this subject and the certification proceedings were very recent.

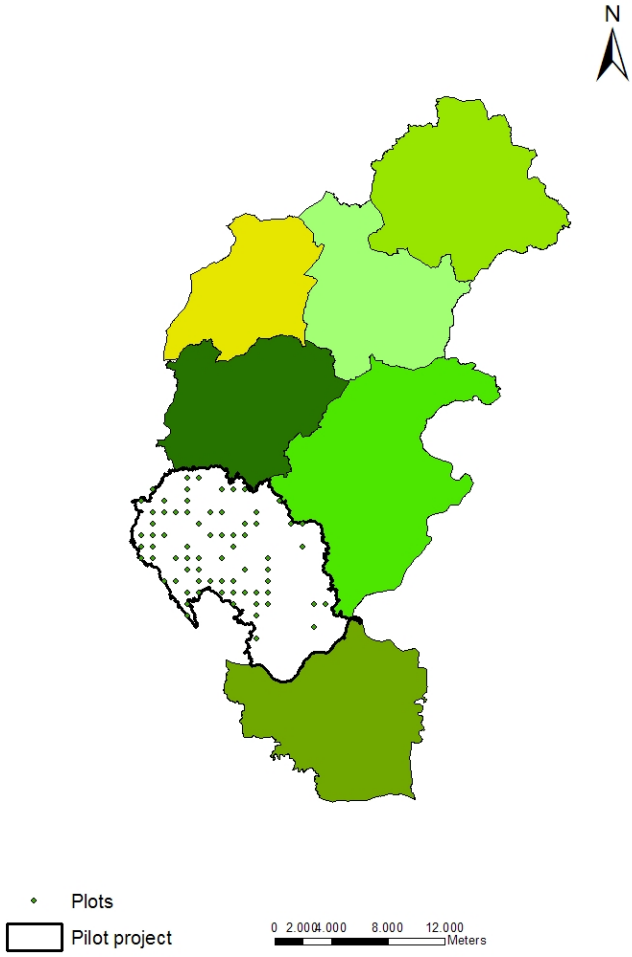
From the list of indicators of sustainable forest management approved in 2002 by the expert groups in meetings held after the MCPFE, AFVS team considered that 30 indicators were important to study at the regional level and from those 30 indicators it chose 18 for a first evaluation under the development of the project.

Given the tasks included in the project and the resources available it was not possible to cover all the 6 municipalities of Sousa Valley. The strategy followed by AFVS team was to consider the municipalities with more forest area and where some experiences in grouped forest management had already been developed. According to these requirements the municipalities chosen were Penafiel, Paredes and Castelo de Paiva. The total area covered by the pilot project was 13228 hectares and 7190 hectares of forest area (IFN, 1995). This forest area represented about 20, 7% of the total forest area of Sousa Valley.

In the area covered by the pilot project it was implemented 109 sample plots distributed by the area of study. These points resulted from a systematic grid with 800 meters spacing, being considered sample plots the ones matching with the class of land use: **Forest**.

[1] *Programa Operacional da Região Norte – Eixo Prioritário 1, Medida 1.4 – Valorização e Promoção Regional Local*

Figure 2: Area of study and sample plots considered by the Pilot Project of SFM in Sousa Valley



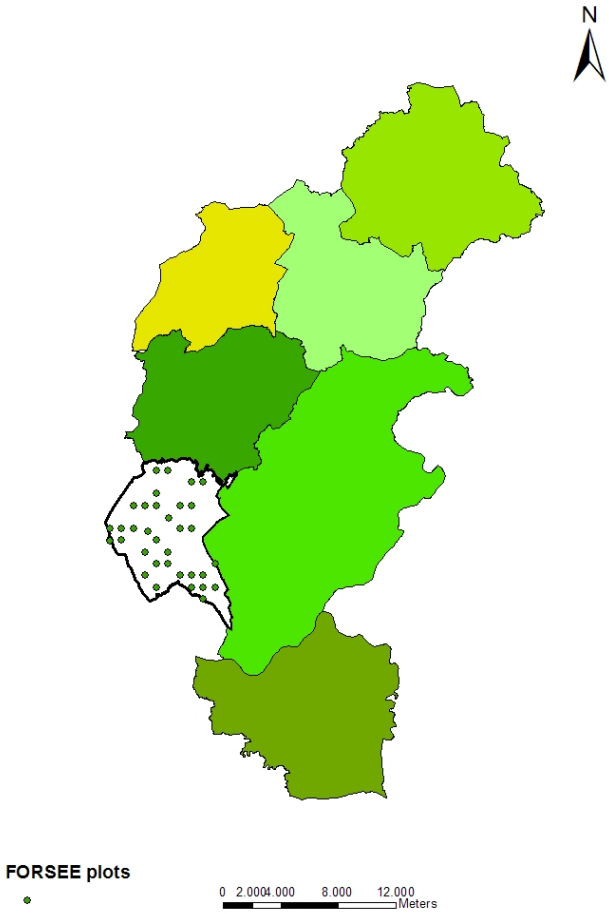
After the development of the **Pilot Project of Sustainable Forest Management** in Sousa Valley, **FORSEE** project was the opportunity to improve the evaluation of the SFM indicators and to evaluate new indicators gaining from the knowledge obtained during the development of the first project.

In addition, **FORSEE** project also benefited from other projects developed by the Forest Owners' Association of Sousa Valley as well as from the knowledge about the social and natural mean, the contacts with the main stakeholders and the information detained about the forest owners provided by its foresters.

h) FORSEE pilot zone and FORSEE plots

Given the 109 plots already implemented and measured under the Pilot Project of Sustainable Forest Management, the FORSEE team decided to take advantage of the location of those plots and the information already collected to keep them in FORSEE project. However, according to the budget available for the region North Portugal the number of plots had to be reduced to 35 plots.

Figure 3: The 35 sample plots considered by FORSEE project



i) Pertinence of FORSEE project in Sousa Valley and the implementation of ZIFs – Zones of Forest Intervention

The announcement of the Law Decree no 127/2005 established in Portugal the Zones of Forest Intervention as well as the rules for its implementation, functioning and extinction. According to the decree the ZIFs have to pursue the following conditions:

1) Being continuous and circumscribed areas constituted mainly by forest lands, submitted to a management plan and to a plan of forest protection;
2) Being managed by one entity;
3) Being constituted by a minimum area of 1000 hectares and including a minimum of 50 forest owners or forest producers and 100 forest holdings.

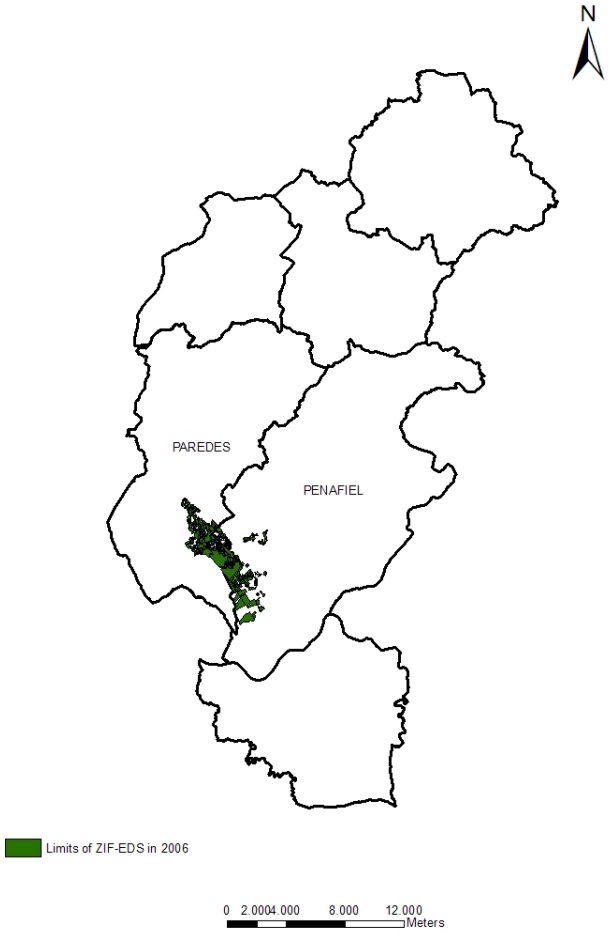
A ZIF is a type of associative management mainly directed to the small scale private forest to protect it against the risk of forest fires and to improve its management in order to benefit the forest owners and the rest of the society. That improvement comes from:

- The recovering of burnt areas;
- The increasing of the production of wood products;
- The forest certification;
- The promotion of non wood forest products;
- The valuation of forest recreation and its cultural values.

In Sousa Valley, AFVS is the entity in charge of the implementation the Zone of Forest Intervention of Entre Douro e Sousa (ZIF EDS) and the Zone of Forest Intervention of Castelo de Paiva. The ZIF EDS covers part of the municipalities of Paredes and Penafiel (7225 hectares) and the ZIF of Castelo de Paiva covers part of the municipality of Castelo de Paiva (7111 hectares).

The assessment of the indicators of Sustainable Forest Management developed under FORSEE project is of great importance for Sousa Valley in the moment of the implementation of the Zones of Forest Intervention. This project constitutes a point of reference to the information systems needed to the forest management and to the certification process of the forest products that will be produced in those areas. This is also important to demonstrate that these zones are achieving the requisites of SFM, with the production of forest externalities that benefit the whole society, justifying the need of public co-financing.

Figure 4: Limits of the Zone of Forest Intervention of Entre Douro e Sousa in 2005



II Legislation and forest policies

NP 4406 - 2003

In order to assure the fulfilment of the requisites of the Systems of Sustainable Forest Management through the accomplishment of the Pan European Criteria of Sustainable Forest Management adopted in the third Ministerial Conference on the Protection of Forests in Europe (MCPFE) it was created the Portuguese Norm 4406 2003 (*Norma Portuguesa*). The Portuguese Norm was published in 1 of April of 2003 by the Portuguese Institute of Quality (*Instituto Português da Qualidade*), and later recognized by the PEFCC – Pan European Forest Certification Council, represented in Portugal by the Portuguese Forest Council (*CFFP – Conselho da Fileira Florestal Portuguesa*).

Given the Portuguese forest reality, it was concluded the necessity of including in the Portuguese Norm of Sustainable Forest Management the requisites of a management system, in this case a System of Sustainable Forest Management.

The system of management is based in the Cycle of Total Quality of Demming – Plan, Do, Check and Act, which constitutes a simple and systematic approach that will permit the compatibility with the international norms of management systems.

The objective of the Portuguese Norm is to promote Sustainable Forest Management, that is, to promote the uses of forest without committing the social, economic and environmental functions of forest. At the same time, when stating the requisites of the system of sustainable forest management, that is, the requisites that can be audited in order to certify that system, the Portuguese Norm allows that the person in charge by the forest unit show to the stakeholders that has implemented a system of sustainable forest management, taking into account the increase of the environmental awareness of society.

This norm does not include absolute requisites of forest performance besides the commitment established by the forest policy of:

1) Continuous improvement;
2) Accomplishment of the Portuguese law;
3) Accomplishment of the applicable rules and other requisites subscribed by the manager of the forest unit;
4) Accomplishment of the Pan- European criteria in order to the sustainable forest management.

The approach adopted by Portuguese Norm was the conception of the System of Sustainable Forest Management; including, since the beginning, the Pan-European criteria and the Pan European guidelines at the operational level to the sustainable forest management.

The Portuguese Norm specify the requisites of a System of Sustainable Forest Management in order to allow that all the entities in charge of a forest management unit can define a forest policy and its objectives taking into account the law and the social, economic and environmental aspects related to forest management.

The Norm can be applied to all the forest management units aiming:

a) The implementation, maintaining and improvement of a system of forest management;
b) To show the conformity in front of the internal forest policy defined;
c) To obtain the certification of the system of forest management by an external entity.

All the requisites defined in this Norm are applicable in all the systems of sustainable forest management. The degree of application of the Norm depends on the forest policy defined by the forest management unit and its nature, structure and conditions.

Not all the indicators considered by the NP 4406 2003 match the indicators chosen by the experts of FORSEE project to be assessed. The following list shows the indicators considered by NP 4406 2003 and from these the ones considered by FORSEE project and the ones assessed by North Portugal team.

The indicators considered by NP 4406 2003 for Criterion 1 are:

a) *Total volume* – Indicator not chosen to be measured within FORSEE project by the expert group;

b) *Structure* - Part of this indicator was chosen to be measured within FORSEE by the expert group: Criterion 4, indicator C4.1 – Trees Species Composition;

c) *Carbon storage* – Indicator chosen to be measured within FORSEE by the expert group. Criterion 1, indicators C1.4.1 – Carbon Stock in the woody biomass, C1.4.2 – Carbon stock in the soils, C1.4.3 – Carbon in the deadwood stock, C1.4.4 – Carbon in the litter stock and C1.4.5 – Carbon in the under storey.

The indicators considered by NP 4406 2003 for Criterion 2 are:

a) *Risk of fire* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 2, indicator C2.4 – Forest damages;

b) *Density of the divisional roads* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 3, indicator C3.6 – Accessibility;

c) *Density of the water points* – Indicator not chosen to be measured within FORSEE project by the expert group;

d) *Defoliation* - Indicator not chosen to be measured within FORSEE project by the expert group;

e) *Nutritional deficiencies* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 2, indicator C2.4.a – Key factors for damages;

f) *Pest and diseases* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 2, indicator C2.4 – Damages.

The indicators considered by NP 4406 2003 for Criterion 3 are:

a) *Main forest production* - Indicator not chosen to be measured within FORSEE project by the expert group;

b) *Productivity of the main forest production* – Indicator chosen to be measured within FORSEE project by the expert group: Criterion 1, indicator C1.2 – Growing stock;

c) *Other productions* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 3, indicator C3.3 – Non wood forest products.

The indicators considered by NP 4406 2003 for Criterion 4 are:

a) *Vegetal diversity* - Indicator not chosen to be measured within FORSEE project by the expert group;
b) *Relevant natural and semi-natural vegetal species* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 4, indicator C4.3 - Naturalness;
c) *Old and cavernous trees* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 4, indicator C4.5 – Deadwood.

The indicators considered by NP 4406 2003 for Criterion 5 are:

a) *Erosion evidences* – Indicator chosen to be measured within FORSEE project by the expert group. Criterion 5, indicator C5.4.1 - Soil disturbance: % of soil in non forest area;

b) *Water quality* - Indicator not chosen to be measured within FORSEE project by the expert group.

The indicators considered by NP 4406 2003 for Criterion 5 are:

a) *Forest investment and costs of forest operations* - Indicator not chosen to be measured within FORSEE project by the expert group;

b) *Revenues* - Indicator chosen to be measured within FORSEE project by the expert group: Criterion 6, indicator C6.03 – Net revenue.

c) Volume and employment qualification: Indicator chosen to be measured within FORSEE project

by the expert group. Criterion 6, indicator C6.06 – Occupational accidents.

d) Occupational accidents: Indicator chosen to be measured within FORSEE project by the expert group. Criterion 6, indicator C6.10 – Accessibility for recreation.

e) *Conservation of places with cultural value*: Indicator not chosen to be measured within FORSEE project by the expert group.

Certification institutions in Portugal

Associação Portuguesa de Certificação

Edifício Serviços Exponor, 2º andar,

Av. Dr. António Macedo

4450-617 Leça Palmeira

Website: www.apcer.pt

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Phone: 00351 229 993 600

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Conselho da Fileira Florestal Portuguesa (**CFFP/PEFC Portugal**)

Rua Marquês Sá da Bandeira, N.º 74, 2.º

1069-076 Lisboa

Website: www.pefc-portugal.cffp.pt

E-mail: cffp@cffp.pt

Phone: 00351 217611521

Fax: 00351 217611529

Portugal Forest Stewardship Council

Person in charge: Vera Santos

Apartado 128

2776-902 Carcavelos

Website: www.fscportugal.org

E-mail: verafsantos@netcabo.pt

Mobile: 00351 914 612 536

Problématique indicateurs et spécificité régionale (Institutions, certification, politique régionales,

….)

III Tested indicators

1. Direct costs of the indicators estimated in the pilot zone of Sousa Valley

Table 5: List of indicators evaluated on the pilot zone for the Criterion 1 and 2 and their direct costs

FORSEE Indicator Code	Title	Scale	Year	Cost (€)	Unit cost (€/ha[2])
C1.1	Forest Area	South of Paredes	1990 and 1995	5675	1,15
C1.2	Growing stock	South of Paredes	2005	1227,3	0,25
C1.4.1	Carbon stock in the woody biomass	South of Paredes	2005	1227,3	0,25
C1.4.3	Carbon in the dead wood stock	South of Paredes	2005	2061,8	0,42
C1.4.4	Carbon in the litter stock	South of Paredes	2005	1707,3	0,34
C1.4.5	Carbon in the under storey	South of Paredes	2005	1707,3	0,34
C2.4.1	Damages	South of Paredes	2005	2068,5	0,42
C2.4.2	Key factors for damages	South of Paredes	2005	2068,5	0,42
C2.4.3	Area of shrubs and forest burnt in forest fires	Sousa Valley	1980-2005	20	0

[2] Per hectare of forest.

Table 6: List if indicators evaluated on the pilot zone for the Criterion 3, 4, 5 and 6 and their direct costs

FORSEE Indicator Code	Title	Scale	Year	Cost (€)	Unit cost (€/ha[3])
C3.1	Increment and fellings	South of Paredes	2002-2005	1227,3	0,25
C3.2	Roundwood harvested	Pilot zone	2005	519,4	0,02
C3.3	Non wood products	Pilot zone	2005	120,6	0,004
C3.5	Forest under management plans	Pilot zone	2005	255,6	0,009
C3.6	Accessibility	South of Paredes	1995	120	0,024
C3.7	Harvestibility	South of Paredes	1995	2433	0,49
C4.1	Tree species composition	South of Paredes	1995	27	0
C4.2 (C4.2.1)	Regeneration (Plantation)	South of Paredes	1995	27	0
C4.3	Naturlaness	South of Paredes	1995	27	0
C4.4	Introduced tree species	Pilot zone	2005	27	0
C4.5	Deadwood	South of Paredes	2005	1820,5	0,37
C5.3.1	Carbon soil stock and water holding capacity	South of Paredes	2005	1300,8	0,26
C5.3.2	Nutritive status/total depth-water table depth	South of Paredes	2005	1300,8	0,26
C6.01	Forest holdings	Penafiel	2005	859,9	0,15
C6.03	Net revenue	Pilot zone	2005	171,3	0,006
C6.04	Expenditure for services	Pilot zone	2005	176,2	0,006
C6.05	Forest sector workforce	Pilot zone	2003	784	0,03
C6.06	Occupational safety and health	Pilot zone	2005	280,6	0,01
C6.10	Accessibility for recreation	Pilot zone	2005	266,2	0,009
C6.12	Total economic value of forest production	Pilot zone	2005	681,9	0,02

[3] Per hectare of forest

2. Results per indicator

a) Criterion 1: Carbon sequestration

General consideration about this criterion

Global concerns about the increase of atmospheric concentrations of greenhouse gases, mainly carbon dioxide (CO2) and the possible consequences of future climate changes have been aroused the interest of researchers to understand and quantify the role of earth ecosystems in the global carbon cycle. Natural and cultivated vegetation plays an important role in the terrestrial carbon cycle. All countries that signed the Kyoto protocol have agreed on the extreme importance of reducing the emissions of greenhouse gases. Forests are assumed to play an important role in climatic change at the global scale, because they are important carbon sinks. It has been suggested the plantation of forest specifically for carbon sequestration in order to mitigate its future increase in atmospheric. Climate change has increased human concerns and future scenarios and implementation of mitigation measures. In this context an accurate evaluation of the carbon sequestered by forest ecosystems is a key issue.

Without an accurate knowledge about the stocks of carbon in the forests of the North of Portugal, this study on Criterion 1 aims:

1. To test the indicators proposed by the expert group, using traditional and/or specific inventory methodologies;
2. To analyse the derived estimates and to compare estimates from different methodologies;
3. To identify the advantages and disadvantages of the methods used.

The study area for the indicators of Criterion 1 is the Southern part of the municipality Paredes, one of the six municipalities of Sousa Valley and includes pure stands of *Eucalyptus globulus* Labill, pure stands of *Pinus pinaster* Aiton and also mixed stands of *Pinus pinaster* and *Eucalyptus globulus*.

Results obtained for the indicators of Criterion 1

Indicator 1.1 : Forest area

Total forest area in Sousa Valley (1995): 34 668 ha

Forest area mapped (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %

Costs

TOTAL COST: 5675€

Costs/ha: 1,14 €

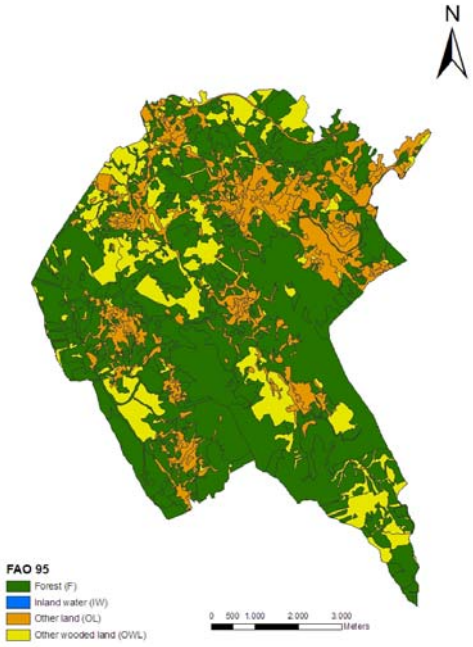
The total cost includes :

1- Data collection 5000 €

2- Data analysis 675 €

Results

Forest area in 1995, mapped according to FAO land use classification



Comparison of the forest area mapped according to the FAO and NFI land use classification in 1990 and 1995

FAO (FRA 2005) class	1990 Area (ha)	1995 Area (ha)	Portuguese NFI Class	1990 Area (ha)	1995 Area (ha)
Forest (F)	3042,173	4956,076	Forest (FL)	3042,173	4956,076
Other Wooded Land (OWL)	1831,94	1871,784	Uncultivated (IC)	1831,94	1871,784
Other Land (OL)	1162,104	1340,92	Agricultural (AG)	886,074	900,210
			Social (SC)	274,39	413,410
			Unproductive (IP)	1,64	27,3
Total	**6036,217**	**8168,78**	**Total**	**6036,217**	**8168,78**

Data sources :

1990: COS 90, produced by IGP, Portuguese Geographic Institute (*Instituto Geográfico Português*), through the interpretation of aerial photographs 1:15 000, taken in August of 1990 and August of 1991. (http://snig.igeo.pt/cgibin/snig/Igd/importacao.cgi?cod=C471; 10 April, 2007)

1995: Aerial photograph 1:40 000, ortorectified. Photo interpretation done by AFVS staff.

Remarks

Comparing the FAO and the Portuguese NFI classification the similarities and the differences are the following:

a) Similarities:

- "Forest": the same concept in both;
- "Other wooded land" in FAO the same as "uncultivated land" in Portuguese NFI.

b) Differences:

- "Other land": in FAO classification is disaggregated in three classes of Portuguese NFI: "Agricultural land", "Social land" and "Unproductive land".

For the mapped area, the table above shows that forest area increased between 1990 and 1995.

Even though there is yet no mapping available for the 2005 NFI, the preliminary results already announced by the Forest Services show a decrease of forest area between 1995 and 2005 in the Sousa Valley.

There are methodological differences between COS 90 and the photo interpretation of the 1995 NFI. These differences refer to the minimum geographical area considered as "Forest":

a) COS 90: minimum surface of 0,2 ha and a minimum width of 15 m;
b) NFI 1995 photo interpretation: minimum surface of 0,5 ha and a minimum width of 20 m.

The FORSEE team attempted to do a simple correction on the data for these differences. These corrected data are reported in the table. The cost of those corrections is included in the cost of map analysis.

Problems and improvements

It was proposed to analyze the land use evolution at the pilot zone over the years 1990, 1995 and 2005 according to FAO definitions. The objective was to identify the new forest areas and the reforested areas taking into account the area that would be considered by Kyoto protocol for carbon stock change estimation. Another objective would be to predict future carbon stocks under alternative land use and management by the construction of different scenarios.
However, it would be necessary to have the land use classes and area for 1990, obtained through the interpretation of the aerial photograph of 1990, the land use classes and area for 1995 obtained through the interpretation of the aerial photograph of 1995 and the land use classes and area for 2005 obtained through the interpretation of the aerial photograph for 2005, all done with the same parameters. The aerial photograph of the 2005 NFI are not available yet. For 1990 what should have been done was the photo interpretation of the aerial photographs ordered by ACEL in 1990. ACEL was the Association of the Enterprises Producers of Cellulose's Pulp (*Associação das Empresas Produtoras de Pasta de Celulose*) that together with FAPEL, Portuguese Association of Paper and Cardboard Producers (*Associação Portuguesa de Fabricantes de Papel e Cartão*) formed CELPA, the Association of Paper Industry (*Associação da Indústria Papeleira*), in 1993. The aerial photographs covering the 6 municipalities of Sousa Valley were lost, or at least, they could not be found by the institution which was supposed to keep them. Therefore, the project team had to rely on the COS 90 which is a map of land use done by IGP, Portuguese Geographic Institute (*Instituto Geográfico Português*) based on photos taken in August of 1990 and August of 1991.The shortcomings of this approach is that there, the methodology used for COS 90 is not the best one for forest inventory purposes.
Another shortcoming is that this indicator does not cover the whole pilot zone. The territory covered is part of the area for which the photo interpretation of the 1995 NFI was already done by AFVS staff. From this area, one mapped here the one where the 35 plots measured under FORSEE project to evaluate C1 and C2 indicators were implemented.
So, the main stumbling block concerning the implementation of this indicator in the pilot zone is not so much the changes in methodologies and the reconciliation of the Portuguese NFI and the FAO classifications but the timely availability of the primary data that is needed here, that is the aerial photographs. So, if improvements can be made for this indicator, they should be done primarily to make those maps easily available.

Comments and conclusions

The relevance of this indicator for sustainable forest management is obvious. The fact that forest area increased from 1990 to 1995 and decreased from 1995 to 2005 shows that this indicator should be monitored very closely and in a time frame shorter that the one used for NFI. This reinforces the recommendation for improving the timely availability of aerial photographs. Capacity for their photo interpretation is available at the local level.
Forest area is not considered by the Criterion 1 of the Portuguese Norm 4406 2003.

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Indicator 1.2: Growing stock

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 1227,3 €

Costs/ha: 0,24 €
Costs/plot: 35 €

The total cost includes:

1- Data collection: 959 €

2- Data analysis: 268,3 €

Results

Growing stock in the South of Paredes in 2005

Strata	Area (ha)	Average (m^3ha^{-1})	Standard deviation (m^3ha^{-1})	n	V_T (m^3)
Eucalyptus globulus	1801.0	126.8	50.4	23	**228422**
Pinus pinaster	269.4	103.4	57.7	4	**27853**
Mixed	1314.5	137.1	98.1	8	**180187**
Total	3384.9			35	**436462**

Sources: UTAD estimates

Error assessment (for a confidence level of 95%)

Strata	V_T (m^3)	Sampling Error (m^3)	Sampling Error (%)
Eucalyptus globulus	228422	39229	**17.2**
Pinus pinaster	27853	24706	**88.7**
Mixed	180187	107819	**59.8**
Total	436462	111343	**25.5**

Sources: UTAD estimates

(**Note**: not all the numbers represent significant figures)

Remarks

The Portuguese National Forest Inventory definition of growing stock differ in some aspects from FAO definition:

a) FAO (FRA 2005 guidebook) defines growing stock as the volume (m^3) over bark of all living trees. FAO also requires information on the national thresholds and the part of the trees that are included in the volume.
b) Portuguese IFN (1995) defines growing stock as the living component of the existing volume.

Growing stock calculated by North Portugal team **refers to the total volume of the stem over bark of all living trees of the main species with a minimum height of 1.30 m.**
Commercial growing stock was not calculated.
Data to evaluate growing stock was obtained through the inventory measurements in 35 plots implemented in half of the municipality of Paredes. The volume of the trees belonging to species that only appears once or twice in the plots (like *Quercus* sp.), were not included in the calculations. The result for the overall growing stock considering all species together is 438105 ±111691 m^3.
Total volumes were obtained using stratified systematic sampling formulas. Results show that it would be needed a higher sampling intensity to obtain a reliable estimation of the growing stock, especially for pine stands and mixed stands of pine and eucalyptus.

Problems and improvements

Results show that the traditional sampling intensity and sampling scheme applied in the region by the local FOA - plot layout of 800 × 800 m- might not be the best to obtain estimations of the total growing stock in the pilot zone with an acceptable sampling error. It is not expected to obtain better results with the Portuguese NFI plot layout since it uses a wider distance between the inventory plots.
Other reason for the high sampling errors is the heterogeneous dimensional distribution of pine stands and mixed stands existing in the coast of North Portugal.
To improve the reliability of data for this indicator in the pilot zone, one suggests the replacement of the actual stratified systematic sampling scheme by a Neyman allocation and the increase of sampling efforts. Neyman allocation takes into account differences in stratum variability (see the difference in standard deviations values of volume for pure and mixed stands) as well as stratum size in sample allocation (not necessarily taken into account with a systematic layout as shows the results of the first table). Besides, this optimal allocation can be adjusted to take in account costs for different stratum sampling.

Comments and conclusion

The assessment of this criterion is already well documented by the forest scientific community. However, the assessment under FORSEE project, which covered different regions of 4 countries and different forest types, pointed out some interesting issues that might be important to remain. From North Portugal case study, with pure and mixed forests, one underline the following points:

a) Growing stock definition is not the same across all the regions (e.g. total/commercial volume under/over bark; minimum dimension of the trees);
b) There must be put efforts in the inclusion of the volume of the trees belonging to species that are rare in the plots (*Quercus* sp.) in the growing stock results;
c) Reliable information on growing stock requires reliable sampling data.

Growing stock is not considered by Criterion 1 of Portuguese Norm 4406 2003.

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Indicator 1.4.1: Carbon stock in the woody biomass

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 1227,3 €

Costs/ha: 0,24 €
Costs/plot: 35 €

The total cost includes:

1- Data collection: 959 €

2- Data analysis: 268,3 €

Results

Method 1: Biomass equations (Fabião, 1986; Lopes, 2005)

	n	Biomass (ton.ha^{-1})	SE %
Eucalyptus globulus	23	81,3	19
Pinus pinaster	4	55,5	87
Mixed	8	98,7	84
Weighted mean		**86**	**37**
	Total	**291 000 ton**	

Sources: Fabião, 1986; Lopes, 2005.

Method 2: Conversion and expansion factors

	n	Biomass (ton.ha$^{-1)}$	SE %
Eucalyptus globulus 0,70	23	88,8	17
Pinus pinaster 0,54	4	56	89
Mixed	8	83,5	63
Weighted mean		**84**	**25**
	Total	**285 000 ton**	

Sources: UTAD

Sistematic grid, n = 35 plots

Remarks

The Portuguese Institute of Environment (*Instituto do Ambiente*) gives 0,70 and 0,78 as the conversion and expansion factors that should be used to esteem the aboveground dry biomass from stem volume in *Eucalyptus globulus* and *Pinus pinaster*, respectively. The value found by UTAD researchers for *Pinus pinaster* is different (0,54 instead of 0,78). One suggests the use of 0,54 for the pine species since one considers it more reliable.

Problems and improvements

Method 1 can have problems if applied for all the existing species because there are no models for non representative species found in the plots of the pilot zone (e.g. *Quercus* species).

Method 2 has more problems. In short, the following can be pointed out:

a) Not all the tested procedures to estimate biomass from volume are general enough.
A new proposal that considers "mixed" and "pure" stands with woody biomass from other species is presented at the FORSEE REPORT, PART 2: MATERIAL AND METHODS.

b) Reliable conversion and expansion factors, ρ and E, are needed, since they are not constant values (a deep study is being developed at the University of Trás-os-Montes e Alto Douro for *Pinus pinaster*).

c) Estimation smoothing allows a narrower confidence interval (but that does not imply a higher accuracy).

d) A clear definition of what is being "converted" and what is being "expanded" should be clearly stated in all studies for comparison of the results.

It should be given more attention to the underground component of biomass either for data collection or for the development of models.

Comments and conclusion

The use of individual tree allometric biomass equations with raw forest inventory data is an expedite process to estimate woody biomass. It is easier to process data and the process is compatible with forest inventories at local, regional or national level. The main inconvenience is that it requires the availability of "good" models for all the forest species existing at the forest plots.

The estimation of biomass from volume is a low-cost alternative for tree biomass equations. When tree inventory data is missing, it could be the only method that foresters and ecologists have to get an estimation of woody biomass. Nevertheless, its "friendly use" might not be a reliable alternative as current users may think. Therefore, the results should be analysed carefully. Further studies on this subject should be developed.

Carbon stock is one of the indicators of Criterion 1 considered by NP 4406 2003. NP 4406 2003 considers that one of the main functions in the forest ecosystems is the capacity of being a carbon sink. The increase of volume of the forest stands has positive consequences in the behaviour of this indicator though the effectiveness of this function is strongly limited by the use given to the products extracted from the forest.

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Indicator 1.4.3: Carbon stock in the dead wood stock

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 2061,8 €

Costs/ha: 0,41 €
Costs/plot: 58,9 €

The total cost includes:

1- Data collection: 1793,5 €

2- Data analysis: 268,3 €

Results

Volume and biomass of logs and snags found in the 35 FORSEE devices

Type of deadwood	Average volume of deadwood in the 11 devices (m^3 ha^{-1})	Average dry matter in the 11 devices (ton ha^{-1})
Logs	1,5 – 25,37	0,53 – 9,99
Snags	0,44 – 9,23	0,74 – 4,453

Sources : UTAD estimates

***1 device:** 4 plots (1 IFN+3 satellites) and 2 transepts (T1, T2).

Remarks

The table above shows the average volume and average dry matter for:

a) **Logs found in 11 devices - transepts T1 and T2;**
b) **Snags found in the 8 devices - IFN plots + satellites.**

For the 11 devices where ***logs*** were found, the total volume is **between 1,5 and 25,37 $m^3.ha^{-1}$** and the total dry matter between **0,53 and 9,99 ton. ha^{-1}.**
For the 8 devices where ***snags*** were found the total volume was **between 0,44 and 9,23 $m^3.ha^{-1}$** and the total dry matter was between **0,74 and 4,453 ton.ha^{-1}.**

Logs with a diameter ≥ 7,5 cm were found in 32% of the FORSEE devices. The average values and standard deviation reported in the table above do not take into account devices where was found logs with a diameter < 7, 5 cm.

Snags were found in 23% of the FORSEE devices.

Problems and improvements

The method of the line intercept is already well documented in forest and ecology literature. The main problems detected during the evaluation of this criterion were:

a) The transepts length (50 m) is too big for the size of the forest holdings in Sousa Valley. The small dimension of forest holdings and its fragmentation makes the transept cross different types of stands and sometimes different types of land use;
b) The classification of the decomposition status;
c) The conversion of volume in biomass using wood density values.

Further studies about density values of decayed wood are required. The values used by North Portugal, applied for *Pinus pinaster* and *Eucalyptus globulus*, are justly empirical being a percentage of an average density of the specific value of the species.

Comments and conclusion

The methodologies to estimate this indicator deserve further attention. They should be modified in order to be easily applied and to incorporate the complete assessment of logs. It would be of great interest the establishment of a working group of researchers on fuel inventory to define the best methods.

Carbon stock is one of the indicators of Criterion 1 considered by NP 4406 2003. NP 4406 2003 considers that one of the main functions in the forest ecosystems is the capacity of being a carbon sink. The increase of volume of the forest stands has positive consequences in the behaviour of this indicator though the effectiveness of this function is strongly limited by the use given to the products extracted from the forest.

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Indicator 1.4.4: Carbon stock in the litter stock

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 1707,3 €

Costs/ha: 0,34 €
Costs/plot: 48,8 €

The total cost includes:

1- Data collection
959 €

2- Data analysis
748,3 €

Results

Dry matter in the litter stock

	Dry matter (ton.ha^{-1}) per litter layer		
Plot ID	**L**	**F**	**L+F**
24	2,03	5,80	7,82
25	3,78	2,47	6,25
64	4,46	8,10	12,57
105	6,43	3,37	9,79
120	5,28	3,26	8,54
126	2,08	12,06	14,13
127	6,87	6,89	13,76
140	3,78	4,19	7,97
165	4,67	1,12	5,79
184	6,45	5,39	11,84
185	2,59	1,56	4,15
189	2,92	2,10	5,02
206	2,00	3,20	5,20
207	3,33	1,84	5,18
208	5,27	5,33	10,60
225	4,63	4,86	9,50
228	5,27	0,94	6,20
229	7,74	6,87	14,61
248	3,58	2,25	5,82
Average	**4,38**	**4,29**	**8,67**
Standard deviation	1,71	2,82	3,41
SE	0,83	1,36	1,64
SE %	**19**	**32**	**19**

Sources : UTAD estimates

Remarks

Litter stock was evaluated in subplots of 25 × 25 cm (one per plot) implemented inside the IFN plot.

Dry matter in the litter stock was measured only in eucalyptus stands.

Dry matter was not converted in carbon because the litter stock was in decomposition and is not adequate to use values of carbon of non decomposed material.

2- Data analysis :	

Problems and improvements

According to the Portuguese field manual (adapted from the *guideterrain.V16.en.v2* from 12/07/2005), litter depth should be taken in 16 points (in 4 corners per 4 squared subplots). North Portugal team decided to reduce the number of the sample to 4 points. Comparative studies should be accomplished in order to assess the ratio precision versus the time spent (and associated costs) of having a different number of samples.
A "hidden" problem that could affect the estimates is the moment of data collection. In order to get reliable values, samples should be taken immediately after the delimitation of the subplot. The collection of litter before the collection other inventory parameters (e.g. trees measurements and soil sampling) does not seem a reliable method because the litter becomes compacted during the movements of the collectors across the plot.

Comments and conclusion

This criterion is easy to evaluate. In order to reduce laboratorial work, litter dry mass could be evaluated with litter models using the height of the layers as explanatory variable. UTAD researchers in forest fires have studies and results on this subject.

<u>Carbon stock</u> is one of the indicators of Criterion 1 considered by NP 4406 2003. NP 4406 2003 considers that one of the main functions in the forest ecosystems is the capacity of being a carbon sink. The increase of volume of the forest stands has positive consequences in the behaviour of this indicator though the effectiveness of this function is strongly limited by the use given to the products extracted from the forest.

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Indicator 1.4.5: Carbon stock in the under storey

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 1707,3 €

Costs/ha: 0,34 €
Costs/plot: 48,8 €

The total cost includes:

1- Data collection
959 €

2- Data analysis
748,3 €

Results

Dry matter and carbon content for shrubs component

Plot Number	Dry mass (ton.ha^{-1})	Carbon (ton.ha^{-1})
24	1,99	1,10
25	6,02	2,96
47	4,14	2,17
48	1,91	0,96
64	4,01	2,28
82	2,22	1,28
83	4,87	2,80
87	5,57	3,18
105	3,11	1,79
120	2,38	1,31
127	1,99	1,10
140	3,47	1,91
144	2,59	1,50
165	2,91	1,49
185	0,95	0,50
189	1,02	0,57
203	20,66	11,83
206	3,88	2,13
207	0,69	0,38
208	1,64	0,90
224	1,16	0,59
225	0,20	0,12
227	2,36	1,21
228	0,44	0,26
229	2,97	1,70
248	9,25	4,56
Mean	**3,55**	**1,94**
Standard deviation	4,02	2,26
SE (%)	**46**	**47**

Sources : UTAD estimates

Remarks

Dry matter was not quantified directly in all the 35 FORSEE devices. In some cases dry matter could be estimated indirectly from the covering percentage. Calculations were done using the provisional model specifically developed by T. Fonseca for this study:

Shrubs dry mass = 0.4305+0.04337 *% Cover_Acum*

Problems and improvements

The evaluation of this indicator is difficult because it requires some caution during data collection and data laboratorial treatment.
The evaluation of this indicator may require more people in the field team than usual.
In order to monitor easily the assessment of this indicator, it might be useful the development of predictive models which can be used to calculate indirectly the weight from the cover.

Comments and conclusion

Evaluation of this criterion is not common when doing forest inventory and might increase considerably the amount of data collected and data analysis. It is suggested to undertake indirect evaluation procedures.
The recommendations of the researchers in fuel inventory can be of great interest to help the establishment of the best procedure to sample this component.

<u>Carbon stock</u> is one of the indicators of Criterion 1 considered by NP 4406 2003. NP 4406 2003 considers that one of the main functions in the forest ecosystems is the capacity of being a carbon sink. The increase of volume of the forest stands has positive consequences in the behaviour of this indicator though the effectiveness of this function is strongly limited by the use given to the products extracted from the forest.

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b) Criterion 2: Forest health

General consideration about this criterion

In Portugal forests are facing important challenges centred on the sustainability of forestry models, on the assurance of a continuous provision of environmental and social services and on the maintenance and increasing of the production of wood and non wood forest products. However, the long term nature of forests and their exposure to biotic and abiotic risks, such as plagues, diseases, fires and storms, call the attention to the complexity of forest management and to the uncertainties that affect forest owners. It is therefore essential to reduce to the minimum extent, the negative influences resulting from anthropological actions and to provide healthy forest ecosystems (in terms of vitality and adaptability) that assure their perpetuity.

To prove that a forest is being managed in a sustainable way, it is important and essential to evaluate the health condition of forest stands and to identify the agents causing health problems as well as to quantify them.

The autochthonous species in Portuguese forest includes *Pinus pinaster*, *Pinus pinea*, *Quercus suber*, *Quercus ilex*, other *Quercus* sp. and *Castanea sativa*. Exotic species include *Eucalyptus globulus*, *Pseudotsuga menziesii*, *Pinus sylvestris*, *Pinus thunbergii*, *Quercus rubra*, *Populus alba*, *Cryptomeria* sp. and *Cypress* sp. There are differences concerning the geographic distribution of some forest species being the Northern part of the country, above Tagus River, the area where forest is mainly dominated by *Pinus pinaster* and *Eucalyptus globulus*.

Maritime pine

In the last years, pine stands have been suffering from the increase of disturbs caused by adverse meteorological conditions (e.g. forest fires). For this specie the main biotic agent causing health problems is pine processionary moth (*Thaumetopora pityocampa* Schiff.) that may cause high defoliation contributing to the decline of the trees. In pine stands the existence of bark beetles such as *Ips sexdentatus*, *Tomicus pineiperda* and *Pissodes notatus* is particularly common in the end of the economic rotation and in places where ecological sites are not good. Drought and forest fires have been increasing the frequency of attacks by these insects.

Eucalyptus globulus

In *Eucalyptus globulus* the main health problems are caused by a biotic agent named borer - *Phoracantha semipuntacta*. This agent is especially harmful in the marginal area of this specie, where the major damages have been noticed. Since 1995, other biotic agent started to attack this specie - the defoliator *Gonipterus scutellatus*. The larvae of *G. scutellatus* starts eating the youngest leaves, then eat the petioles and the oldest leaves. The adults eat mainly the oldest leaves.

In Sousa Valley, the main specie is *Eucalyptus globulus* (NFI, 2005). Also, in the 35 FORSEE devices, implemented in half of the municipality Paredes, the main specie found was *Eucalyptus globulus*. Based in the field data collected during the field work, the FORSEE team concluded that the biotic agents found in the devices do not seems to cause important damages in this specie and the timber is not affected. The main damages are associated with the presence of defoliators, namely *G. scutellatus*, which let the leaves full of holes because they eat them. These attacks do not seem also to cause important consequences on the health condition of the Eucalyptus. This may be due to the fact that *Eucalyptus globulus* is well adapted to the natural conditions of Sousa Valley, presenting enough resistance to face those agents.

Forest fires

An important damage that is not completely covered by FORSEE project but of great importance in Sousa Valley is the forest fires. Since the health assessment was done in living plots and the plots located in burnt areas were not considered the real intensity of this abiotic agent was not considered. Then, FORSEE North team decided to include another indicator that is the area of forest and shrubs burnt every year. This is pertinent given the frequency and forest losses caused by forest fires in the pilot zone. The indicator is named C.2.4.3 – Area of shrubs and forest burnt in forest fires.

In Portugal, the apprehension about forest fires is so high that the Portuguese Norm 4406 2003 includes the indicator “risk of fire” in its list of indicators considered important to evaluate.

Results obtained for the indicators of criterion 2

Indicator 2.4.1: Forest damages

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of devices: 35

Costs

TOTAL COST: 2068,5 €

Costs/ha: 0,41 €
Costs/device: 59,1 €

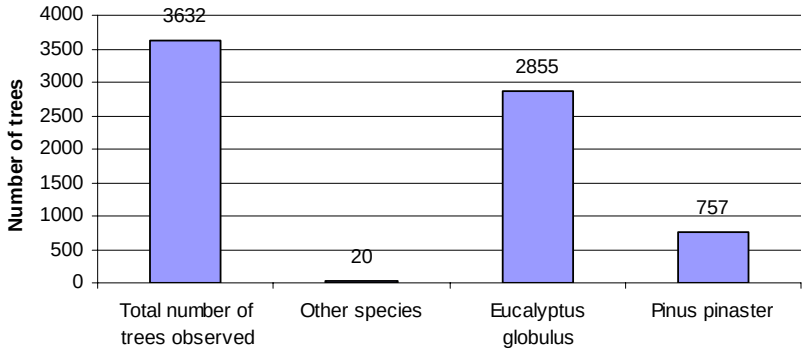
The total cost includes:

1- Data collection: 1793,5 €

2- Data analysis: 275 €

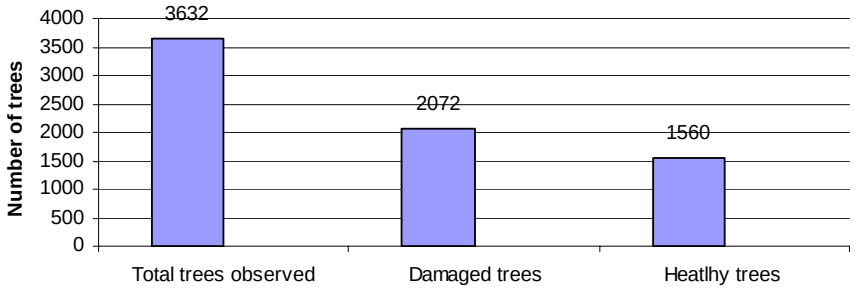
Results

Number of trees observed per specie



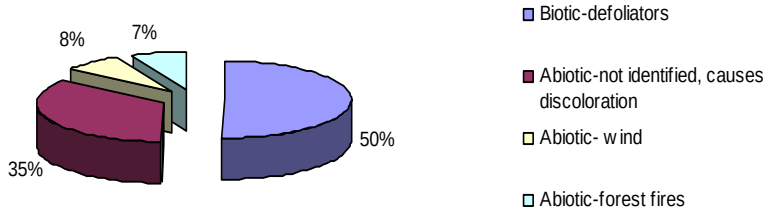
Source: Field sheets

Damaged and healthy trees in the **total of trees** observed



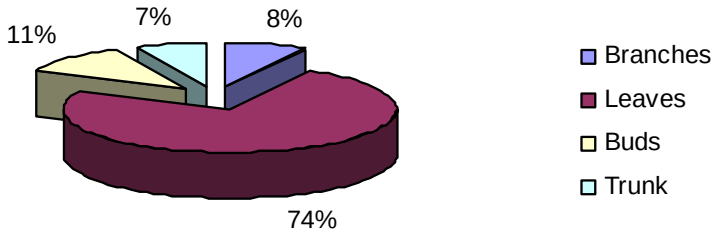
Source: Field sheets

Agents causing damages in ***Eucalyptus globulus***



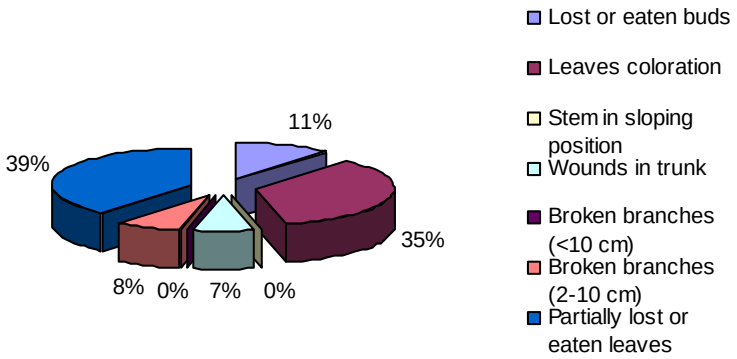
Source: Field sheets

Parts of ***Eucalyptus globulus*** affected



Source: Field sheets

Damages in ***Eucalyptus globulus***



Source: Field sheets

***1 device:** 4 plots (1 IFN+3 satellites) and 2 transepts (T1, T2).

Remarks

The main species found in FORSEE NFI and satellite plots are *Eucalyptus globulus* and *Pinus pinaster*. Some individuals of other species (*Quercus suber*, *Quercus sp*. and *Arbutus unedo*) were also found but only in 2 or 3 devices.
According to data collected during the field work about 2072 trees were damaged (57% of the total of trees observed). As the main specie found was *Eucalyptus globulus* the data reports the main agents and damages found for this specie.
Concerning *Eucalyptus globulus*, the agent causing more damages is a defoliator insect identified as being *Gonipterus scutellatus* and the main part affected are the leaves. The signal which permitted to identify this agent was the attacked leaves, eaten or partially lost.
Other important signal noticed by the field team was leaves discoloration. It was not identified the agent causing this discoloration but one can point out the narrow stand compass which probably put *Eucalyptus globulus* under intra specific competition for soil nutrients.

Problems and improvements

It is worthy to point out that is very important to assess this indicator in the correct season otherwise agents and damages can not be identified. For instance, the larvae of *G. scutellatus* eat first the youngest leaves and then the petioles and the oldest ones. The major incidence of this agent happens in the Spring (March, April and May) and in the Autumn (September, October, November).
In North Portugal pilot zone, the field work for health assessment started in the end of March and finished only June, being some devices observed in this month, out of the recommended period to observe this agent. If the decision is to keep the methodology to assess health condition in the device, that is, the NFI plots plus the 3 satellites, one suggests to do the inventory measurements of all NFI plots in a first stage, and then return and to carry out the health assessment in the NFI plots and satellites in a second stage. This way, the period of time for health assessment will not be so large and the evaluation can be done in a shorter period, preferably in the period where more biotic agents can be noticed.
Given the small number of devices where *Pinus pinaster* was found the results of health assessment for this specie are presented only in FORSEE DATA report. However, it can be added that for this specie, the main biotic agent causing damages is *Thaumetopora pityocampa*. Given the period of assessment (between the end of March and June) the number of trees where this agent was noticed is minimal. This might have happened because the period was not the right one to observe the processionary moth: the nests are especially visible in July/August and October/November.
Another think to be reported about this assessment seems to be the small notice of damages caused by forest fires in the FORSEE plots. Sousa Valley is a region under a high risk of forest fires, with many forest stands burning every year. As the burned plots and satellites were excluded from the sample, the evidences of damages caused by forest fires were only the observed in the trees that were not very affected.

Comments and conclusion

This indicator allows the manager to know the proportion of healthy and damaged trees, the main agents causing damages and the main parts of the tree affected. However, the manager only will know if it is necessary an intervention if he knows the intensity of the damages.
The importance of forest fires is not well assessed with this methodology for the reasons already referred.

<u>Forest damages</u> (pests and diseases) is one of the indicators of Criterion 2 considered by NP 4406 2003. NP 4406 2003 considers that biotic agents, causing damages in the different parts of the plants are the main agents of forest decline. The fight against pests and diseases doing in advance and using direct measures (biologic fight, sanitarian cuts or traps, etc.) or indirect measures (resistant plants, appropriate forest management, etc.) together with an attitude of surveillance, are indispensable for the management of a good sanitarian condition in a sustainable forest.

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Indicator 2.4.2 : Intensity of forest damages in *Eucalyptus globulus*

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %

No of devices: 35

Costs

TOTAL COST: 2068,5 €

Costs/ha: 0,41 €

Costs/device: 59,1 €

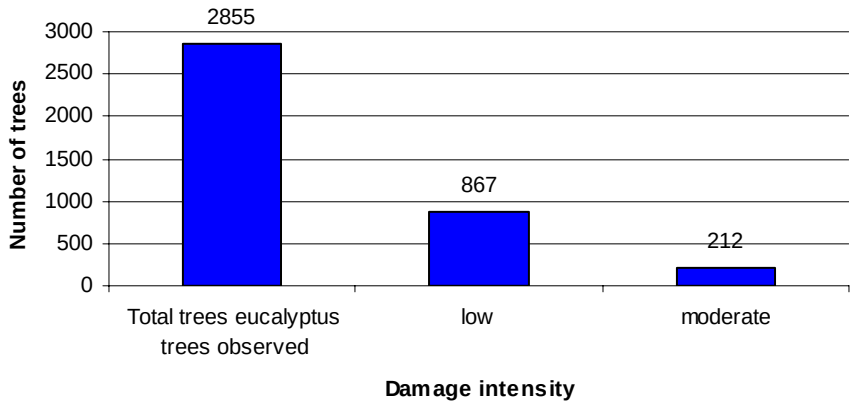
The total cost includes:

1- Data collection: 1793,5 €

2- Data analysis: 275 €

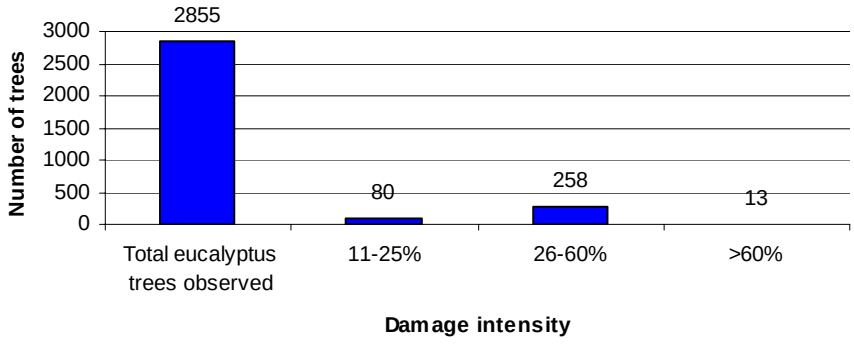
Results

Leaves discoloration in ***Eucalyptus globulus***



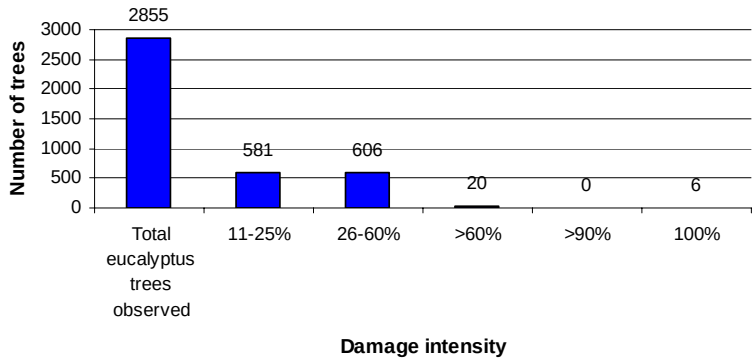
Source: Field sheets

Partially lost or eaten buds in ***Eucalyptus globulus***



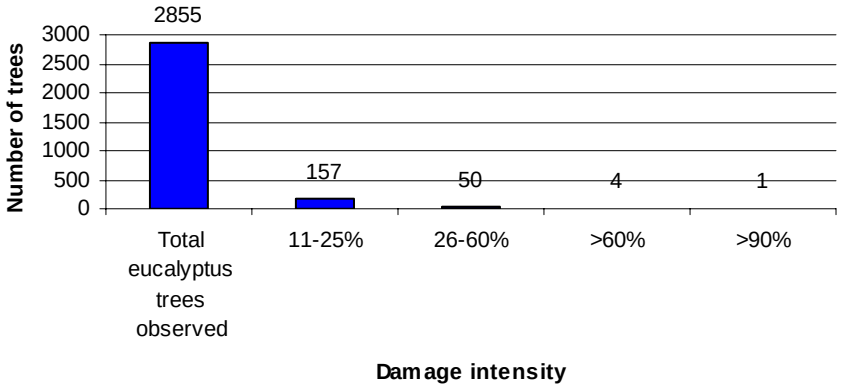
Source: Field sheets

Partially lost or eaten leaves in ***Eucalyptus globulus***



Source: Field sheets

Damages caused by forest fires in ***Eucalyptus globulus***



Source: Field sheets

Remarks

The results report *Eucalyptus globulus* since it is the main specie in Sousa Valley and also in the South of Paredes where the FORSEE devices were implemented. The main damages found in this specie were "leaves discoloration", "lost or eaten buds", and "eaten or partially lost leaves".
More than one thousand of eucalyptus trees were affected with "leaves discoloration". However, this discoloration is mainly slight discoloration. FORSEE field team suggests that "slight discoloration" in the leaves may be a result of the narrow compasses used in intensive forest management.
The intensity of the damage "lost or eaten buds" varies mainly between 26 and 60%.
The intensity of the damage "eaten or partially lost leaves" varies between 11 and 60%.
The intensity of the damage "forest fires" is almost negligible.
It has to be pointed that the number of eucalyptus trees affected with each type of damage is low compared with the total number of eucalyptus trees observed.

Problems and improvements

The methodology used by FORSEE field team (12/07/2005guideterrain.V16.en.v2) in order to assess forest health does not permit to assess the intensity of forest fires in Sousa Valley. The importance of eucalyptus stands, due to their productive functions, "obliges" the forest managers to remove the burnt trees from the stands and to replace the burnt stands with new trees. Then, the damages caused by forest fires are not strongly noticed during a health assessment in the field.
In Sousa Valley this indicator should consider also the area burnt every year per specie in order to understand the important damages caused by this abiotic agent.

Comments and conclusion

According to data collected on the field, forest stands in Sousa Valley do not seem to have significant health problems caused by biotic agents. Even *Pinus pinaster*, that in Portugal have been suffered considerable attacks of pine processionary moth, in Sousa Valley seems to be protected against this agent. Of course, these evidences have to be analysed carefully since the number of *Pinus pinaster* trees observed was small and the period of assessment was not the recommended to observe this specie.
The main agent causing problems is abiotic – forest fires - and has been causing several damages in *Pinus pinaster* and *Eucalyptus globulus* stands. The intensity of these damages is not assessed by this methodology since the burnt stands, and consequently the burnt plots, are excluded from the sampling.

<u>Forest damages</u> (pests and diseases) is one of the indicators of Criterion 2 considered by NP 4406 2003. NP 4406 2003 considers that biotic agents, causing damages in the different parts of the plants are the main agents of forest decline. The fight against pests and diseases doing in advance and using direct measures (biologic fight, sanitarian cuts or traps, etc.) or indirect measures (resistant plants, appropriate forest management, etc.) together with an attitude of surveillance, are indispensable for the management of a good sanitarian condition in a sustainable forest.

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Indicator 2.4.3: Area of shrubs and forest stands burnt in forest fires

Total area in Sousa Valley: 76706 ha

Forest area in Sousa Valley (2005): 29274,16 ha

Costs

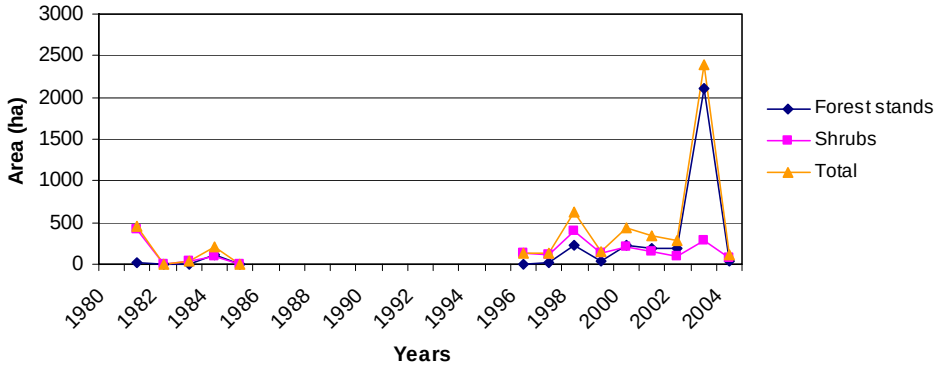
TOTAL COST: 20 €

This cost include:

1- Data analysis *Human resources:* 20 €

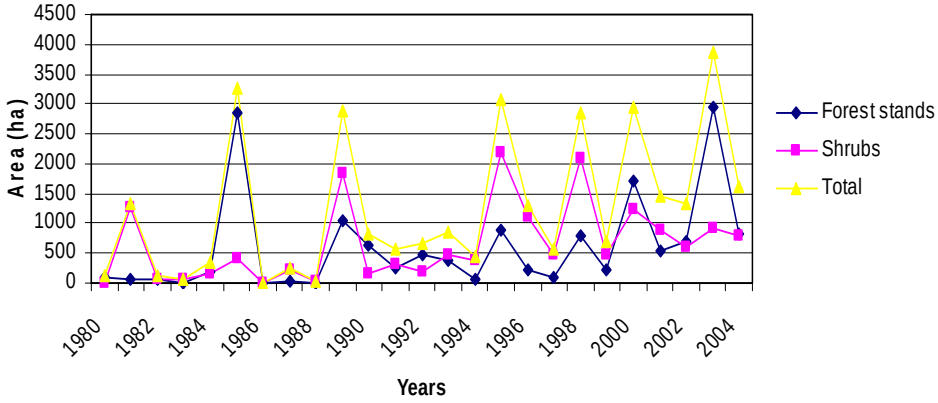
Results

Area burnt between 1980 and 2005 in the municipality of Paredes where the FORSEE plots are located



Source: *O país em números, Versão 2, Instituto Nacional de Estatística, 2004*

Area burnt between 1980 and 2005 in Sousa Valley



Source: *O país em números, Versão 2, Instituto Nacional de Estatística, 2004*

Remarks

In Sousa Valley, the main agent causing significant damages in the forest species is an abiotic agent - **forest fires**. Between 1980 and 2002 the area of shrubs burnt was usually higher that the area of forest stands burnt. After 2002 it happens the opposite being the area of forest stands burnt higher that the area of shrubs.
Through the graphs above it is possible to see that in Sousa Valley and also in the municipality where the FORSEE plots are located, Paredes, the area of forest and shrubs burnt suffered a sharp increase in 2005.

Shortcomings and improvements

The decision of add this new indicator to the list of FORSEE indicators has to do with the following facts:
a) The health assessment is only done in living plots, giving no indication about the burnt areas;
b) Most of this area corresponds to intensive management of Eucalyptus stands and the burnt areas recovered by new plantations as well as the damaged trees removed from forests just after the forest fires;
c) The pine stands, where damages caused by forest fires are more visible are very scarce in Sousa Valley and more in the municipality of Paredes where the FORSEE plots where located. Then the observations are not enough to show the importance of these damages in forest stands.

FORSEE team concluded that in the region of North Portugal it is important to consider an indicator of this type. Other information to consider is the one about the risk of forests fires. This information can be found in the map of risk of forest fires from 2004 available at http://www.dgrf.min-agricultura.pt/v4/dgf/pub.php?ndx=856 (recovered in May, 2007).
For the municipalities of Sousa Valley the risk of forest fires is considered to vary from **Mean** (in the average) to **High.**

Comments and conclusion

Given the gravity of forest fires in Portugal and as well as in Sousa Valley, it would be important to include this indicator in the list of FORSEE indicators. Other regions where this indicator is certainly also important are Portugal Centre and Galicia.
In Portuguese norm 4406 2003, the risk of fire is the first indicator considered by Criterion 2.

Risk of forest fires is an indicator considered by Criterion 2 of the Portuguese norm 4406 2003.

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c) Criterion 3: Forest products

General considerations about this criterion

The indicators of Criterion 3 evaluated in Sousa Valley are C3.1 – Increment and fellings, C3.2 – Roundwood harvested, C3.3 – Non Wood Products, C3.5 – Forest under management plans, C3.6 – Accessibility and C3.7 – Harvestability. The assessment of these indicators relies on secondary data collected at the Forest Owners Association of Sousa Valley (AFVS) and data collected by FORSEE field team. The productive function of forests is important for forests maintenance since it brings income to the forest owners and makes them interested in the management of their forests. At the same time the risk of forest fires is reduced.

Production forests, sometimes poor in terms of biodiversity, are also providers of other types of indirect uses values like carbon storage and soils protection.

In Sousa Valley, *eucalyptus and pine stands* are mainly maintained with production objectives. Here, pulp and paper industries manage significant areas of forests for its own consumption contributing to the Sousa Valley local economy through:

a) The rents paid to the forest owners which provide them a source of income and maintain their lands managed;
b) The wood bought to the timber merchants that in other hand buy wood to the forest owners;
c) The task work given to forest contractors and their employees in order to carry out forest operations (e.g. shrub cleanings, plantations, soil preparation, twigs' selection and cut).

In addition, the most significant Portuguese wood furniture industry is located in two municipalities of Sousa Valley, Paços de Ferreira and Paredes. Although this industry consumes a small quantity of wood produced in the Sousa Valley, its location constitutes a potential market which can stimulate the wood production.

The periodic assessment of the indicators approved by the expert group for Criterion 3 is

important because they provide information about forest production and also data needed to estimate the income of forest owners as well as the conditions of wood management (accessibility and harvestability). When the production increases and in consequence the income of the forest owners also increases, that may assure in part forest sustainability since it keeps the forest owners interested in maintaining forest productivity.

Under FORSEE project, the North Portugal team had the possibility to find which are the data and data sources available to assess the indicators of Criterion 3. There were some constraints to get the data needed since most of them are not available at the regional level. The existence of a local forest owner's organisation in the pilot zone was essential to provide data at this level and also to link the research institutions enrolled in the project (UCP and UTAD) with the local experts and local forest owners.

Increment was possible to esteem through the collection data in two different periods of time: the first forest inventory was taken in 2002 during a project developed by the local forest owner's organisation named "*Pilot Project of Sustainable Forest Management in Sousa Valley*" and the second forest inventory was taken in 2005 under FORSEE project. The geographic location of the plots is known and if needed the inventory can be repeated a third time.

Fellings only considered the wood sold in the market (**roundwood harvested**). The volume of wood that is sold in the market is an approximated estimation given by local experts connected with the pulp and paper industries because official entities do not collect this type of data. The pulp and paper industries, which manage a large area of forest in Sousa Valley, keep records on wood removals but do not publish them and the only way to have access to these data is through direct contacts with local experts who work or are linked with them. The volume of wood for own consumption is not known since Forest Services do not keep this type of records for private ownership.

So far, wood products are the main forest products in Sousa Valley, especially eucalyptus wood. **Non wood forest products** are limited to honey which is produced both for own consumption and to sell to middle men and then exported to other countries (mainly Germany). Game is also a non wood forest product very important in Sousa Valley; generating significant revenues every year (see C6).

The local forest owners' organisation, AFVS, has been promoting the production of other

non wood forest products as sources of extra income for the forest owners. Those non wood forest products are mushrooms and aromatic and medicinal plants.

Forest under management plans is another indicator that relies on secondary data provided by the local forest owner's organisation. It only considers data recorded by this organisation and not data extended to all forests in Sousa Valley. This indicator can be over estimated since the forest fires that occur in this region interrupt the production cycle every year, leading the forest owners to the abandonment of the plans of management undertaken since the recovering of the cycle of production (new soil preparation and new plantation) requires a high financial effort.

Digital maps needed to build the indicators **accessibility** and **harvestability** were also provided by local forest owner's organisation. Here the FORSEE team limited to take advantage of the digital maps available covering only a small part of Sousa Valley (South of Paredes) instead of buying most recent ones. It was decided to pay for this information to AFVS and left the choice of buying new digital maps to foresters and board working there. They are aware of their necessities and priorities in terms of cartographic information. In the future, AFVS can improve these two indicators following the guidelines of FORSEE project.

Results obtained for the indicators criterion 3

Indicator 3.1 : Increment and fellings

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %
No of plots: 35

Costs

TOTAL COST: 1227,3 €

Costs/ha: 0,24 €
Costs/plot: 35 €

The total cost includes:

1- Data collection: 959 €

2- Data analysis: 268,3 €

Results

Net increment in Sousa Valley between 2002 and 2005

Species	Net increment between 2002 and 2005 ($m^3.ha^{-1}$)			Annual net increment ($m^3.ha^{-1}$)
	Average value	SE	SE (%)	
Eucalyptus	53,4	17,8	33,2	17,73
Maritime pine and *Maritime pine* x *Eucalyptus* [4]	41,7	50,3	>100%	13,9

Source: UTAD

Volume harvested in Sousa Valley year and per hectare each year

Species	1) Area in Sousa Valley in 2005 (ha)	2) Average volume harvested each year (m^3 o.b.)	Average volume harvested per hectare each year ($m^3.ha^{-1}$)
Eucalyptus (pure stands)	17099,51	270000	15,79
Maritime pine (pure and mixed with eucalyptus)	9499,72	107500	11,32

1) **Source:** IFN 2005;
2) **Source:** Local foresters working for the pulp and paper industries.

Extraction rate in Sousa Valley per hectare each year

Species	Annual net increment (m^3 ha^{-1}/year)	Harvested volume (m^3 ha^{-1}/year)	Extraction rate (%)
Eucalyptus	17,73	15,79	88,7
Maritime pine and *Maritime pine* x *Eucalyptus*[5]	13,9	11,32	81,4

Extraction rate = (volume harvested/net increment)*100

[4] SE refers to sampling error at 0.95 significance level
[5] SE refers to sampling error at 0.95 significance level

Remarks

Data availability:

a) *Net increment:* Data came from two forest inventories in the same plots. The first was carried out by AFVS in 2002 during the development of the Pilot Project of Sustainable Forest Management (2001 - 2002). With data collected during the field work carried out in 2002 and the data collected during the field work carried out in 2005 it was calculated the net annual increment per year for the area where the plots were located (South of Paredes) considering a period of 3 years (2002-2005). This net annual increment was considered to be the same in the 6 municipalities of Sousa Valley (Paredes, Penafiel, Paços de Ferreira, Castelo de Paiva, Felgueiras and Lousada).

b) *Fellings*: Local experts linked with the pulp and paper industries were contacted to provide the volume of wood harvested and marketed per year in the region of Sousa Valley.
According to the tables above, the extraction rate is very high.

Problems and improvements

In order to monitor this indicator it would be needed to accomplish forest inventories in the same plots in regular periods. There are some data limitations that can be affecting the results:

a) The net annual increment was calculated for 35 plots which represents only half of 1 municipality of Sousa Valley;
b) Sampling errors are high, 33,2% for *Eucalyptus globulus* and >100% for *Pinus pinaster*;
c) In the calculations, mixed stands of *Eucalyptus globulus* and *Pinus pinaster* are considered as pure stands of *Pinus pinaster;*
d) The volume of wood harvested only covers the volume of wood marketed being these data an gross estimation by local experts.

An improvement to be done is to increase the sampling plots because with 35 plots results obtained for *Pinus pinaster* are not reliable

Comments and conclusion

The results suggest that forest sustainability in Sousa Valley can be committed given the high rates of extraction (88, 7 % for *Eucalyptus globulus* and 81, 4 % for *Pinus pinaster and Pinus pinaster x Eucalyptus globulus)*.
These high rates of extraction correspond to the excess of derived demand given the shortness of wood available, very affected by forest fires.
Local experts linked to pulp and paper industries confirm this trend.
There is the necessity of improving and continue the collective organisation and the support of the forest owners in order to have Sustainable Forest Management in Sousa Valley.

Net annual increment of wood is one of the indicators of Criterion 3 considered by NP 4406 2003. NP 4406 2003 considers that the net annual increment is a way to evaluate the average growing rate of the main forest product. It has big influence in the decision of the optimum moment of harvesting.

Projet cofinancé par l'Union Européenne
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Indicator 3.2 : Roundwood harvested (value and volume)

Total area in Sousa Valley: 76706 ha

Forest area in Sousa Valley (2005): 29274,16 ha

Costs

TOTAL COST: 519,4 €

This cost include:

2- Data collection: 159,4 €

2-Data analysis: 360 €

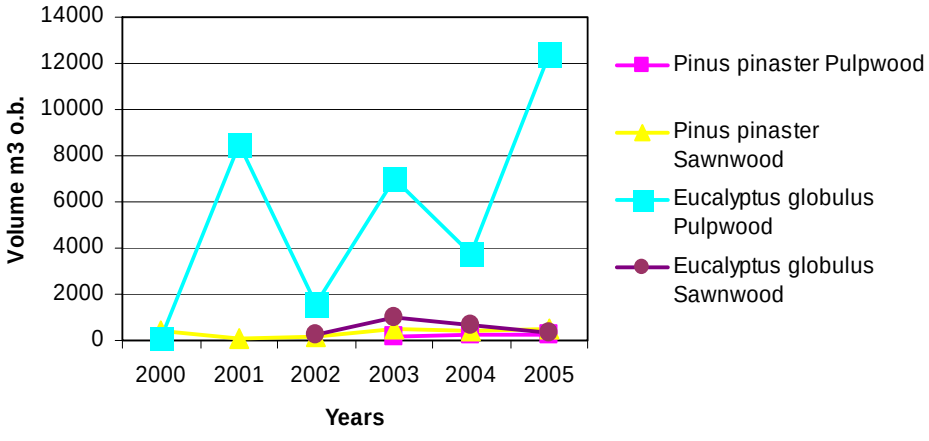
Results

Wood harvested in Sousa Valley in 2006 (value and volume)

Specie	Destination	Annual volume o.b. (m^3)	Stumpage price (€/m^3 ob)	Value (M €)
Eucalyptus	Pulpwood	170 000	17,5	2,975
	Sawn wood and laminates	70 000	22,5	1,575
	Biomass/fuel	30 000	5	0,15
Total		**270 000**		**4,7**
Maritime pine	Pulpwood	30 000	9	0,27
	Sawn wood and laminates	60 000	30	1,8
	Agglomerates	10 000	13,5	0,135
	Biomass/fuel	7500	5	0,0375
Total		**107 500**		**2,2425**
TOTAL				**6,9425**

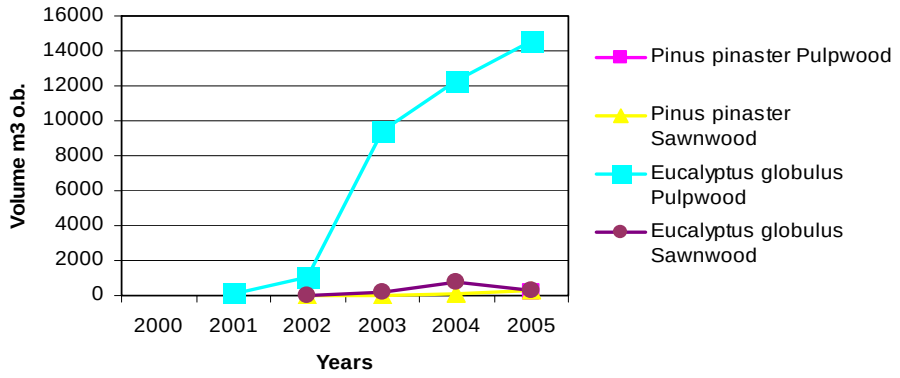
Source: Foresters linked to the pulp and paper industries

Volume over bark bought at stumpage price by **one** local timber merchant in Sousa Valley between the years 2000 and 2005 per type of destination



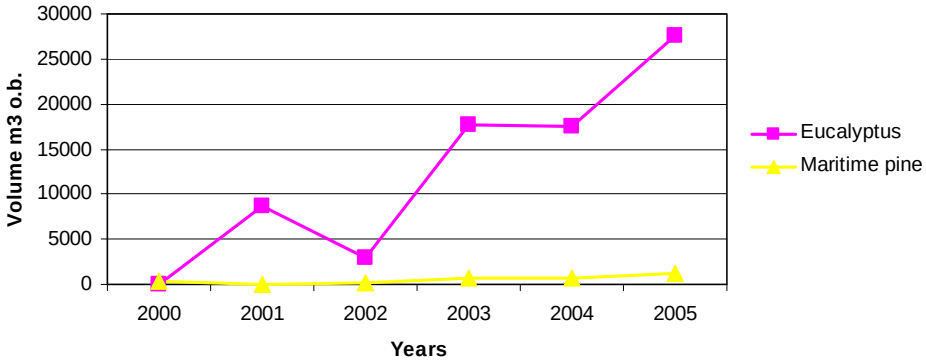
Source: AFVS (Data collected by AFVS from one local timber merchant)

Volume over bark bought **at roadside** by **one** local timber merchant in Sousa Valley between the years 2000 and 2005 per type of destination



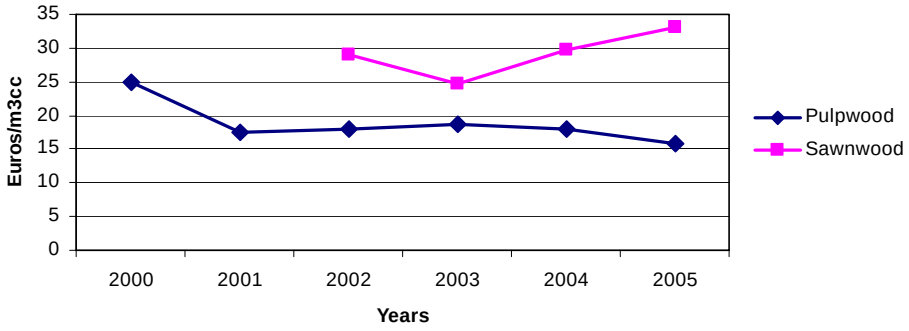
Source: AFVS (Data collected by AFVS from one local timber merchant)

Total volume of wood bought (at stumpage price and at roadside) by the timber merchant between 2000 and 2005



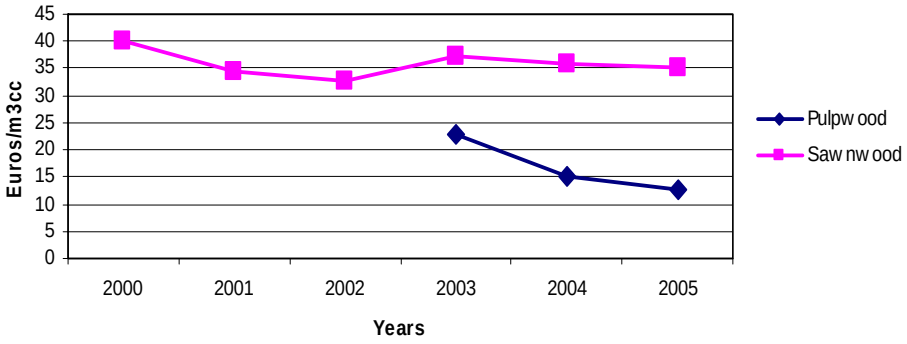
Source: AFVS (Data collected by AFVS from one local timber merchant)

Average weighted **stumpage price** paid by a local timber merchant for **Eucalyptus wood** in Sousa Valley per type of destination



Source: AFVS (Data collected by AFVS from one local timber merchant)

Average weighted **stumpage price** paid by a local timber merchant for **Maritime pine wood** in Sousa Valley per type of destination



Source: AFVS (Data collected by AFVS from one local timber merchant)

Remarks

In Sousa Valley the species marketed are *Eucalyptus globulus* and *Pinus pinaster*.

Timber produced by these two species can have the following destinations:

a) Eucalyptus globulus: Pulpwood, sawn wood, laminates, biomass/fuel.

b) Pinus pinaster: Pulpwood, sawn wood, agglomerates, laminates, biomass/fuel.

According to the NFI (2005), there is in Sousa Valley 3 449, 9 hectares of pure pine stands and 17 099, 51 hectares of pure Eucalyptus stands. The last being the specie that more contributes to the income of forest owners.

Eucalyptus wood is mainly consumed by pulp and paper industries. Pine wood is mainly transformed in sawn wood and laminates. According to local sources, timber with small diameter and without value for industry is used as energy (fuel) in restaurants, bakeries and houses. About 30 000 m^3 of eucalyptus timber is used like this as well as 7500 m^3 of pine wood.

Concerning the average weighted stumpage price over bark (Euros/ m^3o.b.):

a) Eucalyptus globulus: The average weighted stumpage price of wood sawn decreases from 2002 to 2003 and increases from 2003 and 2005. The price of wood for pulp decreased in 2001 and after that is almost constant until 2004, declining again in 2005.

b) Pinus pinaster: The average weighted stumpage price of wood for sawn floats between 30 and 40 €/ m^3 o.b. in the period 2000 – 2005 and the average weighted stumpage price of wood for pulp decreases from about 20 €/ m^3 o.b to about 10 €/ m^3 o.b, between the period 2003 - 2005.

Shortcomings and improvements

In Portugal there are not official data published on wood removals from private forests per municipality, only the wood removals from public forests are registered by Public Administration. Since there are no public forests in Sousa Valley, it was necessary collect that information close to the main actors of Sousa Valley wood market.
Thus, the main sources for this indicator are the foresters linked to pulp and paper industries and with other timber enterprises.
The volume of wood provided by these sources only covers the wood marketed and not the wood harvested for own consumption. For that reason the volume of wood harvested per year might be underestimated.
Concerning the wood prices at regional level, there are some official information published by SICOP **- Forest Information System on Products and Prices in the Production,** in the website of the Forest Services (http://cryptomeria.dgrf.min-agricultura.pt/). Other can be collected close to the same sources inquired for wood removals.

To improve this indicator it would be necessary to accomplish periodic inquiries to forest owners, timber merchants and timber enterprises through partnerships between the Forest Services and the local forest owners' organisation.
Other way to improve the indicator would be to take advantage of the work that is going to be developed by the local FOA during the ZIFs management that will permit to record of data on wood removals available for the municipalities of Sousa Valley where ZIF's are going to be implemented. The first ZIF 023/06 (ZIF EDS) to be implemented covers an area of about 7000 ha of **contiguous** forest land in the Southern part of the municipalities of Paredes and Penafiel. Here, the local FOA is preparing a project of joint forest management according to the legislation regulating these zones. This will include data collected on wood production and wood removals.
Using these sources it would be possible to have an information system on wood removals and prices for Sousa Valley region and to measure the importance of forest production there.

Comments and conclusion

According to data collected there is a trend of decline of the nominal and real prices of eucalyptus wood with pulp as main destination, which seems to be the same time the main type of wood marketed in Sousa Valley. This suggests a decline in the income of forest owners.

Concerning this indicator, data provided by foresters linked to the pulp and paper industries and to the timber enterprises is possible to give an approximated estimative of the income coming from the selling of wood.
However, the information available by local sources on wood marketed in Sousa Valley is not so reliable as if it was taken from the official sources.

Main forest production is one of the indicators of Criterion 3 considered by NP 4406 2003. NP 4406 2003 considers that forest stands are maintained with the objective of maximization of the productivity of the main forest product (in Portugal can be wood, cork or fruits). This product is in the basis of the management system and is subject to the main cultural treatments.

In Sousa Valley, the main forest production is wood.

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Indicator 3.3 : Non wood products - Honey

Total area in Sousa Valley: 76706 ha

Forest area in Sousa Valley (2005): 29274,16 ha

Costs

TOTAL COST: **120,6 €**

This cost include:

1 – Data collection 75,6 €

3- Data analysis 45 €

Results

Number of beehives in Sousa Valley per municipality in 1999

Municipality	Number of beehives	No of holdings	No of beekeepers
Castelo de Paiva	379	49	41
Felgueiras	289	23	19
Lousada	195	70	15
Paços de Ferreira	302	33	28
Paredes	211	20	49
Penafiel	1042	50	26
Total	**2418**	**245**	**178**

Source: Recenseamento Geral Agrícola, 1999 *in* O país em números, Versão 2**,** Instituto Nacional de Estatística, 2004.
Local sources confirmed this number based on their knowledge about the activity (2005).

Honey productivity per beehive

1) Average productivity per beehive in Portugal (Kg)			2) Average productivity per beehive in Sousa Valley (Kg)
2001	2002	2003	
20	18	18	20

Sources: 1 Programa apícola 2004-2007;
2 Local beekeepers (2005)

Average price of the honey at the beekeepers' gate in Sousa Valley in 2005

Sources	Average price (€/Kg)
Beekeeper A	1,5
Beekeeeper B	4

Source : Local beekeepers

According to local beekeepers the main production is exported and paid at 1, 5 €/Kg

Value of honey production in Sousa Valley in 2005: 72540 €

Remarks

Apart from game (see C6), honey is the main non wood forest product (NWFP) produced in Sousa Valley. Honey production can have two objectives:

a) Commercial purposes, bringing extra income to the forest owners and farmers;
b) Own consumption.

According to local sources (mainly from Penafiel), a significant part of the production is bought by middle men and then exported to Germany.
There are high evidences of the importance of beekeeping activity in Sousa Valley:

a) More than 8 places (in 35 visited) with beehives were seen during the field work by the field team;
b) There are two enterprises established in Sousa Valley that produce and sell material for beekeeping. This suggests that exist demand for this type of material;
c) Data published by the National Institute of Statistics and data provided by the Regional Direction of Agriculture concerning the number of beehives in the 6 municipalities of Sousa Valley and the numbers given by local sources.

The marketing of honey can be done in two different ways:

a) Sold by the producer directly to the consumers;
b) Sold by the producer to middle men who sell it to honey processing enterprises, mainly located in Germany.

In Sousa Valley, Penafiel is the municipality where more beehives are registered: 1042 beehives in 1999.
One considers that the number of beehives has been almost the same in Sousa Vally since 1999.
According to local sources, Sousa Valley is propitious to the production of honey and being the average productivity of honey per beehive a little higher than the average productivity of honey per beehive in Continental Portugal.
Big part of the production of honey in Sousa Valley is exported and paid at 1,5 €/kg by middle men to honey producers.
Considering data collected, the total value of honey production in Sousa Valley in 2005 is **72540 €.**

Shortcomings and improvements

According to the General Direction of Agriculture of Entre-Douro and Minho (*Direcção Regional de Agricultura de Entre Douro e Minho*, DRAEDM in Portuguese initials) located in Penafiel, data on the number of beehives is reliable once the producers have a benefit for registering close to the official entitites the right number of beehives they own. This benefit consists on getting sanitarian products against bee's diseases for free. The amount of sanitarian products they can get depends on the number of beehives owned.
During the data collection, it was noticed that the number of beehives in Sousa Valley given by INE and the number of beehives in Sousa Valley given by DRAEDM were exactly the same. However, DRAEM claims that data collected by INE in 1999 through the General Agricultural Censuses (*Recenseamento Geral Agrícola*) is totally independent from data collected by DRAEM.

Comments and conclusion

The production of NWFP is important since it can be a way to increase the income of forest owners.
Although the forest in Sousa Valley has been mainly a production forest, there are signs of decline in the prices of wood products and increase of the importance of NWFPs.
These types of products should already be taken into account in the projects of Sustainable Forest Management of the region.
In 2005, honey and game were the main NWFPs produced there, but the production of edible mushrooms and aromatic plants has been encouraged by the local FOA.
With that purpose AFVS organised some field visits and training actions under the project AGRIS 8, to inform the forest owners how to produce NWFPs.

<u>Other productions</u> is one of the indicators of Criterion 3 considered by NP 4406 2003. NP 4406 2003 considers that forests can produce a diversified sort of goods and services besides the main product. Although most of those goods and services are not marketed in a structured market there are others for which the market is well established and organised. In these cases the diversification of the production is desirable because it reduces the dependence against market fluctuations associated to the main forest product and increases the total revenues of the forest holdings.

In Sousa Valley, honey and game are other forest productions.

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Indicator 3.5 : Forest under management plans

Total area in Sousa Valley: 76706 ha

Forest area in Sousa Valley (2005): 29274,16 ha

Costs

TOTAL COST: **255,6 €**

This cost include:

1 – Data collection
75,6 €

2- Data analysis
180 €

Data available upon request at the local FOA.

Results

Percentage of forest under management plans by specie

Specie	Area (ha)	%
Acer sp.	0,75	0,003
Broadleaves	114,25	0,390
Castanea sativa	10,76	0,037
Castanea sativaxQuercus rubra	2,66	0,009
Chamaecyparis sp.	4,47	0,015
ConifersxBroadleaves	389,62	1,331
Cupressus lusitanica	10,7	0,037
Eucalyptus globulus	26,26	0,090
Eucalyptus globulus (Pulp and paper industries)	4908	16,766
Fraxinus angustigolia	6,78	0,023
Juglans regia	11,45	0,039
Pinus pinaster	452,35	1,545
Pinus pinasterxCupressus lusitanica	9,5	0,032
Pinus pinasterxEucaliptus globulus	3,85	0,013
Pinus pinasterxQuercus rubra	1,2	0,004
Pinus pinea	0,74	0,003
Prunus avium	3,8	0,013
Quercus robur	8	0,027
Quercus rubra	52,5	0,179
Quercus rubraxCupressus lusitanica	6,32	0,022
Quercus suber	0,7	0,002
Total forest under management plans	**6024,66**	**20,580**
Total forest area in Sousa Valley	**29274**	**100,0**

Source: AFVS

Area under management plans per type of forest owner

Area managed by NIPFO (ha)	1154,24	3,8 % of the total area
Area managed by pulp and paper industries (ha)	4908	16,7% of the total area
Total forest under management plans	**6023,56**	**20,5 % of the total area**

Source: AFVS

Remarks

In the North and Centre of Portugal, private forest holdings are mainly of small dimension. Before the afforestation programmes co-funded by the EU, most the forest owners did not follow any formal forest management plan. Only in public forests, communal forest, forest holdings belonging to the pulp and paper industries and the private forest holdings of big dimension were likely to be under forest management plans.

After 1986, the EU co-funded forest programmes allowed the non industrial private forest owners (NIPFO) to benefit from funds to develop actions such as afforestation of forest lands, afforestation of agricultural lands, improvement of forests stands or the prevention of forests against the risk of biotic and non biotic agents. One of the requisites to apply for those funds is to present a forest management plan together with the application form and the documents needed. If the applications are approved, the forest owners have to follow the management plan presented during the period stated in the application form. Taking advantage of the local FOA implemented in Sousa Valley since 1994, the NIPFOs interested on getting funds through those programmes asked the services of the foresters working at the FOA to drew up the forest management plans, to fill the application forms and to provide technical assistance if the applications are approved.

In Sousa Valley, the NIPFOs applied for the following forest programmes:

- Reg. (EEC) 2080/92: active between 1992 and 1994;
- PAMAF: active between 1994 and 1999;
- PDF: active between 1994 and1999
- AGRO: active between 2000 and 2006;
- RURIS: active between 2000 and 2006.

Data presented considers that the area of forest under forest management plans in Sousa Valley is the one belonging to the NIPFO, who applied for the EU-forest funds during the period 1994-2006 with the technical assistance of the local FOA, plus the area belonging to the pulp and paper industries.

This gives about **3,8%** of forests belonging to NIPFOs under forest management plans and about **16,7%** of forests belonging to pulp and paper industries under forest management plans. The areas together sum about **20,5%** of forest under forest management plans in Sousa Valley. According to the local FOA, some forest owners require the drawing of forest management plans without asking EU co-financing but they only represent a very small percentage of the total forest of Sousa Valley (less than 0,5%).

The main species under forest management plans are *Eucalyptus globulus* (14,2%) and *Pinus pinaster* (1,3%).

Shortcomings and improvements

Data only reports forest management plans drew up and assisted by the local FOA. Area of forest under management plans belonging to other forest owners who are not members of the local FOA is not reported. However, one of the reasons why NIPFOs became members of the local FOA was to be assisted in the drawing of applications for public funds to plant, manage and improve their forest stands. The local FOA provide them information about the laws, fill the application forms, draw up the management plans and provide them technical assistance in order to accomplish the forest management plan. Based on this, one considers that the NIPFOs who follow a forest management plan are the members of the local FOA and then the underestimation is not significant, which means that data reports almost all the area of NIPFOs under forest management plans.
The indicator can be also **underestimated in 3,5%** because the area of forest projects for which AFVS database did not have information about its current situation, about **1027,06 hectares**, was not considered in the analysis.
In the other hand, forests in Sousa Valley are under a high risk of forest fires and big areas are burnt every year. Due to this agent the area of forest under management plans in 2006 may be **overestimated**: when a forest belonging to NIPFOs burns, the forest management plan is not followed anymore because of the big efforts needed to recover the area again.
The area of forests under forest management plans, belonging to NIPFOs and to the pulp and paper industries, is being recorded in GIS cartography by the foresters of the local FOA. The digital maps show the distribution of these forest holdings and its characteristics. The map is presented at the FORSEE Data report.
In a coming future, with the implementation of the 5 ZIFs in Sousa Valley (Zones of Special Implementation) a huge percentage of forest is going to be under a forest management plan.

Comments and conclusion

Concerning data availability needed to evaluate this indicator one can conclude that it is available at the local FOA. The information only contains data about the area of forest under the forest management plans drew by the foresters working at this organisation and forest area belonging to pulp and paper industries.
In terms of sustainable forest management, the conclusion is:
a) The percentage of forest under forest management plans is mainly due to the contribute of the pulp and paper industries;
b) The area corresponding to NIPFOs, even completely known is only given the first steps, being far from the objectives of sustainable forest management.

Indicator not considered by Criterion 3 of the Portuguese Norm 4406 2003.

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Indicator 3.6 : Accessibility

Total forest area in Sousa Valley (1995): 34668 ha

Forest area mapped (1995): 4956,1 ha

Percentage of the total forest covered: 14,3 %

Costs

TOTAL COST: 120 €

Cost/ha: 0,024 €

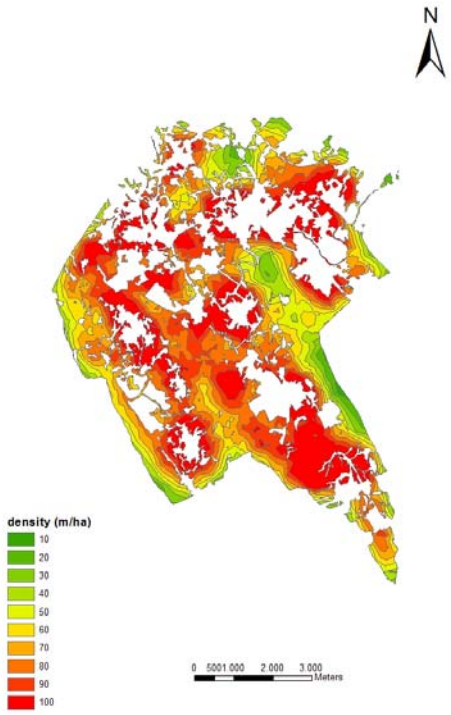
The total cost includes :

1- Data collection
75 €

2- Data analysis:
45 €

Results

Forest land accessibility in half of the municipality of Paredes in 1995



Area and percentage of forest in each interval of density in the South of Paredes in 1995

Density (m/ha)	Forest area (ha)	%
10	6,6	0,2
20	46,7	1,2
30	119,7	3,0
40	209,2	5,2
50	333,9	8,4
60	437,3	11,0
70	564,6	14,2
80	714,3	17,9
90	615,5	15,4
100	937,5	23,5
Total	**3985,3**	**100,0**

Source: Values given by *ArcGIS 9*

Remarks

The indicator **accessibility** only considers the land use classified as **Forest** in**1995**.
The **accessibility** is described as the net of roads that let the access to forest, measured in meters of roads per hectare. The indicator was assessed using the road map and the land use map available at the local FOA for half of the municipalities of Paredes and Penafiel.
Using the digital maps available, the roads were reclassified according to the expert group protocol in:
a.1) Permanent roads – Serve permanently the accessibility to the forest. This class was divided in:
-Access roads and main roads
- Secondary roads
a.2) Temporary roads – Roads built for a short term use and for a specific project, especially during wood lodging.
a.3) Public roads – Classified by the administration

It was only considered permanent roads and public roads as the ones contributing to forest accessibility in Sousa Valley.
According to FAO, the minimum of 20 lineal meters per hectare is desirable to access the forest without problems at a landscape level.
The calculations show that more than half of the forest land has a density above this reference: In 1995, in the South of Paredes, about 56, 8 % of the forest had a road density (m/ha) between 80 and 100. This suggest the existence of a very broken forest, for which also contributes the big number of small villages scattered in the Southern part of the municipality of Paredes.

Shortcomings and improvements

The analysis was done only for the South of Paredes, one of the 6 municipalities of Sousa Valley, since there were no digital maps available for all Sousa Valley.
To improve the assessment of this indicator the road map had to be reclassified because the classification only differentiated highways, roads and paths; This was done using the military map (*carta militar*). **The roads were then reclassified in:**
a) Access roads/main roads;
b) Secondary roads;
b) Temporary roads and public roads – highway.
There were also **other limitations** in the evaluation of this indicator:
1) Road map was out-of-date: digital road map used for the analysis of this indicator was bought by the local FOA in 2002. In 2005, 3 years later, the net of roads is probably different;
2) Land use map out-of-date: digital land use map refers land use in 1995 and forest area in 1995;
3) The roads' width was not considered: this characteristic was indicated by the expert group to be included in the analysis of this indicator. This happened because the digital road map available did not have that information.
To improve the indicator it would be necessary to buy an updated road map or to check the accessibility conditions in the field (probably with the collaboration of the foresters working at the technical forest office of each municipality and the foresters of the local FOA).
Given the high density of roads in this region (witnessed by the FORSEE field team) the work needed to check the type of roads in the field would probably be a long and expensive task.
It would be also important to look for the ideal density of roads in the pilot zone regarding sustainable forest management. That is not defined and should be discussed with the managers and foresters working at the pilot zone.

Comments and conclusion

As the density of roads excluded the roads classified as temporary roads, there are some places where the density of roads in meters per hectare is low. However, there is a high density of temporary roads on forest in Sousa Valley which also contribute to forest accessibility. This was witnessed during the field work carried out in FORSEE forest plots. Even the places with low density of forest roads have a high density of temporary roads which assure forest accessibility, at least in the summer.
According to a previous study developed by the technical staff of the local FOA[6], the net of roads (permanent and temporary roads) is dense and more than 90% of the area of study, which include the area considered by this indicator, is at maximum distance of 150 meters from a road.
During the field work, it was also noticed that some of the roads shown by the road map and classified within FORSEE project as temporary roads had disappeared and others had been constructed. This fact supports the decision of excluding the temporary roads from the analysis.
As a conclusion one can said:
a) The accessibility is good in terms of forest management;
b) The high density of roads can facilitate the access of firemen in the forest;
c) Probably, the high density of roads is not so good in terms of landscape quality;
d) The high density of roads can be propitious to the abusive access of people inside forest property.

Density of the net divisional road is one of the indicators of Criterion 2 (not Criterion 3) considered by NP 4406 2003. NP 4406 2003 considers that the deficient accessibility of the forest areas is responsible for the great intensity of damages caused by the forest fires. The development of a well managed net of roads and divisional infra-structures can contribute to the minimization of the risk of fire in the forest areas.

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[6] Relatório Final do Projecto-Piloto de Gestão Florestal Sustentável no Vale do Sousa, Eixo Prioritário 1, Medida 1.4 – Valorização e Promoção Regional Local. Associação Florestal do Vale do Sousa. Paredes, 2004.

Indicator 3.7 : Harvestability

Total forest area in Sousa Valley (1995): 34668 ha

Forest area mapped (1995): 4956,1 ha

Percentage of the total forest covered: 14,3 %

Costs

TOTAL COST: 2433 €

Cost/ha: 0,49 €

The total cost includes :

1- Data collection 2388 €

2- Data analysis : 45 €

Results

Forest harvestability in half of the municipality of Paredes in 1995

Percentage of forest area where timber can be harvested without the need of building new forest roads

Type of accessibility to harvest in forest	Hectares	%
Not accessible	250,960	5,06
Accessible 1	1427,924	28,8
Accessible 2	2182,924	44,04
Accessible 3	521,608	10,52
Total area of Forest	**4956,076**	**100**

Source: Values given by *ArcGIS 9*

Remarks

The spatial analyse of this indicator was done after the reclassification of the road map done for the indicator accessibility.
The type of accessibility was classified as the following types:
Not accessible: Forest land at a distance of more than 2000 m of a permanent road
Accessible 1: Forest land at a distance lesser than 200 m of a permanent road
Accessible 2: Forest land at a distance between 200 and 1000 m of a main road and with a slope below 60 %
Accessible 3: Forest land between 1000 and 2000 m of a main road and with a slope below 35 %.

According to the map and the associated table, in the forest area covered by this indicator, only 5 % of the forest area (in 1995) is classified as not accessible and then not harvestable. All the remaining forest is accessible being about 44% of the forest area at a distance between 200 and 1000 m of a main road and with a slope below 60 %.

Shortcomings and improvements

As the evaluation of this indicator depends on the evaluation of the indicator 3.6 the shortcomings and improvements to be done are the same.

One suggests the indicator accessibility and the indicator harvestability to be evaluated as just one indicator because the evaluation of the last one depends on the evaluation of the first.

Comments and conclusion

With updated road maps and with the evaluation of the indicator 3.6 well done, the spatial analyse of the indicator 3.7 and the calculation of the percentage of forest land where timber can be harvested without the need of constructing new forest roads this indicator is of easy evaluation and feasible in Sousa Valley.

In terms of Forest Sustainable Management one can conclude that in 1995, in half of the municipality of Paredes, almost all the forest was accessible for harvesting.

Indicator not considered by Criterion 3 of the Portuguese Norm 4406 2003.

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d) Criterion 4: Biodiversity

General considerations about this criterion

Given to budget restrictions, it was not possible to assess all the indicators with the same deepness. Also because for some criteria, C1, C2, C3 and C6, the institutions enrolled in the project, UCP, UTAD and AFVS were more able to give support and scientific advice in the subjects covered by those criteria than in the ones covered by C4 and C5 indicators. Thus, the evaluation tried to match the information available with what was asked by C4 indicators. To evaluate them, apart from indicator C4.5, it was not collected primary data in the field, only secondary data available at the local forest owner's organization. The perceptions achieved by the field team during the field work were also taken into account.

From of the indicators chosen by North Portugal to be evaluated, it was not possible to obtain data to evaluate the indicator C4.2 – Regeneration.

The assessment of C4 indicators permitted to conclude that the structural diversity of the forest stands in Sousa Valley is low.

Considering only half of the municipality of Paredes, pure stands are the main type of forest stands in 1990, 1995 and 2005, especially pure stands of Eucalyptus.

For Sousa Valley, NFI (2005) the same is verified, with pure of stands Eucalyptus representing almost 60 % of the total forest: in 29 274, 16 hectares of forest, 17099, 51 hectares are pure stands of Eucalyptus (58, 4 % of the total forest) and 3449, 9 hectares are pure stands of Maritime pine (11, 7 % of the total forest). This means that in 2005 about 70 % of Sousa Valley forest was constituted by pure stands of Eucalyptus and pure stands of Maritime pine.

Mixed stands of Eucalyptus and Maritime pine represent about 21 % of the total forest and other broadleaves, pure or mixed with Eucalyptus or Maritime pine, only 9 % of the total forest of the pilot zone. These stands are located especially along the water courses being of great importance in terms of animal biodiversity and water and soil protection. The main species occurring in these stands are *Quercus* sp., like *Quercus suber*, *Quercus robur*, and some riparian species such as *Fraxinus excelsior* and *Alnus glutinosa*.

The dominance of Eucalyptus in Sousa Valley is a result of the economic revenues that forest owners can take from the cultivation of this specie, associated with the good natural conditions offered by the region for its growing. In general, the presupposition is that mono specific forests are related with low diversity of the animal communities. Indicators such as **C4.10b – Carabid diversity** and **C4.10c – Birds diversity,** not assessed by North Portugal team due to budget restrictions, would be important as verifiers of animal biodiversity in Sousa Valley and should be taken into account in the future.

In Sousa Valley, where the main function of forest is production, ZIF's that are planned to be implemented there, can increase structural diversity of forests. The objectives of the ZIF's – Zones of Special Intervention are to protect forests against the risk of fire,to recover burnt areas, to increase the production of timber, to assure forest certification, to promote the production of non-wood forest products and to improve the recreational and cultural areas. In these zones the economic and the ecological function of forests will live together under the same forest management plan. Then, **ZIFs by promoting the production of other forest goods but timber, also promote the diversification of forest species and the increase of biodiversity, at least indirectly**.

Results obtained under FORSEE project for the indicators of this criterion

Indicator 4.1 : Tree species composition

Total forest area in Sousa Valley (1995): 34668 ha

Forest area covered (1995): 4956,1 ha

Percentage of the total forest covered: 14,3 %

Costs

TOTAL COST: 27 €

The total cost includes :

1- Data analysis : 27 €

Results

Trees species composition according to **1990** land use the **South of Paredes**

Type of stands	Nº of species	Area	%
Pure eucalyptus	**1**	**1213,1**	**39,9**
Pure maritime pine	**1**	**1056,8**	**34,7**
Other broadleaves	>1	180,1	5,9
Broadleaves x coniferous	>1	171,3	5,6
Maritime pine (dominant) and eucalyptus	2	153,4	5,0
Coniferous x broadleaves	>1	135,3	4,5
Pure maritime pine and oaks	>1	64,6	2,1
Maritime pine and other broadleaves	>1	33,7	1,1
Eucalyptus (dominant) and maritime pine	2	24,6	0,8
Oaks	>1	5,2	0,2
Eucalyptus and other broadleaves	>1	4,0	0,1
TOTAL		**3042,1**	**100**

Source: COS 90

Trees species composition according to **1995** land use in the **South of Paredes**

Type of stands	Nº of species	Area (ha)	%
Pure eucalyptus	**1**	**1782,4**	**36,0**
Burnt areas or cut areas where the specie could not be identified	n.a.	1493,5	30,1
Maritime pine (dominant) and eucalyptus	2	764,1	15,4
Eucalyptus (dominant) and maritime pine	2	550,4	11,1
Pure maritime pine	1	238,7	4,8
Other broadleaves	>1	77,8	1,6
Maritime pine and other broadleaves	>1	30,7	0,6
Eucalyptus and other broadleaves	>1	18,6	0,4
TOTAL		**4956,2**	**100**

Source: Interpretation of the aerial photograph of 1995 done and available at AFVS

Evolution of the main species between **1990** and **1995** in the **South of Paredes**

	1990	1995	Increment
Main species	**Area (ha)**	**Area (ha)**	
Pure stands of eucalyptus	1213,09	1782,39	569,304
Pure stands of maritime pine	1056,81	238,49	-818,32
Total area of forest stands	**3042,1**	**4956,2**	**1941,1**

Remarks

In 1990, the most representative type of stands in the South of Paredes was pure stands of eucalyptus, about 40 % of the forest area, followed by pure stands of maritime pine, about 35% of the forest area.
In 1995, the percentage of pure stands of eucalyptus concerning the same area decreased to 36% and the percentage of pure stands of maritime pine declined to only 5 %. Mixed stands of maritime pine and eucalyptus increased from 5, 8% in 1990 to 26, 5 % in 1995.
Both in **1990 and 1995,** mixed stands of coniferous and broadleaves, eucalyptus and other broadleaves and pure stands of broadleaves only represented small percentages of forest area in the South of Paredes,.
It is likely that mixed stands of maritime pine and eucalyptus had become pure stands of eucalyptus in the last years.
The dominance of pure stands of eucalyptus and the small percentage of broadleaves in the South of Paredes revealed by data available was confirmed by the field team during the work developed in 2005 under FORSEE project: in the FORSEE 35 plots, 22 were in pure eucalyptus stands, 4 in pure Maritime pine stands and 8 in mixed maritime pine x eucalyptus. Some *Quercus* and strawberry trees appeared in 2 plots, one of eucalyptus and other of maritime pine.
The South of Paredes is then poor in terms of diversity of forest species. In **1990, about 75 % of the forest area presented only 1 forest specie, Maritime pine (34,4%) or Eucalyptus (39,9%)**. **In 1995, the area with only 1 specie was reduced to 50% but with a decrease especially in the area of pure Maritime pine (from 34,4 to 4,8%).**

Problems and improvements

Data available for 1990 do not distinguish the other species of broadleaves but only the main species as Maritime pine and Eucalyptus.
During the field work it was also possible to classify the tree species composition of FORSEE plots and to compare it with official data.
In terms of improvements, it would be important to assess this indicator for the remaining 5 municipalities of Sousa Valley (the North of Paredes, Penafiel, Paços de Ferreira, Felgueiras, Lousada and Castelo de Paiva) and to compare if there are differences per municipality. Under FORSEE project, the option was to use data on land use available at the moment and covering the South of Paredes where the field work was carried out. In the beginning of 2007 it was published the NFI 2005 which can be now used to calculate the percentages of the different types of tree specie composition in Sousa Valley.

Comments and conclusion

It is possible to assess this indicator using the attribute tables of digital land use maps for different years, 1990 and 1995. The field work is also a good practise to confirm the tree species composition in the area of study.
In terms of tree species composition, it is possible to conclude that in the South of Paredes, in both 1990 and 1995, the high percentage of forest was the one classified as having 1 specie and Eucalyptus the main specie.
Eucalyptus, being fast growing specie from which forest owners can take revenues after 12 years of rotation, is gaining area to Maritime pine and to other forest species. If a poor tree specie composition is correlated with biologic diversity, the South of Paredes presents a low level of biologic diversity.
The stands of mixed broadleaves, located mainly along the streams and where Oaks are predominant specie (according to the field work records), assume a high importance in terms of soil and water protection.
The assessment of the indicator tree species composition, defined as area of forest classified according to the number of tree species occurring and the forest type, is similar to what is asked for the assessment of the indicator forest structure considered by NP 4406 2003 in terms of type of forest structures (mono specific/mixed stands, regular/irregular stands).

The forest structure is one of the indicators of Criterion 1 (not Criterion 4) considered by NP 4406 2003. NP 4406 2003 considers that the structural variability of the forest stands has a big influence in the management and in the characteristics of the forest ecosystem. The variability of the vertical structure considers the crown distribution by hierarchic class and the variability of the horizontal structure considers the distribution by classes of diameter.
The simplified structures (mono specific or regular stands) optimize the forest production while the complex structures (mixed or irregular stands) are more effective on the provision of goods and services and in general present higher values of biologic diversity.

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Indicator 4.2.1: Plantation

Total forest area in Sousa Valley (IFN2005): 29274,16 ha

Percentage of the total forest covered: 100 %

Costs

TOTAL COST: 27 €

The total cost includes :

1- Data analysis: 27 €

Results

Area of the main species **planted** between **1994** and **2004** in **Sousa Valley** co-financed by EU forest programmes

Specie	Area (ha)	(%)
Pinus pinaster	**452,35**	**40,509**
Coniferous x Broadleaves	**389,62**	**34,892**
Broadleaves	**114,25**	**10,231**
Quercus rubra	52,5	4,702
Eucalyptus globulus	26,26	2,352
Juglans regia	11,45	1,025
Castanea sativa	10,76	0,964
Cupressus lusitanica	10,7	0,958
Pinus pinaster x *Cupressus lusitanica*	9,5	0,851
Quercus robur	8	0,716
Fraxinus angustigolia	6,78	0,607
Quercus rubra x *Cupressus lusitanica*	6,32	0,566
Chamaecyparis sp.	4,47	0,400
Pinus pinaster x *Eucaliptus globulus*	3,85	0,345
Prunus avium	3,8	0,340
Castanea sativa x *Quercus rubra*	2,66	0,238
Pinus pinaster x *Quercus rubra*	1,2	0,107
Acer sp.	0,75	0,067
Pinus pinea	0,74	0,066
Quercus suber	0,7	0,063
Total area of forest plantations	**1116,66**	**100,000**
Total forest area in Sousa Valley	**29274,16**	
% of area of forest planted in the total forest area		**3,8**

Source: AFVS

Area of eucalyptus belonging to the pulp and paper industries in Sousa Valley in 2005

Area of Eucalyptus under the pulp and paper industries management in Sousa Valley in 2005 (1)	4900 hectares
Total forest area in Sousa Valley in 2005 (2)	29274,16 hectares
(1)/(2) %	**16,7 %**

Sources: 1- AFVS; 2- NFI, 2005

Remarks

This indicator is substituting the indicator C4.2 – Regeneration because

1) Data about regeneration was not available

The indicator C4.2 - Regeneration, defined as the area of regeneration according to the regeneration type, natural or artificial was not feasible at the pilot zone level. However, the field work carried out in FORSEE plots allow the field team to observe the following:

- In mixed and abandoned stands the natural regeneration was abundant and constituted by *Quercus sp*., *Arbutus unedo* and *Pinus pinaster*;
- Natural and artificial regeneration is very important to assure the continuity of the forest stands. In Sousa Valley, natural regeneration seems not to be sufficient to assure the sustainability of *Pinus pinaster* stands. One of the reasons is the forest fires that every year destroys it;
- The regeneration of *Eucalyptus globulus* stands is assured by plantation and also by natural regeneration. Also here the natural regeneration is threatened by the forest fires;
- Once having the forest burnt, more difficult it is to keep the forest owners motivated to prepare the soil and to plant the land again. The abandonment of the stands and the lack of management, sometimes due to the frequency of forest fires, make natural regeneration grow in excess. This happens mainly in Eucalyptus stands belonging to NIPFOs and can be negative for SFM because it reduces the diversity of plants and increase again the risk of forest fires, favouring its propagation and the degree of danger. The excessive regeneration can also turn the forest more susceptible to the attacks of pests and diseases.
- During the field work carried out under FORSEE project it was also observed the *Pteridium aquilinium* in the undercover. This can be negative for natural regeneration since it competes with it for sun light.

2) Plantations are very important in the pilot zone

Given the importance of plantations in Sousa Valley, North Portugal team decided to present the information about plantations in Sousa Valley as a new indicator. This indicator is important since the forest in the pilot zone is mainly forest of production that is continuously regenerated to produce raw material for the pulp and paper industries. The pulp and paper industries can plant new areas and regenerate by plantation areas formerly planted with eucalyptus.

In Sousa Valley, especially since 1994, the EU co-financed afforestation projects and the services provided by the local FOA have been given support for NIPFO to plant new forest areas or to plant previous forest areas with different species from the ones that were there.

2.1) Plantation by NIPFO

The table above shows the main species planted between 1994 and 2004 in Sousa Valley by NIPFOs. In order to take advantage of the EU co-financed forest programmes many forest owners have asked to the local FOA to draw the forest management plans and to provide them the technical assistance required for the implementation of new forest areas. These plantations may happen in agricultural land or in forest land were the previous specie was not the one they planted through forest programmes and it is not possible to find whether it is regeneration or not;

In terms of accumulated area, between 1994 and 2005 the NIPFO supported by EU afforestation programmes planted about **3,8%** of forest in Sousa Valley.

2.2) Plantation by pulp and paper industries

In addition, in 2005 there were about 17099, 51 hectares of pure eucalyptus stands in Sousa Valley. In 2005, 4900 ha of eucalyptus were under the management of pulp and paper industries. This area could have resulted from new plantations, natural regeneration and regeneration by plantation. Pulp and paper industries must keep records of the area planted every year in Sousa Valley but FORSEE team did not try to find if these data were available or not upon request close to the pulp and paper industries. Considered that this area was all planted, this corresponds to a percentage of **16,7%** of the total forest area in Sousa Valley.

Problems, improvements and conclusions

In Sousa Valley, eucalyptus plantations are important not only in terms of the amount of forest land they represent, but also because they are the forest species that can generate income more quickly for forest owners.

In many cases they have been replacing pine forests and other kinds of forests destroyed by forest fires.

For these reasons these plantations need to be monitored very closely. Building capacity for forest inventory in the local forest owners' association is a way to improve this kind of monitoring.

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Indicator 4.3: Naturalness

Total forest area in Sousa Valley (2005): 29249,16 ha

Percentage of the total forest covered: 100 %

Costs

TOTAL COST: 27 €

The total cost includes :

1- Data analysis: 27 €

Results

Area of semi-natural forests in Sousa Valley in 2005

Type of stands	Area (ha)	%	Type of forest
Pure stands of broadleaves	1099,97	3,76	Semi-natural (planted or not)
Mixed stands of broadleaves and other species	1449,96	4,96	
Total forest in Sousa Valley	**29249,16**		

Source: NFI 2005

Remarks

Naturalness is the area of forests, undisturbed by man, semi-natural or planted but not under intensive management.
Non disturbed forest is defined as old forests, mainly composed by native species without human intervention during at least 50 years. According to local sources, this type of forests is inexistent in Sousa Valley.
Semi-natural forests are defined as forests that are not under intensive management for a significant period of time. For this type of forest there was data available from NFI 2005.
It was considered that semi – natural forests in Sousa Valley are:
a) Pure stands of broadleaves: these stands include *Acacia* spp., *Fraxinus* spp., *Quercus* sp.;
b) Mixed stands with diverse broadleaves and other species: these stands include *Acacia* spp., *Fraxinus* spp., *Quercus* sp, *Pinus pinaster, Eucalyptus globulus, Pinus pinea*.

Pure stands of *Eucalyptus globulus* and *Pinus pinaster* and mixed stands of *Eucalyptus globulus* x *Pinus pinaster* were not considered as semi-natural forests because these stands are forest under intensive management given its production function.
In terms of visual assessment at the plot level it was recorded only 2 plots out of 35 located in stands where *Eucalyptus globulus and Pinus pinaster* were mixed with other broadleaves. These plots were considered to be "semi-natural".

Problems and improvements

In Sousa Valley, there are other stands that can be considered semi natural forests. According to foresters working at the local FOA there are some old stands composed by mixed or pure broadleaves with a high conservation value, some of them surrounded by walls (when they are inside aristocratic farms). The characteristics of these stands and their location should be recorded and kept in a database at the local FOA. This organisation is the main entity which carries on frequent contacts with forest owners and provides them technical assistance in the field. The foresters working there know most of those semi-natural stands and are able to identify their characteristics because some of the owners are members of AFVS.
Mixed with the remaining forests inventoried during the National Forest Inventories, these stands of high conservation value can not be distinguished among data. Only the identification and the reference at the local level would report their importance.

Comments and conclusion

Non disturbed forests by man do not exist in Sousa Valley.
Since it is a region with a high population density, almost all the forest is intensively managed and disturbed by man.
Data available to assess semi-natural forests came from the National Forest Inventory (2005). From the field work and through digital cartography available for 1995, it was possible to see that these forests are mainly located along the rivers and streams.
Data about the location and the characteristics of stands with significant conservation value are not available. However, some of these stands are known by the local FOA and at least some information can be checked close to the foresters working there.
These stands should be recorded and forest owners should be supported and encouraged to manage them with the proper forest management.
In abandoned stands, where broadleaves are mixed with Eucalyptus and Maritime pine it would be important to start managing in order improve the quality of these semi-natural forests and to create forests close to the semi-naturalness. Those forests could be important to provide environmental services such as soil and water protection, biodiversity conservation and landscape. This can be considered by the management plans that are going to be prepared for the Zones of Special Intervention.

Naturalness is one of the indicators of Criterion 4 considered by NP 4406 2003. NP 4406 2003 considers that the conservation of relevant natural and semi-natural vegetal communities is important not only as guarantee of the vegetal species that compose them but also as habitat of animal species, some of them endangered.

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Indicator 4.4: Introduced tree species

Costs

Total forest area in Sousa Valley (2005): 29274,16 ha

Percentage of the total forest covered: 100 %

Costs

TOTAL COST: 27 €

The total cost includes :

1- Data analysis: 27 €

Results

Area of *Eucalyptus globulus* in Sousa Valley in 2005

Area of *Eucalyptus globulus* mixed dominant and pure (ha)	20449,41
Total forest land (ha)	29274,16
% of mixed dominant and pure *Eucalyptus globulus* in the pilot zone	**70%**

Source: NFI, 2005

Other species introduced in Sousa Valley in the last 12 years with public co-financing

Specie	Origin	Area (ha)
Chamaecyparis sp.	North America	4,47
Cupressus lusitanica	Mexico	11,45
Juglans regia	Asia and Western Mediterranean	10,7
1) Total		**26,62**
2) Total area of forest in Sousa Valley in 2005, IFN 2005		**29274,16**
% of other introduced species in 2005 (1)/(2)	**0,091 %**	

Source: AFVS

Remarks

The main specie introduced in Sousa Valley is *Eucalyptus globulus* which has its origins in Tasmania. The plantations of this specie took off in Portugal in the 1960s in order to supply wood for the pulp mills recently installed in the country. This specie has been replacing part of the pine forest damaged by forest fires. In the take off of this specie, the Forest Services played an important role by distributing plants free of charge to the forest owners. From 1981 to 1998 a programme financed by the World Bank provided credit to the public pulp and paper companies and to the Forest Services to carry on afforestation with *Eucalyptus globulus*. Some incentives for its plantation existed after this programme but they were drastically reduced in the end of the 1980s. So the more recent growth in the area of *Eucalyptus globulus* is almost totally funded by pulp and paper companies and private forest owners. The growth in eucalyptus stands has been taking over some of the burnt pine forests and some agricultural lands which are abandoned or which were actively farmed before but where this fast growing species are becoming economically more attractive than agricultural uses. In 2005, pure stands of this introduced specie occupied about **58,4 % of the total forest area of Sousa Valley**.
Pinus pinaster may have been introduced by men's hands, but long time ago, because there are traces of it since the Neolithic period. This specie expanded since the XVI century by plantation, by natural and artificial dissemination and by natural regeneration. For some time, the Forest Services distributed seeds to the local populations who spread them in the fields that were abandoning from agriculture. In other cases, the dissemination of pine forests in abandoned farmland happened simply by natural dissemination.

Lately, the co-funded EU afforestation programmes has been promoting the introduction of other species. Some examples are the *Chamaecyparis* sp., *Cupressus lusitanica* or *Juglans regia.* The area in the table above only covers the one planted by forest owners that are members of the local FOA. They have a very small representation in the total forest of Sousa Valley.

Problems and improvements

This indicator is feasible at the regional level and can be updated every time that a new NFI is accomplished. More specified data on introduced tree species can be obtained close to the local FOA. However, that information only covers the forest belonging to its members and not to the remaining forest. In the future, the forest area covered by ZIFs (Zones of Forest Intervention) will be under forest management plans and the information on introduced tree species will be probably recorded by the local FOA.

Comments and conclusion

Eucalyptus globulus is the main specie introduced in Sousa Valley and also the main forest specie there. The introduction of other species is been undertaken with the help of EU co-funded forest programmes but the area stills insignificant.
The diversification of forest species may help to diminish the risk of fire propagation as well as the attacks of pest and diseases. However, this diversification is difficult to put in practise since *Eucalyptus globulus* is very important in terms of local economy and the forest owners prefer to have revenues in the short run.
In Sousa Valley, the continuous stands of Eucalyptus have been more and more damaged by fire which is negative in terms of its sustainability.
The local FOA has been providing details to the forest owners about the alternatives to the *Eucalyptus globulus* and the advantages of planting broadleaves of valuable timber in the long run.
Besides the introduced species referred above, Sousa Valley offers good conditions to the development of the following species: *Pinus radiata*, *Salix alba*, *Platanus hybrida* and *Pseudotsuga menziesii*.
So far, the plantations with other broadleaves but Eucalyptus and other slow growing species occur mainly with the help of public financing. Collective forest organisation is a possible solution to congregate at the same time economic and conservation management options in Sousa Valley.
The diversification of forest species can be important in terms of conservation, animal biodiversity and reduction of the risk of forest fires.

Indicator not considered by the Criterion 4 of the Portuguese Norm 4406 2003.

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Indicator 4.5: Deadwood

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %

Costs

TOTAL COST: 1820,5 €

Costs/ha:0,36 €
Costs/plot: 52 €

The total cost includes:

1- Data collection: 1793,5 €

2- Data analysis: 27 €

Results

Logs in transepts (T1, T2) and classes of decay

Type of stands	No of devices		Classes of decay				
			1	2	3	4	5
EcEc	6	Nº logs	1	7	10	3	
		mean diameter	7,8	17,9	10,3	10,8	
PbEc	4	Nº logs	1	2	2	3	1
		mean diameter	19,8	14,0	8,2	17,3	10,3
Pb x broadleaves	1	Nº logs		1			
		mean diameter		8			
Total number of logs found in the plots			31 logs in 11 devices (T1,T2)				

Source: Field sheets

In about 2/3 of the forest devices (68%) was not found any logs.

Snags in FORSEE devices (IFN and satellites)

Type of stands	No of devices		Classes of decay				
			1	2	3	4	5
EcEc	4	Nº logs	3	1	4		
		mean diameter	9,5	9,8	11,7		
PbPb	2	Nº logs	1	2			
		mean diameter	12,5	8,5			
Pb x broadleaves	2	Nº logs		3			
		mean diameter		16,3			
Total number of snags found in the plots			13 snags in 8 devices				

Source: Field sheets

Volume of deadwood in the FORSEE devices

Type of deadwood	1) Total volume of deadwood in the devices (m^3)	2) Area of forest assessed (ha)	Volume ($m^3.ha^{-1}$)
Logs	106,81	4956,2	0,0215
Snags	22,74		0,004588
Total	129,55		0,02601

Source: 1) UTAD estimates;
2) Area corresponding to half of the municipalities of Paredes, photo interpretation 1995.

Remarks

Logs were found in 11 devices (T1 and T2) from the 35 possible; 6 devices were pure stands of *Eucalyptus globulus* and 5 devices were pure or mixed stands of *Pinus pinaster*. Probably because of the intensive management of the stands, it was not found many logs in the transepts. Managers of production forests try to keep the levels of deadwood very low due to the sanitarian problems this type wood can bring to the stands.
Given the high classes of decay (between 1 and 4) of the logs found in the 6 devices of pure stands of Eucalyptus they may correspond to abandoned or not managed stands. In the remaining devices of pure stands of *Eucalyptus globulus* managed by pulp and paper industries there it was not inventoried any log in the transepts.
Mixed stands of *Pinus pinaster* and *Eucalyptus globulus* are the type of stands with logs in all classes of decay, even in the highest class (class of decay number 5).
In terms of ***snags***, they were only found in 4 devices, being classified in the lowest classes of decay.
The volume of logs found in the FORSEE transepts per hectare is 0,0215 $m^3.ha^{-1}$ and the volume of snags 0,004588 $m^3.ha^{-1}$

Problems and improvements

As already stated for indicator 1.4.3, the logs sampling using the line intercept method is already well documented in the forestry and ecology literature. The main problems detected during the test of this indicator were:

a) The length of the line (50 m) is very high for the size of the forest holdings in Sousa Valley. The small scale of the forest holdings and its fragmentation makes the transept cross different types of stands or even different types of land use;
b) The classification of the classes of decay;
c) The conversion of volume in biomass using wood density values.

In terms of the low levels of deadwood found in the plots, one can add that even though the intensive management of the forest stands in Sousa Valley, there were logs with a diameter < 7,5 cm that were not considered. Field team witnessed they existed in the stands but as it followed the 1st version of the FORSEE field guide (FORSEE.guideterrain.V1.es), which only asked for the measurement of logs with a diameter equal or above 7,5 cm did not note them down. This may also have contributed to the record of low levels of logs in the transepts.

Comments and conclusion

Deadwood is an important component of forest ecosystems in providing habitat, nutrients and shelter to a range of forest organisms. This is a recognised indicator of forest biodiversity because it helps to describe the quality and status of the habitats, and the structural diversity within a forest. In Sousa Valley, and especially in the South of Paredes, where the 35 FORSEE devices were located, the forest is mainly productive and there are not many ***logs*** and ***snags*** in the stands. This may happens because its presence can increase the risks of pests and diseases and the risks of fire propagation. Thus, forest managers opt to keep **logs** and ***snags*** in low levels. From the field work sheets and UTAD estimates (FORSEE Data report, table 17) it was possible to record that in the devices located in pure Eucalyptus stands under active management the volume of deadwood (***logs***) varies between 1,5 and 5,04 while in not managed or even abandoned Eucalyptus stands (example of the devices 120 and 248) the volume of deadwood is much higher, 15,79 $m^3.ha^{-1}$ and 25,37 $m^3.ha^{-1}$ respectively. According to WWF, the volume of deadwood recommended for productive stands in order to follow sustainable forest management maintaining the conservation value of forests is 20-30 $m^3.ha^{-1}$ divided between ***logs*** and ***snags***. This means that stands in Sousa Valley present a volume of deadwood (only ***logs*** considered) much lower than what is recommended by the ONG.
Nowadays, international forest policies are considering deadwood an important indicator of naturalness in forest ecosystems. It is a decision of forest managers in Sousa Valley to follow this indication and to let more ***logs*** or ***snags*** in the forest stands in order to support biodiversity or not.

<u>Old and cavernous trees</u> is one of the indicators of Criterion 4 considered by NP 4406 2003. NP 4406 2003 considers that most of the silvicultural systems indicate the final cut of the trees in the early ages, far from longevity. As a consequence of that practise, the forest areas usually present a scarce number of old trees and trees with big diameters. In general, the trees of big diameters have a set of natural holes which are very important as shelter to a variety of animals. These functions are also assured by dead trees.

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e) Criterion 5: Forest soils

General considerations about this criterion

The understanding about the natural processes that assure the life in the planet stills in a very insipient phase. In the two last decades of the 20th century, the soil appeared to be an important key component of the ecosystems contributing to the recognition of the necessity of maintaining and improving its capacity of carrying out a multiplicity of functions (Nortcliff, 2002). In the other hand, researchers are aware that soil is not an unlimited resource and if used improperly or under bad management practises it can be lost in a short period of time with few chances to be recovered again. In fact, the organic carbon of the soil constitutes the biggest reservoir of carbon in the terrestrial biosphere. About 75% of the total terrestrial carbon is stored in the soils with forest soils contributing with about 40% of that percentage. Therefore, soil dynamics in these systems have significant implications in the global carbon storage (Chhabra *et al*., 2003; Li *et al*., 2005). Due to the great importance of the soil in the terrestrial ecosystems and the proportion of carbon stored there, small variations resulting from perturbations, like changes in the vegetal cover and soil mobilization can have big influence in the sustainability of the ecosystems in the long run (Percival *et al*., 2000). The indicators proposed by FORSEE project aim to measure the change of some relevant properties concerning a detected sustainability risk over the time.

Given to budget restrictions and lack of technical support for the evaluation of C5 indicators, from the list of indicators approved by C5 working group, North Portugal chose only 2 indicators to assess: C5.3.1 – Carbon soil stock and Water Holding Capacity and C5.3.2 – Topsoil Nutritive Status (Cations, C, C/N, P, pH). The soil samples were collected by a team of three people, after the inventory measurements and forest health assessment. The analysis was done at the laboratory of soils of University of Trás-os Montes e Alto Douro (UTAD). After having the results of the analysis, arose the problem of what should be done with them since C5 experts did not provide the nutritive requisites for the species occurring at the pilot zone: *Eucalyptus globulus* and *Pinus pinaster*.

Results obtained under FORSEE project for the indicators of this criterion

Indicator 5.3.1 : Carbon soil and water holding capacity

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %

Number of plots: 35

Costs

TOTAL COST: 1300,75 €

Costs/plot: 37,1 €

The total cost includes:

1-Data collection 462,5 €

2-Data analysis 838,25 €

Results

% of Organic Matter in the soils per type of stands

Type of stands	Pb		Euc	
Depth (cm)	0-30	30-60	0-30	30-60
O.M. (%)	8,2	3,1	8,4	2,7
C (%)	4,76	1,80	4,87	1,57

Source: UTAD laboratorial analysis

% of Organic Matter in the soils per type of stands

Type of stands	PbEc		EcPb	
Depth (cm)	0-30	30-60	0-30	30-60
O.M. (%)	9	1,6	6,4	1,8
C (%)	5,22	0,93	3,71	1,04

Source: UTAD laboratorial analysis

Classes of M.O. in Eucalyptus soils (%)

Classes of organic matter	Organic Matter (%)	
	***"Textura grosseira"* (gross texture)**	***"Textura fina"* (thin texture)**
Very low	<1	<1,5
Low	≥ 1 and < 1,5	≥ 1,5 and < 2
Mean	≥ 1,5 and < 3,5	≥ 2 and < 4
High	≥ 3,5 and < 5	≥ 4 and < 6
Very High	≥ 5	≥ 6

Source: *Fabres et al.* (2005). Indicadores de fertilidade do solo e do estado nutricional da planta para o cultivo de *Eucalyptus globulus.* RAIZ – Instituto de Investigação da Floresta e do Papel.

Classes of M.O. in Maritime pine soils (%)

Classes of organic matter	Organic Matter (%)
Very low	0,6
Low	3,3
High	7,6
Very High	10,9

Source: Gandullo, JM.; S. Gonzalez Alonso y O. Sanchez Palomares (1994). Estaciones Ecológicas de los pinares españoles. ICONA Madrid. 188p.

Remarks

Fabres *et al.* (2005) parameters (RAIZ)

According to the Fabres *et al*. (2005), have developed applied research in the field of the forest soils and nutrition with the aim of establishing reference values to parameters of soil analysis and foliar concentration of nutrients that allow to a good interpretation of Eucalyptus' cultivation. These authors suggest classes of soil fertility and classes of foliar concentration of nutrients to the evaluation of the fertility of the soil and its nutritional state. It was defined 5 classes corresponding to different levels of soil nutrients: Very low, Low, Mean, High and Very High. The classes Very Low and Low are considerate to have a level of nutrients that restrict the growing of eucalyptus, the classes Mean and High are considerate to have an adequate level of nutrients for the eucalyptus growing and the class Very High is considered to have an excessive level of nutrients for the eucalyptus growing.

The assumptions to the interpretation of the RAIZ table are:

1) The soil deepness referred by the levels is 40 cm, except for thin soils;

2) The average stony of soils considered was 15%;

3) The classes were established in order to include most of the forest productivities found in Portugal (between 10 m^3 /o.b./ha/year and 40 m^3 /o.b./ha/year;

4) The classification of the nutrients of the soils is only valid to the methods of analysis used by RAIZ (method of extraction of nutrients of Egner-Riehm - P and K in mg/kg - and acetate of ammonium - K, Ca and Mg in cmol/kg).

Gandullo *et al.* (1994) parameters

Gandullo *et al.* (1994) present reference values for Maritime pine, but only define 4 classes of soil fertility: Very low, Low, High and Very High.

MARITIME PINE

The reference values were given by Gandullo *et al.* (1994).

Considering the soil deepness in the range 30-60 cm, the results of soil analysis done by UTAD laboratory, which uses the same extraction methods than RAIZ (Egner-Riehm and acetate of ammonium), show that in pure Pine stands and mixed Pine stands were Pine is dominant, the values of O.M. in percentage are 3,1 and 1,6 respectively. These values correspond to the level **Low** in Gandullo *et al.* (1994) classification. If one considered the soil deepness in the range 0-30 cm, the values of O.M. in percentage are higher, namely 8,2 in pure pine stands and 9 in mixed pine stands were pine is dominant.

EUCALYPTUS GLOBULUS

The reference values were given by Fabres *et al.*(2005), RAIZ.

For eucalyptus stands we have to consider the soil deepness in the range 30-60 cm since is where the deepness 40 cm, considered by RAIZ, is included. Then the results of soil analysis are 2,7% of O.M. in pure eucalyptus stands and 1,8% of O.M. in mixed eucalyptus stands where Eucalyptus is dominant. Since the texture determined by UTAD analysis is mean (see DATA report) one can considered that the classes of O.M. in eucalyptus stands in Sousa Valley goes from **Low** to **Mean**, according the values given by RAIZ.

Problems and improvements

The expert group for criterion 5 couldn't provide reference values for the forest species of the Atlantic arc. The reference values for Portuguese forest soils presented in this report were given by RAIZ a private non-profit research institute committed to support the competitiveness of the Portuguese Pulp and Paper Industry. The link with future research related to FORSEE project and RAIZ should be kept given the knowledge and expertise accumulated through the years by this research institution in what is concerning to the cultivation of Eucalyptus.

The comparison between the reference values and the soil analysis in the pilot zone can give a general idea about soils nutrition and contents of O.M. but is it is hard to state if the sustainability of forests is being accomplished or not since there is a high number of variable interfering on that.

This data was very convenient since the pilot zone is almost covered by Eucalyptus and small areas of Maritime pine.

There was also a change in the methodology of soils collection that can be affecting the results. If FORSEE field guide was requiring 10 samples per plot, collected in a systematic way (see FORSEE field guide), the FORSEE field team decided to collect only 3 samples per plot in three different location inside the plot.

This happened because:

a) **Logistic reasons** that impeded to transport in the car 10 soil samples per plot;

b) **Financial reasons**, given the high costs of the laboratorial analysis.

Other shortcoming is that the soil samples were only collected in the South part of the municipality of Paredes and not in all Sousa Valley.

Comments et conclusion

This indicator is feasible but costly given the human resources needed to collect the soil samples, the human strength that is needed to collect the samples and the laboratorial analysis *per se*.

However it seems important to assess the nutrient characteristics of the forests soils in determined intervals that can be more or less spaced in time according to soil researchers.

The main species in Continental Portugal are Maritime pine and Eucalyptus. For Maritime pine it was difficult to find reference values but for Eucalyptus RAIZ could provide some reference values.

Since RAIZ can provide data on this indicator (for *Eucalyptus globulus*), the link and the contacts with this institute should be kept.

Information about other forest species would be also important since it could be used as a reference tool by forest managers (ex. foresters working at the local FOA) with the objective of helping them choosing the correct forest species for the new forest areas.

Indicator C5.3.1 is not considered by Criterion 5 of the Portuguese Norm 4406 2003.

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Indicator 5.3.2 : Nutritive status

Forest area covered (1995): 4956,1 ha

Percentage of the total forest area in Sousa Valley: 14,3 %

Number of plots: 35

Costs

TOTAL COST: 1300,75 €

Costs/plot: 37,1 €

The total cost includes:

1-Data collection 462,5 €

2-Data analysis 838,25 €

Results

Chemical characteristics of soils in the FORSEE forests plots

	Pb		Ec		PbEc		EcPb	
Depth (cm)	**0-30**	**30-60**	**0-30**	**30-60**	**0-30**	**30-60**	**0-30**	**30-60**
pH (H2O)	4,4	4,7	4,3	4,6	4,3	4,4	4,5	4,7
pH (KCl)	3,8	3,9	3,7	3,9	3,5	3,7	3,9	4
P2O5 (mg/kg)	5,1	2,7	**5,2**	**3,9**	7,2	2,7	6,6	5
K2O (mg/kg)	51,6	58,8	**47,3**	**43**	59,3	60,7	69	49
Ca (cmol+/kg)	0,3	0,4	0,3	0,3	0,3	0,1	0,2	0,2
Mg (cmol+/kg)	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
K (cmol+/kg)	0,1	0,1	0,1	0,1	0,1	0,1	0,2	0,1
Na (cmol+/kg)	0,1	0,05	0,1	0,1	0,1	0,1	0,1	0,1
Al (cmol+/kg)	1,7	1,4	1,5	0,9	1,6	1,8	1,2	0,9

Source: UTAD laboratorial analysis

Pb- Pure stands of *Pinus pinaster*; Ec- Pure stands of *Eucalyptus globulus*; PbEc- Mixed stands of *Pinus pinaster* and *Eucalyptus globulus*; EcPb- Mixed stands of *Eucalyptus globulus* and *Pinus pinaster*.

Classes of soil fertility in the soils of Eucalyptus stands in Portugal

Classes of fertility	**Concentration in the soil**				
	P	**K**		**Ca**	**Mg**
	mg/kg	mg/kg	cmol/kg	cmol/kg	
Very low	< 5	< 16	< 0,041	<0,15	<0,05
Low	≥ 5 and < 10	≥ 16 and < 40	≥ 0,041 and < 0,103	≥ 0,15 and < 0,35	≥ 0,05 and < 0,10
Mean	≥ 10 and < 25	≥ 40 and < 75	≥ 0,103 and < 0,192	≥ 0,35 and < 0,80	≥ 0,10 and < 0,20
High	≥ 25 and < 50	≥ 75 and < 120	≥ 0,192 and < 0,308	≥ 0,80 and < 1,5	≥ 0,20 and < 0,50
Very high	≥ 50	≥ 120	≥ 0,308	≥ 1,5	≥ 0,50

Source: *Fabres et al.* (2005). Indicadores de fertilidade do solo e do estado nutricional da planta para o cultivo de *Eucalyptus globulus.* RAIZ – Instituto de Investigação da Floresta e do Papel.

Classes of acidity for forest soils

Classes of soil acidity	**pH (in water)**
Very acid	<4,1
Acid	≥ 4,1 and < 5
Fairly acid	≥ 5 and < 6,5
Neutral	≥ 6,5 and < 7
Alkaline	≥ 7 and < 8
Very alkaline	≥ 8

Source: *Fabres et al.* (2005). Indicadores de fertilidade do solo e do estado nutricional da planta para o cultivo de *Eucalyptus globulus.* RAIZ – Instituto de Investigação da Floresta e do Papel.

Classes of acidity in Maritime pine stands

Classes of acidity	**pH (in water)**
Very low	4,5
Low	4,6
High	5,6
Very high	6,1

Source: Gandullo, JM.; S. Gonzalez Alonso y O. Sanchez Palomares (1994). Estaciones Ecológicas de los pinares españoles. ICONA Madrid. 188p.

Remarks (1)

Fabres *et al.* (2005) parameters

Fabres et al. (2005) have developed applied research in the field of the forest soils and nutrition with the aim of establishing reference values to parameters of soil analysis and foliar concentration of nutrients that allow to a good interpretation of Eucalyptus' cultivation. These authors suggest classes of soil fertility and classes of foliar concentration of nutrients to the evaluation of the fertility of the soil and its nutritional state. It was defined 5 classes corresponding to different levels of soil nutrients: Very low, Low, Mean, High and Very High. The classes Very Low and Low are considerate to have a level of nutrients that restrict the growing of eucalyptus, the classes Mean and High are considerate to have an adequate level of nutrients for the eucalyptus growing and the class Very High is considered to have an excessive level of nutrients for the eucalyptus growing.

The assumptions to the interpretation of the RAIZ table are:

1) The soil deepness referred by the levels is 40 cm, except for thin soils;
2) The average stony of soils considered was 15%;
3) The classes were established in order to include most of the forest productivities found in Portugal (between 10 m^3 /o.b./ha/year and 40 m^3 /o.b./ha/year;
4) The classification of the nutrients of the soils is only valid to the methods of analysis used by RAIZ (method of extraction of nutrients of Egner-Riehm - P and K in mg/kg - and acetate of ammonium - K, Ca and Mg in cmol/kg).

Gandullo *et al.* (1994) parameters

Gandullo *et al.* (1994) present reference values for Maritime pine, but the parameters available are only for pH in water. They define 4 classes of acidity: Very low, Low, High and Very high.

EUCALYPTUS GLOBULUS

The reference values were given by Fabres *et al.*(2005), RAIZ.

1) pH (in water): The results of soil analysis show that for a soil deepness between 30-60 cm the pH (H2O) is 4,6 in pure stands and is 4,7 in mixed stands where Eucalyptus is dominant. According to the reference values given by RAIZ the pH of forest soils in Eucalyptus stands in the pilot zone is **Acid**;
2) P2O5: The results of soil analysis show that for a soil deepness between 30-60 cm, the content of P2O5 is 3,9 in pure stands and 5 in mixed stands where Eucalyptus is dominant. According to the reference values given by RAIZ the content of P2O5 of forest soils in Eucalyptus stands in the pilot zone is **Very Low** to **Low**;

Remarks (2)

3) K2O: The results of soil analysis show that for a soil deepness between 30-60 cm, the content of K2O is 43 in pure stands and 49 in mixed stands where Eucalyptus is dominant. According to the reference values given by RAIZ the content of K2O of forest soils in Eucalyptus stands in the pilot zone is **Mean (in the average).**
4) Ca: The results of soil analysis show that for a soil deepness between 30-60 cm, the content of Ca is 0,3 in pure stands and 0,2 in mixed stands where Eucalyptus is dominant. According to the reference values given by RAIZ the content of Ca of forest soils in Eucalyptus stands in the pilot zone is **Low.**
5) Mg: The results of soil analysis show that for a soil deepness between 30-60 cm, the content of Mg is 0,1 in pure stands and 0,1 in mixed stands where eucalyptus is dominant. According to the reference values given by RAIZ the content of Mg of forest soils in Eucalyptus stands in the pilot zone is **Mean (in the average).**

MARITIME PINE
The only references one has are the values for pH in water given by Gandullo *et al.* (1994).
Then:
1) pH (in water): The results of soil analysis show that for a soil deepness between 30-60 cm the pH (H2O) is 4,7 in pure stands and is 4,4 in mixed stands where Maritime pine is dominant. According to the reference values given by Gandullo *et al.* (1994) the pH of forest soils in Pine stands in the pilot zone is **Low**.

Problems and improvements

The expert group for criterion 5 couldn't provide reference values for the forest species of the Atlantic arc. The reference values for Portuguese forest soils presented in this report were given by RAIZ a private non-profit research institute committed to support the competitiveness of the Portuguese Pulp and Paper Industry. The link with future research related to FORSEE project and RAIZ should be kept given the knowledge and expertise accumulated through the years by this research institution in what is concerning to the cultivation of Eucalyptus.

Data provided by this institute was very convenient since the pilot zone is almost covered by Eucalyptus however for Maritime pine it was not founf references about their nutritive requirements or reference values for the soils where this specie is dominant.

The comparison between the reference values and the soil analysis in the pilot zone can give a general idea about soils nutrition and contents of O.M. but is it is hard to state if the sustainability of forests is being accomplished or not since there is a high number of variable interfering on that.

There was also a change in the methodology of soils collection that can be affecting the results. If FORSEE field guide was requiring 10 samples per plot, collected in a systematic way (see FORSEE field guide), the FORSEE field team decided to collect only 3 samples per plot in aleatory way.

This happened because:

a) **Logistic reasons** that impeded to transport in the car 10 soil samples per plot;

b) **Financial reasons**, given the high costs of the laboratorial analysis.

Other shortcoming is that the soil samples were only collected in the South part of the municipality of Paredes and not in all Sousa Valley.

Comments et conclusion

This indicator is feasible but costly given the human resources needed to collect the soil samples, the human strength that is needed to collect the samples and the laboratorial analysis *per se*.

However it seems important to assess the nutrient characteristics of the forests soils in determined intervals that can be more or less spaced in time according to soil researchers.

The main species in Continental Portugal are Maritime pine and Eucalyptus. For Maritime pine it was difficult to find reference values but for Eucalyptus the RAIZ institute could provide some reference values.

Since RAIZ can provide data on this indicator (for *Eucalyptus globulus*), the link and the contacts with this institute should be kept.

Information about other forest species would be also important since it could be used as a reference tool by forest managers (ex. foresters working at the local FOA) with the objective of helping them choosing the correct forest species for the new forest areas.

Indicator not considered by Criterion 5 of the Portuguese Norm 4406 2003.

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f) Criterion 6: Socio-economic functions of forests

Results obtained under FORSEE project for the indicators of this criterion

Indicator 6.01 : Forest holdings

Forest area covered (1995): 9638 ha

Percentage of the total forest area in Sousa Valley: 35 %

Costs

TOTAL COST: 859,9 €

The total cost includes:

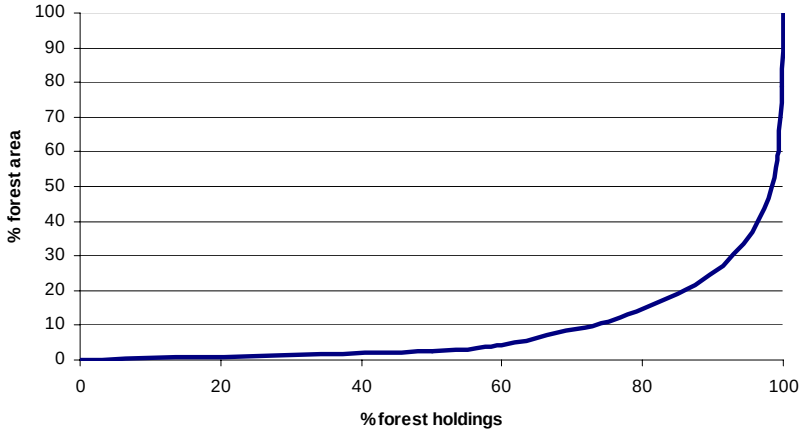
1-Data collection 499,88 €

* This value corresponds only to the secondary data provided by the local FOA. The costs of field work done by this FOA in order to obtain the data about cadastre are not included in the total costs considered in this indicator.

2- Data analysis: 360 €

Results

Lorenz curve



Gini coefficient: **0,830435**

	Type of management	Area (ha)	%
Forest holdings surveyed	Non industrial private forest holdings	3865,246	68
	Industrial private forest holdings	1800	32
	Total	5665,246	100
Forest in Penafiel in 1995		**9638**	
% forest holdings surveyed			**58,7**

Source: AFVS

Shortcomings and improvements

There is no cadastral data available being the data available in the **fiscal registers** of the local tax office, but not compiled (compilation being a very time consuming job) and not always accurate.
Data available only covers about 35% of the total forest land of Sousa Valley (34668 hectares). Considering only the municipality of Penafiel (9638 hectares), for which more information on cadastre based on fiscal registers was available, the percentage raises to 58%.

In the coming future this methodology for data collection will yield **more representative results** as others ZIFs will be implemented covering most of the forest land in the pilot zone. Also the data will become **more accurate through** Official cadastral data (Forest Services) and Unofficial cadastral data (forest owners' association).

The recommendations for improvements are to take into account the forest holdings that are included in ZIFs**,** to take into account forest holdings belonging to members of the local forest owners' association**,** to carry out specific studies on forest owners' socioeconomic characteristics and attitudes towards forests.

Comments and conclusion

So far, the feasibility of this indicator depends on the collaboration and information available on local FOAs. **In terms of relevance of the indicator for SFM**, it can be said that without further qualifications, this indicator in itself is **not of enough relevance** for SFM since what really matters for this purpose in the context of private and small scale forestry is whether or not the forest owners are **individually and collectively organized** in order to promote SFM. This depends on the size of their holdings, but this size is not always essential for that purpose.

Indicator not considered by Criterion 6 of the Portuguese Norm 4406 2003.

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Indicator 6.03 : Net revenue

Forest area covered (2005): 29274,16 ha

Percentage of the total forest area in Sousa Valley: 100 %

Costs

TOTAL COST: 171,3 €

The total cost includes:

1-Data collection 36,3 €

2-Data analysis 135 €

Results

Costs and revenues in *Eucalyptus globulus* stands

Year	Cost	Revenues	Revenues - Costs	Revenues – Costs (r=3%)
0	1350		-1350	-1350
1	0	0	0	0
2	150		-150	-141,389
3	80		-80	-73,2113
4-6	0	0	0	0
6	150		-150	-125,623
7-11	0	0	0	0
12	3420	5850	2430	1704,353
13	0	0	0	0
14	100		-100	-66,1118
15-23	0	0	0	0
24	3249	5557,5	2308,5	1135,629
25	0	0	0	0
26	100		-100	-46,3695
27-35	0	0	0	0
36	3249	5557,5	2308,5	796,5074
			NET PRESENT VALUE	**1833,785**

Source: Local foresters working for the pulp and paper industries.

Costs and revenues in *Pinus pinaster* stands

Year	Costs	Revenues	Revenues - Costs	Revenues – Costs (r=3%)
0	1350		-1350	-1350
1	0	0	0	0
2	150		-150	-141,389
3-11	0	0	0	0
12	150		-150	-105,207
23-15	0	0	0	0
16	950	1625	675	420,6377
17-21	0	0	0	0
22	1520	2600	1080	563,6439
23-44	0	0	0	0
45	1520	2600	1080	285,5937
			NET PRESENT VALUE	**-326,721**

Source: Local foresters working for the pulp and paper industries

Notes:

1) Base year: 2006;
2) Discount rate: 3%

Remarks (1)

The only data available comes from the pulp and paper industries since NIPFOs do not keep accounts of the costs and revenues in their forest holdings. Data presented refers to the costs and revenues **per hectare** of the pulp and paper industries in forest stands under their management. This data only covers about 4900 hectares of forest in Sousa Valley and was provided by foresters linked to pulp and paper industries. They know the costs of soil preparation, plantation and maintenance as well as the revenues coming from the wood selling of the two most important species in this region: Eucalyptus and Maritime pine.

EUCALYPTUS GLOBULUS

Assumptions:
Rotation: 12 years
Average productivity: 15 m^3/ha/year
Number of rotation: 3

Costs (for 2006):

Year 0 – Costs of soil preparation -750 €/ha (Include construction of infrastructures for management and fire prevention);
Year 0 - Planting costs - 600 €/ha (Include plantation, labour and 1400 plants/ha, and fertilization, labour and slow fertilization plus deep fertilization);
Year 2 - Shrub cleaning – 150 €/ha;
Year 3 - Fertilization (N, K, P) - 300 kg/ha of fertilizer plus labour – 80 €/ha;
Year 6 - Shrub cleaning – 150 €/ha;
Year 12 - Harvesting costs - 6 € /m^3 ob x 180 m^3 ob;
Year 12 - Wood's piling up - 5 € /m^3 ob x 180 m^3 ob;
Year 12 - Transportation costs to the paper mill for an average distance of 100 km - 8 € /m^3ob;

2nd rotation[7]
Year 2 or 3 - Twigs selection – 100 €/ha
(…)

3rd rotation[8]
Year 2 or 3 - Twigs selection – 100 €/ha
(…)

Revenues (prices for 2006):

Price of wood at mill's gate: 32,5 €/ m^3 ob.

According to data provided by our sources, after 3 rotation (36 years), each hectare of Eucalyptus under pulp and paper industries management has a net revenue of **1833,8 €.**

[7] In the 2nd and 3rd rotation it was considered a decrease of productivity of 5%.
[8] In the 2nd and 3rd rotation it was considered a decrease of productivity of 5%.

Remarks (2)

MARITIME PINE
Assumptions:
Rotation: 45 years
Average productivity: 2 m^3 /ha/year

Costs (for 2006)
Year 0: Soil preparation costs, includes construction of infrastructures for management and fire prevention- 750 €/ha;
Year 0: Planting costs, includes plantation (labour + 1400 plants/ha) and fertilization (labour +slow fertilization + deep fertilization) - 600 €/ha;
Year 2-3: Shrub cleaning – 150 €/ha
Year 12: Shrub cleaning – 150 €/ha
Year 16: 1st thinning, includes harvest costs + costs of wood piling up + transportation costs to the paper mill – 19 €/m^3 x 50 m^3
Year 22: 2nd thinning, includes harvest costs + costs of wood piling up + transportation costs to the paper mill - 19 €/m^3 x 80 m^3
Year 45: Final cut, includes harvest costs + costs of wood piling up + transportation costs to the paper mill - 19 €/m^3 x 80 m^3

Revenues (for 2006)
Year 16: 1st thinning (harvest revenues) - Price of wood at mill's gate: 32,5 €/ m^3 ob x 50 m^3
Year 22: 2nd thinning (harvest revenues) - Price of wood at mill's gate: 32,5 €/ m^3 ob x 80 m^3
Year 45: Final cut - Price of wood at mill's gate: 32,5 €/ m^3 ob x 80 m^3

According to data provided by our sources, after 1 rotation (45 years), each hectare of Maritime pine has a net revenue of **- 326,7 ha.**

Shortcomings and improvements

There is forest accounting data for this zone. To our knowledge no forest owners keeps accounts of his forest operations and there no organization yet to collect this kind of data.

Comments and conclusion

The feasibility conditions of the indicator in the pilot zone are not good since the forest owners do not have accounting data.
The assessment of this indicator relied on the technical staff of the pulp and paper companies who have reliable expertise about the costs and revenues of the forestry operations on their forest lands.

<u>Net revenue</u> is one of the indicators of Criterion 6 considered by NP 4406 2003. NP 4406 2003 considers that the diversification of the sources of revenue (multiple uses) and of the profitable moments (continued production) turn the forest areas more attractive in financial terms.

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Indicator 6.04 : Expenditure for services

Forest area covered (2005): 29274,16 ha

Percentage of the total forest area in Sousa Valley: 100 %

Costs

TOTAL COST: 176,2 €

The total cost includes:

1-Data collection 131,2 €

2-Data analysis 45 €

Results

Public expenditures for long term sustainable services in Sousa Valley between 2004 and 2006

Long term sustainable services		Amount (000 €)			
		Ministry of Agriculture			4) Ministry of Interior (2005/2006)
		1) AGRIS [9] programme 2004/2005	2) FFP [10] programme 2005/2006	3) RNPV[11] (2005)	
Protection of forests against forest fires	Prevention	308,5	636,37372	non elegible	70
	Fighting	non elegible	non elegible	28,8	6 volunteer fire departments
Total		**308,5**	**636,37372**	**28,8**	

Sources:

1)Municipalities of Sousa Valley and http://www.ifadap.min-agricultura.pt/ifadap/incentivos/agris/mainAGRIS.html;
2)http://www.ifadap.min-agricultura.pt/ifadap/incentivos/ffp/listagem.html#area%202
3) http://scrif.igeo.pt/servicos/pvigia/;
4) AFVS

[9] AGRIS Programme
[10] *Fundo Florestal Permanente* (Forest Permanent Fund)
[11] *Rede Nacional de Postos de Vigia* (National Net of Surveillance Towers)

Remarks

The main long term sustainable services in Sousa Valley are the actions of protection of forests against forest fires which include prevention and fire fighting. In Sousa Valley, the public stakeholders that spends funds with this actions are the Ministry of Agriculture and the Ministry of Interior:

A) Transfers from the Ministry of Agriculture to the municipalities

The 6 municipalities of Sousa Valley do not own forest land; however they spend public money in the protection of forests against fires through de development of preventive and strategic actions in public forest roads or other public spaces. For this activity, there were some public funds available from 2000 to 2006 through the AGRIS Programme the Permanent Forest Fund (FFP-*Fundo Florestal Permanente*).

The table above shows the total of funds approved for the 6 municipalities. The transfers of funds from the Ministry of Agriculture to the 6 municipalities of Sousa Valley amounted **308500 Euros** for the period 2004/2005 for funds coming from the AGRIS Programme and **636373, 72 Euros** for the period 2005/2006 from funds coming from the FFP.

B) Expenditures of the Ministry of Agriculture with the Fire Surveillance Towers in Sousa Valley

In Sousa Valley there are 4 surveillance towers under the responsibility of the Ministry of Agriculture. These towers are active during the months of higher risk of forest fire, usually the months of June, July, August and September. Each tower of surveillance has 4 people working by turns of 8 hours earning about 600 Euros/month. This makes a total of **28800 Euros** spent by the Ministry of Agriculture per tower of surveillance and per year. (4 towers x 4 people x 600 Euros x 3 monthes).

C) Transfers from the Ministry of Interior to the local FOA

In 2005, the Ministry of Interior transferred 70 000 Euros to the local FOA in order to co-finance the work of fire prevention carry out by the 2 brigades of forest sappers with 5 men each working there.

Shortcomings and improvements

In the coming future, as the process of the implementation of ZIFs will evolve in most of the forest land in the pilot zone, more of this kind of data can be collected from the local FOA which will be in charge of managing those areas.

Comments and conclusion

Indicator not considered by Criterion 6 of the NP 4406 2003.

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Indicator 6.05 : Forest sector workforce

Forest area covered (2005):
29274,16 ha

Percentage of the total forest area in Sousa Valley:
100 %

Costs

TOTAL COST:
784 €

The total cost includes:

1-Data collection
244 €

2-Data analysis
540 €

* Data from DGEEP: includes 21% of taxes=33,88 €

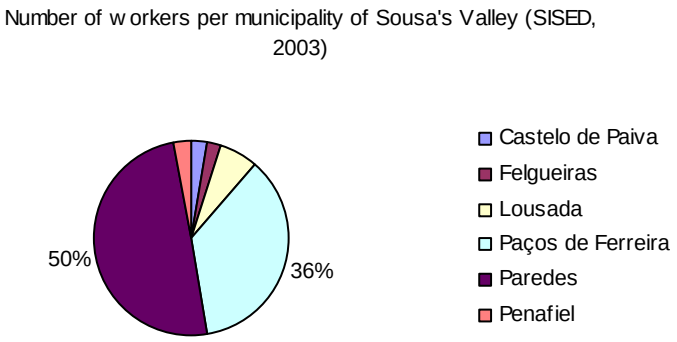
Data from INE: 86,96 € (discount of 50% for education institutions)

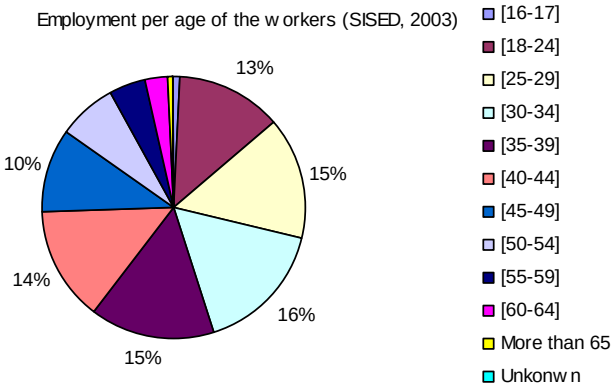
Results

Number of workers per type of activity

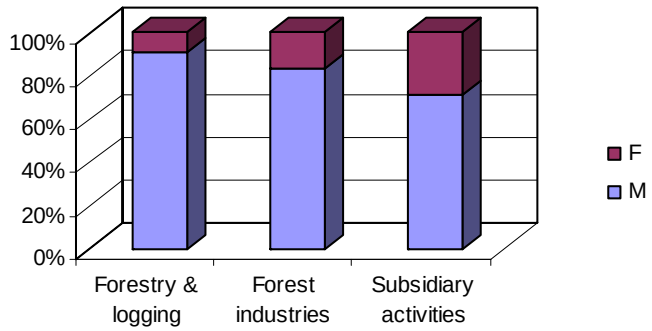
Activities	Number of workers	Percentage
Forestry & forest logging and forest services (1)	354	2%
Forest industries (2)	16668 (Furniture-13565)	94,9%
Subsidiary activities (2)	13	0,1%
Trade and forest products (2)	498	2,8%
Services related to forestry and forest industries (2)	40	0,2%
Total	**17573**	**100%**

Sources: 1) local sources; 2) SISED database

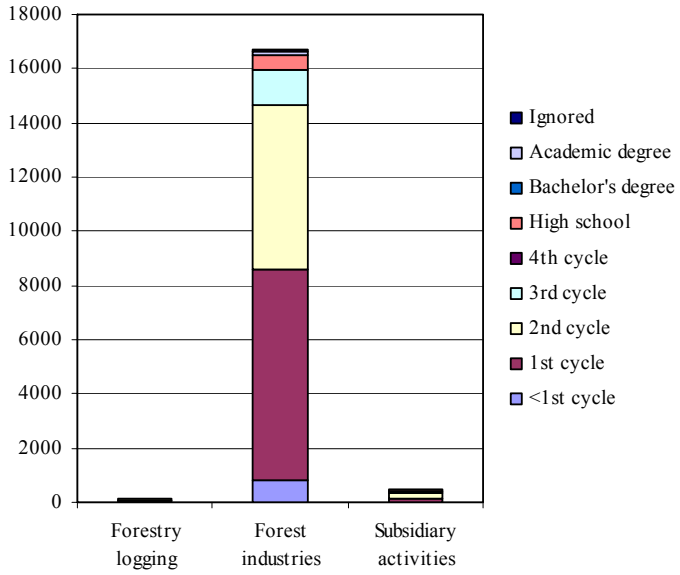




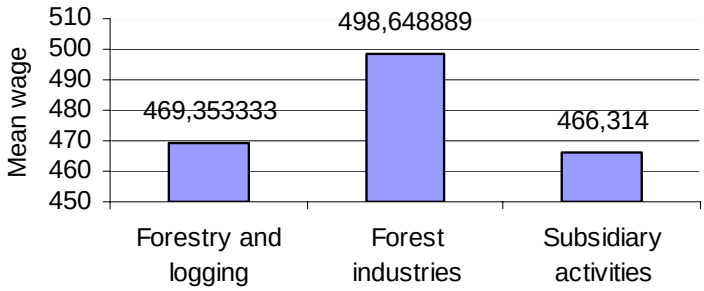
Workers per gender (SISED, 2003)



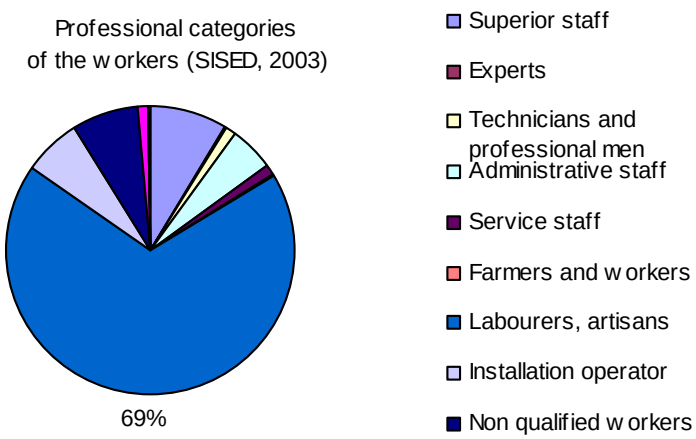
Qualification of the workers per activity (SISED, 2003)



Mean wages per activity (SISED, 2003)



Results


Professional categories
of the w orkers (SISED, 2003)
69%
Superior staff
Experts
Technicians and professional men
Administrative staff
Service staff
Farmers and w orkers
Labourers, artisans
Installation operator
Non qualified w orkers

Remarks

According to the expert group report, one used the concept of **forest cluster,** instead of the concept of forest sector. This is a broader concept is because it includes the following components:
1-Direct employment: activities directly related with the forest sector;
2-Indirect employment: industries and services related to inputs or outputs of the forest sector.
The detailed list of these activities making up the forest cluster is presented in report methodology based on the Portuguese Classification of the Economic Activities (*Classificação Portuguesa das Actividades Económicas – CAE – Rev. 2, 1992*) and on EUROSTAT NACE Classification Rev. 1.1.

Employment per type of forest activity
In 2003, there were 17573 workers in the forest cluster of the 6 municipalities of Sousa Valley. The activities related to forest industries were the ones employing more workers, 16 668 workers, about 13565 employed by the furniture industries.

Geographic repartition of the employment
At the local level, data shows that in 2003 the two municipalities which had mainly contributed to the employment in the forest cluster in Sousa Valley were Paredes (50%) and Paços de Ferreira (36%). The last one is called by "*capital do móvel*" (The capital of furniture) because of the amount of furniture produced there.

Age, gender, qualification of the workers and wages
In 2003, 83% of the workers of the forest cluster were between the 18 and the 49 years old being mostly men.
In terms of qualification, in 2003 most of the workers had between the 1st and the 2nd cycle of school education.

Professional categories of the workers
In Sousa Valley, in 2003, most of the workers in the forest sector were labourers or artisans (68, 4%).

Shortcomings and improvements

The source of data for employment (SISED database, 2003) in the forest cluster for the 6 municipalities of Sousa Valley gave detailed information about the number of workers per municipality, gender, age, mean wage, qualification and professional categories of the workers. However, official data was very incomplete for forestry and logging activities and for services related to forestry and forest industries.

1) **Data on the number of workers in the Forestry & Logging is probably underestimated**.

From the field work done in order to collect data regarding occupational safety and health in forest logging (Indicator 6.06) timber merchants inquired gave a number between 50 and 80 timber merchants acting in the 6 municipalities of Sousa Valley. If each timber merchant employs in average 4 workers (number given by the timber merchants inquired), this gives a number between **200** and **320** workers in this activity (in 2006). This range is higher than the number given by SISED database: 138 workers for Forestry & Forest logging which includes the activities of beekeeping, forestry and forest logging.

2) Data on the number of forest workers in *Other animal production – raising of game* (CAE 1252), *Services related to hunting and game propagation* (CAE 1502) and *Services related to forestry and forest logging* (CAE 2020) were not available at SISED database.

From the field work done in order to collect data regarding the indicators Occupational Safety and Health in forest logging (Indicator 6.06) and Total Economic Value of Forest Production in Sousa Valley (Indicator 6.12) it was possible to obtain local data on employment in those activities which are not mentioned by SISED database.

In the activity **Services related to forestry and forest logging** (CAE 2020) there are:

- Foresters working for the local FOA in 2003
- Administrative staff working for the local FOA in 2003
- Foresters working for the Technical Forest Offices in 2003 (GTF in Portuguese initials)
- Foresters working for the forest sectors of the agricultural cooperatives in 2003
- Forest sappers working for the local FOA in 2003
- General Direction of Forest Resources (DGRF - regional office):

In the activity **Other animal production – raising of game** (CAE 1252) there are:

- Workers for raising and selling units for game propagation

In the activity **Services related to hunting and hunting propagation** (CAE 1502) there is:

- Game guards working in hunting associations
- Other employees of hunting associations

Considering data obtained for all these activities the total number of workers in the forest cluster in Sousa Valley (6 municipalities) is about **17573** workers.

In order to improve this indicator, it have been established contacts with the National Institute of Statistics and the Ministry of Labour in order to carry out a protocol to improve employment data on:

a) Forestry & forest logging and on services related to forestry and to forest industries;

b) Very small enterprises in the furniture industry and related activities.

Comments and conclusion

To assess this indicator there are official data not published but available from the National Institute of Statistics and from the Ministry of Labour (SISED database from DGEEP). However, this official data is incomplete for forestry and logging activities and for services related to forestry and forest industries. This missing data can be obtained but with the help of local informants.
In terms of **relevance of the indicator for SFM**, since most of the forest employment in this area is related to forest industries and since most of these industries do not consume local forest products, these data, as whole, is not of very high relevance for SFM. **What is of more relevance are data concerning the services related to forestry and logging.**

<u>Volume and employment quantification</u> is one of the indicators of Criterion 6 considered by NP 4406 2003. NP 4406 2003 states that forest activity has been pointed as a solution of employment with high potential in rural areas. Then, it is important to clarify the contribution of the rural areas to the rural employment, as well as to promote the quality of life of the forest workers (promoting qualification, specific training and equality of genders in forest work).

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Indicator 6.06 : Occupational safety and health

Forest area covered (2005): 29274,16 ha

Percentage of the total forest area in Sousa Valley: 100 %

Costs

TOTAL COST: **280,6 €**

The total cost includes:

1-Data collection 190,6 €

2-Data analysis 90 €

Results

Number of serious accidents per 100 forest workers in [2003 -2006]

Entities inquired	Number of total workers in Sousa Valley	Number of accidents	Number of serious accidents per 100 Forest workers in 4 years
Forest contractors (sample=20)	93	4	4,3
1 FOA	10	0	0
1 AS	15	13	86,6
1 PPI	1	1	100
Total	**120**	**19**	**15,8**

Source: Phone inquiries to local timber merchants

Number of small accidents per 100 forest workers in [2003-2006]

Entities inquired	Number of workers in Sousa Valley	Number of small accidents
Forest contractors	93	n.q.
1 FOA	10	24
1 AS	15	n.q.
1 PPI	2	n.q.
Total	**120**	**n.q.**

Source: Phone inquiries to local timber merchants

FOA- Forest Owner Organisation
AS- Agricultural society
PPI- Pulp and paper industry
n.q. – non quantified

Remarks

Data report occupational accidents occurred in Forestry and Forest logging in the period 2003-2006 in the 6 municipalities of Sousa Valley mainly for the forest workers employed by forest contractors and timber merchants.
It was also considered the forest sappers employed by the Forest Owners Association of Sousa Valley (AFVS), the supervisors of one pulp and paper industry with forest area in Sousa Valley and the forest workers employed by one agricultural society. The total number of forest workers covered by this indicator is **120**, being 93 employed by forest contractors and timber merchants and 27 employed by other entities. The number of occupational accidents is given per 100 forest workers and it is divided in two categories: serious accidents and small accidents.
It were considered as serious accidents the injuries that have to be treated at the hospital, putting the worker without capacity to work for more than 8 days or even for the rest of his life. In the period 2003-2006 forest workers in Sousa Valley had suffered 19 serious accidents which gives a rate of 15,8 occupational accidents per 100 forest workers. However, it can be pointed that if the analyse were done according to the type of entities inquired (timber merchants/forest contractors or others) the rates would be very different: the rate of occupational accidents per 100 forest workers is low for timber merchants and forest contractors as well as for the FOA compared to the rate of occupational accidents occurred with forest workers of the SA.
Wounds, muscular distensions or scratches were considered as small accidents. For this type of accidents most of the timber merchants and forest contractors did not quantified the right number even though they had admitted their existence. Some of them assured that these small accidents do not put workers out of work for more than 1 week.
The FOA was the only entity contacted where these small accidents were registered.
Some of the forest lodging enterprises inquired assured that because they provide services to the pulp and paper industries they are obliged to follow the laws of security and hygiene in work, reducing the risks of occupational accidents among their forest workers.
Others stated that the reason why they never have serious accidents is more a matter of luck than of following or not the rules of security and hygiene in work.

Shortcomings and improvements

The production of statistical information about occupational safety and health is based on the system of repair (*Sistema de reparação*) settled in the Insurance Companies (*Companhias de Seguros*), framed by the constant juridical regime of the Law no 100/97, of 13th September and by the Law no 143/99, of 30th April, which regulate it. The information results from the collection, validation and treatment of the constant data of the participations, sent to the Insurance Companies, referring to the moment of the accident occurrence and the maps of closing of the process. Before 2005, only the enterprises with more than 100 workers were obliged to inform the official entities about the number of occupational accidents per year. At the national level, the number of occupational accidents in the forest sector is included in the occupational accidents of Agriculture, animal production, hunting and forestry and is not broken up at regional level and at a lower level of activity's classification. In Sousa Valley, the enterprises employing forest workers are mostly small enterprises employing between 3 and 5 workers, a number much below the 100 workers and so far these enterprises were not obliged to inform the official statistics about occupational accidents they have had.

Data had to be checked at the local level using several sources, namely the local FOA which put available the contacts of a group of timber merchants and forest contractors who are the main employers of forest workers. Some of the timber merchants contacted provided information about other timber merchants they know. The pulp and paper industries and the foresters working in the field were also contacted. According to local sources, the number reaches about 80 timber merchants and forest contractors employing forest workers in Sousa Valley. The sources contacted could only provide information about 20 of them. These 20 employers were the ones inquired about the occupational accidents of their workers. Data reliability depends on the sincerity of timber merchants and forest contractors. Since no official entities ask for this type of data they do not feel obliged to tell the truth.

In order to improve data, the list of contacts of timber merchants and forest contractors can be increased through the collaboration of the timber merchants and forest contractors inquired under FORSEE project and for whom the contacts are already available.

Comments and conclusion

To be an indicator able to be monitored in the future it will be needed to record the contacts of the timber merchants and forest contractors inquired and to ask them periodically to quantify the number of occupational accidents they have had in a stated period. The timbers merchants inquired during FORSEE project can be maintained and some can be added through the information given by the formers. In order to reach them, a list of contacts is already provided in FORSEE Methodology Report.
This indicator is important for SFM since the right management of the forest also depends on the good working conditions of the managers and other forest workers.

Occupational accidents is one of the indicators of Criterion 6 considered by NP 4406 2003. NP 4406 2003 states that forest activities, by the characteristics they have, are under a high risk when compared with other activities. However, there are several codes of health and work security that, when accomplished by the workers and forest contractors, contribute to reduce or even to finish the number of accidents and mainly the number of serious accidents.

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Indicator 6.10 : Accessibility for recreation

Forest area covered (2005): 29274,16 ha

Percentage of the total forest area in Sousa Valley: 100 %

Costs

TOTAL COST: 266,2 €

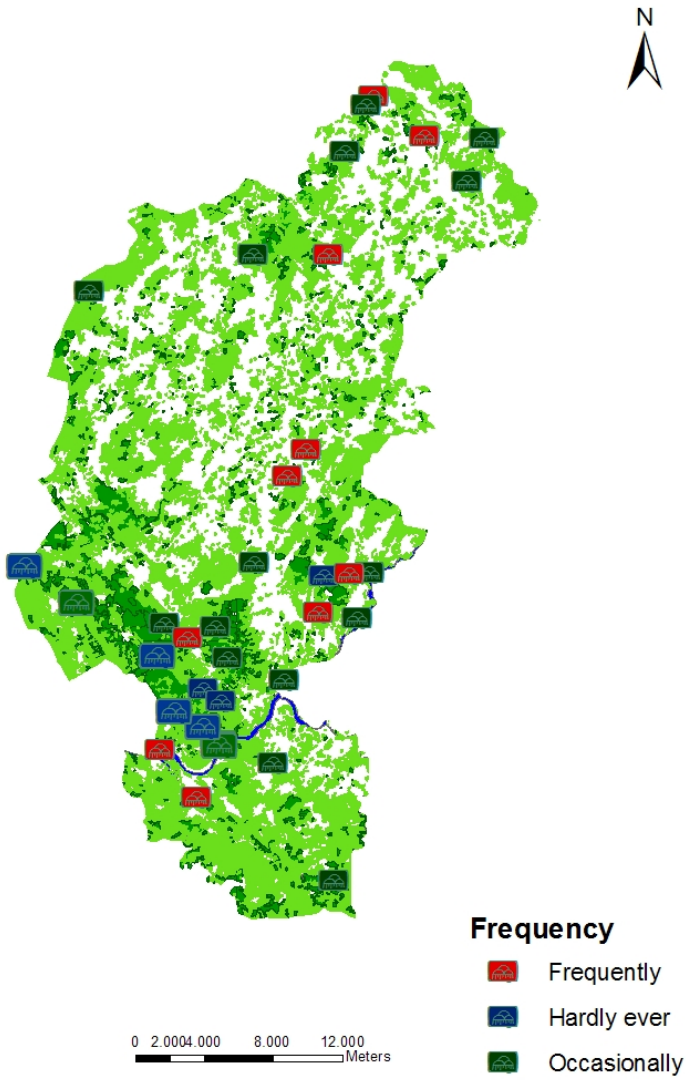
The total cost includes:

1-Data collection
131,2 €

2-Data analysis
135 €

Results

Recreational sites within forest and other wooded land where public has a right of access for recreational purposes



Sources: Land use map: COS 90
Recreational sites: GTF's (Technical Forest Offices) of the municipalities of Sousa Valley

Remarks

Recreational sites in Sousa Valley include parks, pedestrian paths, shooting fields, camping, forest roads (used for 4x4 races), belvederes and interesting landscape. The main types of recreational places identified are parks (parks to have lunch or to take an afternoon snack). The frequency varies between *hardly ever* and *frequently*. Most of the places are classified as *frequently* and *occasionally* visited. Some of the recreational sites are parks associated with churches or small chapels. These places held, at least once per year, the religious feast attended by several Christians who take advantage of the parks too have lunch and to rest. These places are visited *occasionally*, that is, at least once per year, when the religious ceremonies take over.
It is important to point that the recreational places which are not connected with chapels and religious ceremonies are mainly visited during the summer. Then, when the places are classified as *frequently* visited, one refers mostly their intensity of use during the summer.

Shortcomings and improvements

Data concerning the spatial locations of the places were taken from the foresters working at the forest technical offices of the 6 municipalities of Sousa Valley, mostly of them in charge of drawing the municipal plans for prevention against forest fires.
Data concerning the frequency of use of the recreational places by the population were based on the opinion of the foresters and other technicians working in the municipalities as well as the opinion of the foresters working at the local FOA. Since it was not carried out a questionnaire to achieve the real frequency of use, the real use can not be much reliable because it depends on the opinion of the referred foresters.
The indicator could be improved if there were the possibility of carrying out a questionnaire to the visitors of each place identified.

Comments and conclusion

This indicator is not of easy assessment since the municipalities do not always have the recreational places inventoried. However, after asking to the foresters (or other type of technicians working at the town councils) to identify the recreational places and to provide the GPS coordinates or the information about the location of the places, it is possible to create a database with this information and to monitor the condition of the places periodically. The foresters working at the municipalities and the foresters working at the local FOA can be contacted in order to classify the frequency of the places based on their knowledge but it is preferable to undertake a questionnaire over the visitors. If more recreational places are created in the forest areas they should be identified by the foresters of the forest technical offices (GTF's in Portuguese initials) of the town councils and added to the list of places already inventoried.
In terms of SFM, it is important to keep these areas were people can access for recreational purposes and to managed them in order to avoid their damage or disappearing. Nowadays, more people are aware of the importance of forests for the provision of services like recreation, landscape and biodiversity conservation. Because of that, society is becoming more willing to share the costs of maintenance of the recreational sites with the forest owners.

Indicator not considered by the Criterion 6 of Portuguese Norm 4406 2003.

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Indicator 6.12 : Total economic value of forest production

Forest area covered (2005):
29274,16 ha

Costs

TOTAL COST:
681,9 €

The total cost includes:

1- Data collection
181,9 €

2- Data analysis
500 €

Results

Total economic value of forest production in Sousa Valley

Outputs	**Estimation for 2006 (thousands of euros)**
Timber harvested	6942,5
Net growth in timber stock	4391,1
Honey	72
Hunting	4095
Informal recreation	120
Carbon sequestration	2927,4
Protection of agricultural soil	731
Protection of water resources	263
Conservation value	76
Total before negative externalities	*19618*
Negative externalities	*-5657,5*
Total	**13960,5**
Total value per hectare of forest (€/ha)	**476,8**

Remarks

To assess this indicator we took advantage of the work on the MCPFE indicators for the FORSEE project.
Only a partial estimation of TEV was attempted in the FORSEE project.
The scope of this estimation is the economic valuation of the **outputs** of forests in Sousa Valley region for 2006, 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 regional 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**.
We will not attempt to deal with the outputs of agro-forestry systems since they are not important in the Sousa Valley. 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), like services provided by forests due to the action of the public sector, and some environmental services which are public goods. Timber is evaluated at stumpage prices.

Shortcomings and improvements

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.

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 state of the art in the region, contributing to set the ground for so much work that remains to be done.
In order to have more reliable data on the indicators **accessibility for recreation** and **forest environmental services**, more specific studies should be developed.

Some progress in the specification is possible **at the regional level** combining national and official sources with local expertise.
In terms of future work there is a need for more specific studies on recreation, hunting and on the evaluation of forest environmental services.

Estimates (1)

DIRECT USE VALUES – Wood forest products

Timber harvested

Data regarding the production of the different types of timber harvested is provided by local sources (direct communication of foresters working for enterprises buying timber in Sousa Valley). This data come in cubic meters over bark. Monetary valuation is based on stumpage prices for 2006 (local sources) considering that the price for different types of destination of the main forest species occurring in Sousa Valley: Eucalyptus and Maritime pine.

Estimates for 2006:

– Eucalyptus

Pulpwood: 170000 m3 ob X 17,5 €/m3 ob = 2975000 €
Sawnwood: 70000 m3 ob X 22,5 €/m3 ob = 1575000 €
Fuelwood: 30000 m3 ob X 5 €/m3 ob = 150000 €
4700000 €

– Maritime pine

Pulpwood: 30000 m3 ob X 9 €/m3 ob = 270000 €
Sawnwood: 60000 m3 ob X 30 €/m3 ob = 1800000 €
Panels: 10000 m3 ob X 13,5 €/m3 ob = 135000 €
Fuelwood: 7500 m3 ob X 5 €/m3 ob = 37500 €
2242500 €

TOTAL: 377500 m3 ob X 18,4 €/m3 ob = **6942500** €

Net growth in timber stock

Physical valuation considers the difference between the annual forest increment and the timber harvested. With data collected in the field during the development of a project carried out by the local FOA (AFVS) between 2001-2003 and data collected in the field during the development of FORSEE project (in 2005) it was possible to determine the net increment between 2002 and 2005 for half of the municipality of Paredes, where the 35 FORSEE plots are located.

Monetary valuation is based on half of the stumpage price for saw logs, considering that not all the annual variation is based on half of the net growth in 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 and for Eucalyptus (local sources, 2006).

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Estimates (2)

Net grow in timber stock
Estimates for 2006:
TOTAL: 15 m3 ob / ha year X 29274 ha X 10 €/m^3 = **4391100 €**

DIRECT USE VALUES – Non wood forest products

Honey
Data for the number of beehives in the 6 municipalities of Sousa Valley was given by the National Agricultural Censuses (INE 2000) and the Regional Direction of Agriculture of Entre-Douro e Minho (DRAEM), settled in Penafiel. The productivity of each beehive was given by local producers as well as the price paid to the honey producers by middle men.
According to local sources almost all the production is sold to middle men but there is one part sold directly to local consumers and other for own consumption. The price of honey paid by local consumers is higher than the price paid by middle men but the estimation considers that the price paid to the producers is the price paid by middle men.
The total number of beehives in Sousa Valley is 2418, the price paid by middle men to honey producers is 1,5 €and the productivity of honey per beehive in Sousa Valley is 20 kg.
Estimates for (2006):
TOTAL: 2400 beehives X 20 kg/bee-hive X 1,5 €/kg = **72000 €**

Hunting
In Portugal, hunting rights can be used under two different and mutually exclusive regimes: the "general" regime and the "special regime". The special regime corresponds to different forms of management of gaming resources (public, associative and private) appealing to excludability mechanisms in order to prevent overexploitation. Associations of hunters manage most of the land under special regime. These associations own and rent land for the purpose of managing gaming resources whose access will be restricted to the members of the association. The other major form of special regime corresponds to the tourist hunting zones which are private lands managed for gaming by private firms selling access to hunting and related services.
The general regime covers the rest of the territory where hunting is allowed to everyone who has a permit issued by the Ministry of Agriculture. In this regime game is "collected" by hunters, but is not actively managed by them. As the special regime expands, the territory for the general regime shrinks, leading to conflicts between the hunters in the two regimes.
In Sousa Valley there are 15 associations and clubs of hunters, 9 of them managing zones of hunting created by the municipalities, and 1 private hunting zone. Data on the number of hunters in Sousa Valley is an average of the values given by the hunters inquired.

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Estimates (3)

Hunting

Estimates for 2006:

TOTAL: 3000 hunters X 1365 €/hunter = **4095000 €**

- Annual costs per hunter:

a) Hunting permit: 24,94 €
b) Dog permits: 3 dogs x 20 €/dog = 60 €
c) Membership fees for hunting clubs: 20 €
d) Insurance: 30 €
e) Dog FOAd: 500 €
f) Outfit and ammunitions: 300 €
g) 20 days in municipal hunting areas X 5 €/day = 100 €
h) Travel costs: 20 days X 50 km/day X 0,33 €/km = 330 €

- Total per hunter and per year: 1365 €

Recreational services - Informal recreation

No data are available regarding the number of visits to forests and other wooded lands for recreational purposes. Therefore, the number of sites frequently visited in Sousa Valley is 8 and the number of sites moderately visited is 14. It was considered that in places frequently visited there are 200 visitors per weekend and in places occasionally visited 100 visitors per weekend. The visits must happen the weekends with good weather that must be around 40 per year. The willingness to pay for this type of recreation is supposed to be 1€.

The number of sites was given by the foresters working at the technical offices of the municipalities as well as the frequency of use.

Estimates:

- 8 recreation sites very visited X 40 weekends X 200 visitors-weekend X 1 €/visitor = 64000 €
- 14 recreation sites moderately visited X 40 weekends X 100 visitors-weekend X 1 €/visitor = 56000 €

TOTAL: 64000 € + 56000 € = **120000 €**

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Estimates (4)

INDIRECT USE VALUES

Carbon sequestration

The net annual increment of carbon storage in the woody biomass of Sousa Valley Forests amounts 5tC/ha year based on the estimative done by T. Fonseca (2006). If this flow is evaluated at the mean social cost of carbon emissions of 20 €/tC as estimated Fankhauser (1995, p.84) for the decade 1991-2000 an estimate of 2927400 € is obtained.

Estimates (2002 – 2005):

TOTAL: 5 tC/ha year X 29274 ha X 20 €/tC = **2927400 €**

Agricultural soil protection:

Estimating the protection of agricultural land begins with the regions facing 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). In Minho, where Sousa Valley is located, the risk of desertification is lower and the annual erosion of agricultural soil under 5-10 t/ha. One considered 1, 5 t/ha as the annual erosion of agricultural soil in Sousa Valley.

Considering an apparent specific weight for sediments of 1,5t/m^3 and a depth of 30 cm for agricultural soils, this erosion corresponds to an annual rate of loss soil of 0,0033%.

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 [(1-1/3)/(1/3)] X 0,033% X Value added of farm production. The gross value of farm production in Sousa Valley is 1500 €/ha x 23499,32 ha of agricultural land (NFI, 2005)= 35248980 €. (28039 ha, NFI 1995)

If the (avoided) losses of crops were irreversible, for a 2% discount rate, the value of 29076,9 € would correspond to a capital loss avoided of 1163216,34 €. If an amount of losses equal to v lasts for n years, the corresponding capital loss V_n is given by the following expression:

$V_n = v\,[1-(1+r)^{-n}/r]$

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 Sousa Valley is 731048,8 €.

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Estimates (5)

Estimates:
- Annual erosion: 1,5 t/ha
- Apparent specific weight of sediments: 1,5t/m3
- Soil depth: 30 cm
- Annual rate of soil loss: = [(1,5 t/ha)/(1,5 t/m3)]/(10000 m2 X 0,3 m) = 0,033%
- Ratio of erosion with forest to erosion without forest: 1/3
- Value of farm production preserved due to forest cover = [(1-1/3)/(1/3)] X 0,033% X Value added of farm production = 0,066% X (1500 €/ha) X 23499,32 ha = 23264,32 €
- Agricultural capital loss avoided at 2% discount rate:

a) Perpetuity (irreversible loss): 23264,32 € / 2% = 1163216,34 €
b) Annuity (eroded land recovered in 50 years): 23264,32 € X {[1-(1+0,02)-50] / 0,02}= **731048,8€**

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 forests' benefits in water conservation. The Management Plans for the main watershed basins (Instituto Nacional da Água, 2000) provide data for the public costs planned for 2001-2020. They relate to the protection of ecosystems (PO3), flood prevention (PO4) and water management (PO6). To estimate the costs that would be borne 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. Based on data from the 1995 Forest Inventory and data taken from the work of Rocha *et al.* (1986) on soil erosion, Mendes (2005) reached a value of protection of water resources for 2001 and for Continental Portugal of 28,9 million €. Dividing this value for the area of forest in Continental Portugal one obtained a value of about 8,62 €/ha. Multiplying this value corrected for inflation by the area of forest in Sousa Valley in 2005 gives an amount of about 263000 €.

Estimates:
29274 ha X 9 €/ha = **263000 €**

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Estimates (6)

Conservation value **(areas with ecological interest):**
The estimated value of forest landscape and biodiversity 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 6634 escudos (33, 090 €/ha) per household and per year and an aggregate willingness to pay of 397, 377 million escudos per year (1,982 million of €/year), based on the total number of households visiting the park between September 1995 and August 1996 (Santos, 1997, p.590). Dividing the aggregated benefit by an estimated surface of forest and other wooded land in Peneda-Gerês National Park, Mendes (2005) obtained a conservation value of 6623 escudos/ha (33, 0353 €/ha). Considering that in Sousa Valley the forest with conservation value are the pure and mixed stands of broadleaves which represents about **8,7 %** of the total forest in Sousa Valley (IFN, 2005) and considering that the willingness to pay of the visitors of Sousa Valley forests is 3 € less than the willingness to pay in Peneda-Gerês National Park one obtained:
Estimates:
8,7% X 29274 ha X 30 €/ha = **76405,14 €**

Negative externalities of forest fires
The costs of most of the forest fires in Portugal may be considered as negative externalities borne by the forest owners and other people in society who share those costs with them.
a) Costs of forest fire prevention: There are 5 main stakeholders in the forest fire prevention system, the NIPFO, the pulp and paper companies, the Ministry of the Interior, the Ministry of Agriculture and the municipalities.
In recent years, the pulp and paper industries spent between 20 € and 25 €/ha in fire prevention (verbal communication). In Sousa Valley these industries manage about 4908 ha of forest which means that in 2006 they spent about **22,5 € x 4908 ha = 110430 €** in Sousa Valley in operations of fire prevention.
In 2006 the Ministry of Interior spent about **70 000 €** in transfers to the local forest owner association to co-fund the 2 brigades of forest sappers under its management. This co-funding represents about 50% of the total operating costs of those brigades.
In 2005-2006 the Ministry of Agriculture transferred about **636373, 72 €** of funds to the 6 municipalities of Sousa Valley to develop strategic actions for fire prevention through the Forest Permanent Fund (*Fundo Florestal Permanente*).
In 2006 the Ministry of Agriculture also spent money with the maintenance of the 4 surveillance towers that exist in Sousa Valley. These towers are active during the months of higher risk of forest fire, usually the months of June, July, August and September. Each tower of surveillance has 4 people working by turns of 8 hours earning about 600 Euros/month. This makes a total of **9600 €**.
Adding these components one get a total of **826403,72 €.**

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Estimates (7)

a) Social costs of fire fighting

There are three main stakeholders involved in fire fighting: the Ministry of the Interior, the local fire departments and the pulp and paper companies.

The calculation of the opportunity cost of the time spent by voluntary fire fighters is based on the number of fires - according to DGF, 150 big fires plus 1400 small fires in 2006 in Sousa Valley - and the assumption of 20 firemen per small fire, each contributing 1 day of work per fire and 40 firemen per big fire, each contributing 3 days of work per fire. Other assumption is that each fireman would earn the minimum wage if working as a full-time employee. In Portugal the minimum wage in 2006 was 385,9 € which means that they would earn about 17,5 €/day. Therefore, the opportunity cost of the time spent in fire fighting in Sousa Valley amounts about **805000 €.**

b) Costs losses in wood and non wood forest production

For 2006, estimates wood production losses at about 675 €/ha.

c) Costs of the restoration of burnt forests

DGF estimates the area of burnt forests in Sousa Valley at about 1500 ha in 2006. Reforestation through new plantations would cost around 1350 €/ha.

Estimates for 2006:

- Fire prevention: 800000 €
- Fire fighting: 600 €/ha of burnt forest X 1500 ha = 900000 €
- Fire fighting (opportunity cost of working days lost):

a) 150 fires (more than 1ha) X 40 fireman X 3 days/fire X 17,5 €/days: 315000 €

b) 1400 small fires (less than 1ha) X 20 fireman X 1 day/fire X 17,5 €/day = 490000 €

- Goods and services lost: 1500 ha X 675 €/ha = 1012500 €
- Reforestation costs: 1500 ha X 1350 €/ha = 2025000 €

TOTAL: **5657500 €**

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Shortcomings and improvements

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.
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 state of the art in the region, contributing to set the ground for so much work that remains to be done.
In order to have more reliable data on the indicators **accessibility for recreation** and **forest environmental services**, more specific studies should be developed.
Some progress in the specification is possible **at the regional level** combining national and official sources with local expertise.
– **In terms of future work there is a n**eed for more specific studies on recreation, hunting and on the evaluation of forest environmental services.

Comments and conclusion

It is important to estimate the economic value of non wood forest goods and services, as well as the value of environmental services, in order to have a basis on which to establish the sharing of the costs of SFM between the forest owners and the rest of the society.

- Some progress in the specification is possible **at the regional level** combining national and official sources with local expertise;
- Feasibility conditions for these indicators in Portugal will **improve in the future**, as more private forestry will go under associative forms of management;
- The existence of a **local organization** involved in forest management (forest owners' association) is essential for the feasibility and utility of these indicators;
- **Partnerships** between these local organizations and research organizations is also essential for the feasibility of these indicators;
- Work on the 6 MCPFE criteria indicators can be useful to calculate a partial estimation of the **TEV** of forest production;
- To develop this estimations additional specific studies are needed in the valuation of **recreation, hunting** and **environmental services.**

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IV Organisations related to the forest sector

In Sousa Valley

Town Councils

Câmara Municipal de Penafiel
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4560-481 Penafiel
Website: www.cm-**penafiel**.pt
Phone: 00351 255710700
Fax: 00351 255711066

Câmara Municipal de Paredes
Parque José Guilherme,
4580-130 Paredes
Website: www.cm-**paredes**.pt
Phone: 00351 255776713
Fax: 00351 255782155

Câmara Municipal de Felgueiras
Praça da República,
4610-116 Felgueiras

Website: www.cm-**felgueiras**.pt
Phone: 00351 255318000
Fax: 00351 255318170

Câmara Municipal de Castelo de Paiva
Largo do Conde – Sobrado
4550-102 Castelo de Paiva
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Fax: 00351 255699660

Câmara Municipal de Lousada
Praça Dr. Francisco Sá Carneiro Apartado 19,
4624-909 Lousada
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Phone: 00351 255820500
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Câmara Municipal de Paços de Ferreira
Praça da Républica
4590-527 Paços de Ferreira
Website: www.cm-pacosde**ferreira**.pt
Phone: 00351 255860700
Fax: 00351 255861420

Ministry of Agriculture

Zona Agrária de Penafiel
Av. Zeferino Oliveira, 10 - 4560-494 PENAFIEL
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Forest Owners' Association of Sousa Valley

Associação Florestal do Vale do Sousa
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Fracçao C-Cave Traseira – Madalena
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E-mail: afvs@mail.telepac.pt
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In Portugal

1. Certification entities

Associação Portuguesa de Certificação
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Conselho da Fileira Florestal Portuguesa (**CFFP/PEFC Portugal**)
Rua Marquês Sá da Bandeira, N.º 74, 2.º
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Fax: 00351 217611529

Portugal Forest Stewardship Council
Person in charge: Vera Santos
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CINCORK – Centro de Formação Profissional da Indústria de Cortiça
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ESAV – Escola Superior Agrária de Viseu
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EFN – Estação Florestal Nacional
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GIMREF – Grupo de Inventariação e Modelação de Recursos Naturais
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SPCF – Sociedade Portuguesa de Ciências Florestais
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3. Public Administration

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IFADAP – Instituto de Financiamento e Apoio ao Desenvolvimento da Agricultura e Pescas
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CAOF – Comissão de Acompanhamento de Operações Florestais
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ICN – Instituto de Conservação da Natureza
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4. National federations of forest owners' associations

FORESTIS – Associação Florestal do Norte e Centro de Portugal
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Fenafloresta - Federação Nacional das Cooperativas de Produtores e Florestais, FCRL
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FPFP – Federação dos Produtores Florestais de Portugal
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5. Professional associations of forest contractors and forest industries

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CELPA – Associação da Indústria Papeleira
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AIMMP – Associação das Indústrias da Madeira e do Mobiliário de Portugal
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