

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 – *In Progress*
North Portugal

2nd Part: Materials and Methodology
April 2007

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FORSEE Project (20) www.iefc.net



Project co-financed by the European Union
A community initiative
ERDF - INTERREG III B Atlantic Area



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I Criterion 1- Carbon Sequestration

Indicator C1.1 – Forest surface

Data collection

Land use of 2005: Aerial photograph of the 2005 NFI for Portugal North pilot zone not available on time;

Land use of 1995: Aerial photograph of 1995 for the pilot zone was photo interpreted previously by AFVS team. Therefore, for half of two municipalities of Sousa Valley, Paredes and Penafiel, photo interpretation of the aerial photographs of 1995 was available at the local forest owners association (AFVS). The area covered by the photo interpretation of 1995 covers the area where the FORSEE 35 plots measured were implemented.

Land use of 1990: Aerial photograph of 1990 for Portugal North pilot zone was not available. The analyse that was going to be done using the aerial photograph of 1990 was substituted by 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. COS 90 is available for free at <http://snig.igeo.pt/cgi-bin/snig/Igd/importacao.cgi?cod=C471> (recovered at 10 April, 2007).

Data analysis

Using the *ArcGis 9* the land use digital map of 1990 and the land use digital map of 1995, covering half of the municipality of Paredes where the 35 plots were located, were classified according to NFI definitions and FAO definitions. Area in each class defined by these two definitions was assessed and compared.

The definitions are described in the following tables:

Table 1 : FAO Land Use Classes (in FRA 2005 – Terms and Definitions, Working paper 83/E)

Forest (F)	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
Other wooded land (OwL)	Land not classified as “Forest”, spanning more than 0.5 hectares; with trees higher than 5 meters and a canopy cover of 5-10 percent, or trees able to reach these thresholds in situ; or with a combined cover of shrubs, bushes and trees above 10 percent. It does not include land that is predominantly under agricultural or urban land use.
Other land (OL)	All land that is not classified as “Forest” or “Other Wooded Land”. Includes agricultural land, meadows and pastures, build-on areas, barren land, etc. Includes areas classified under the sub-category “Other land with tree cover”.
Other land with tree cover	Includes groups of trees and scattered trees in agricultural landscapes, parks, gardens and around buildings, provided that the canopy cover criteria is met, includes tree plantations established mainly for other purposes than wood, such as fruit orchards.
Inland water	Area occupied by major rivers, lakes and reservoirs.

Source: FAO terms and definitions (2004)

Table 2 : Portuguese NFI Land Use Classes

Forest (FL)	Whenever the area greater than 0.5 ha and width greater than 20 m, presents arboreal formations, composed by forest tree species, or non-arboreal formations, in which those species attain a cover ratio of, at least, 10%. Includes plantation areas, recent seedbed areas, burnt and clear-cut areas.
Uncultivated (IC)	Whenever the area greater than 0.5 ha and width greater than 20 m, is occupied by shrubs-like, herbaceous or woody vegetation coverage, where there is no forest or agricultural usage whatsoever. It may be a result of an agricultural fallow, a spontaneous pasture or, even, an abandoned area. They may also be land plots that are supposed to become forested, but that have not been planted or sown yet.
Agriculture (AG)	Whenever the area greater than 0.5 ha and width greater than 20 m, is composed by arable land, permanent cultures, and permanent meadows and pastures.
Unproductive (IP)	Whenever the area greater than 0.5 ha and width greater than 20 m, is composed by practically sterile soil, from a vegetal production point of view, resulting of both natural limitations (rock outcrops) and anthropogenic action (e.g. quarries, gravel-pits, dumping sites and mining zones).
Social (SC)	Comprises urban areas, social amenities and equipment and large highways
Inland water (HH)	Firths or large watercourses, lagoons, dams, weirs, etc.

Source: FAO terms and definitions (2004)

Note: The definition of the indicator C1.1 according to the expert group protocol was: “*The extent of forest area and other wooded land (ha) classified by forest type and by availability for wood*”

supply". However, the definition of "availability for wood supply" is not included in the Portuguese NFI classification.

Conclusion

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. If improvements can be made for this indicator, they should be done primarily to make those maps easily available.

Indicators C1.2, C1.4.1, C1.4.2, C1.4.4

Data collection

In 2006 it was undertaken a forest inventory in 35 plots located in the Southern part of the municipality of Paredes. These plots are part of a bigger set of plots established and in 2001 by the Forest Owners' Association of Sousa Valley (AFVS) during the development of the Pilot Project of Sustainable Forest Management and measured in 2002. Some of them, the permanent plots, were also measured in the following year (2003). As the National Forest Inventory was only undertaken in 2006, dendrometric data needed to evaluate FORSEE C1 indicators were not available during the development of FORSEE project and because of that Portugal North team decided to measure again 35 of the total plots implemented by AFVS in 2002. To the dendrometric data collected during FORSEE project, it was also added the information collected by AFVS during the forest inventory carried out in 2002. This methodology was considered helpful in the analysis of some indicators given the short period of time available for fieldwork. Field work was developed according to the 12/07/2005guideterrain.V16.en.v2, available at www.iefc.net.

Characterization of FORSEE IFN plots

IFN sampling plots implemented by FORSEE team had an area of 500 m². The distance between each tree and the center of the plot was measured as well as the angle between these directions (connecting the tree with the sampling plot center) with the North. That means that permanent sampling plots will be available even after FORSEE project.

In each sampling plots dbh of all trees were measured, using a caliper, and the specie identified. In the area where the plots were implemented, south of the municipality of Paredes, *Eucalyptus globulus* and *Pinus pinaster* were almost the unique species found.

When the tree was located in the limit of the sampling plot it was registered on field sheets.

Trees were distributed by the following dbh classes:

10 with dbh $\in [7.5; 12,5[$

15 with dbh $\in [12.5; 17,5[$

20 with dbh $\in [17.5; 22,5[$

25 with dbh $\in [22.5; 27,5[$

30 with dbh $\in [27.5; 32,5[$

35 with dbh $\in [32.5; 37,5[$

40 with dbh $\in [37.5; 42,5[$

45 with dbh $\in [42.5; 47,5[$

50 with dbh $\in [47.5; 52,5[$

Volume of *Eucalyptus globulus* was determined by means of diameter grouping with a proportional representation for diameter classes, named method of Draudt (see also Anuchin, 1970). In practice, all dbh were measured and distributed into classes. In each dbh class, the first tree in a group of three measured trees (taking the amplitude of selection of 3 trees) was considered as a sample tree. Subsequently, in each dbh class, the 4th, the 7th, etc. tree in each dbh class were also measured. The height and volume of all these sample trees were measured using a Bitterlich relaskop.

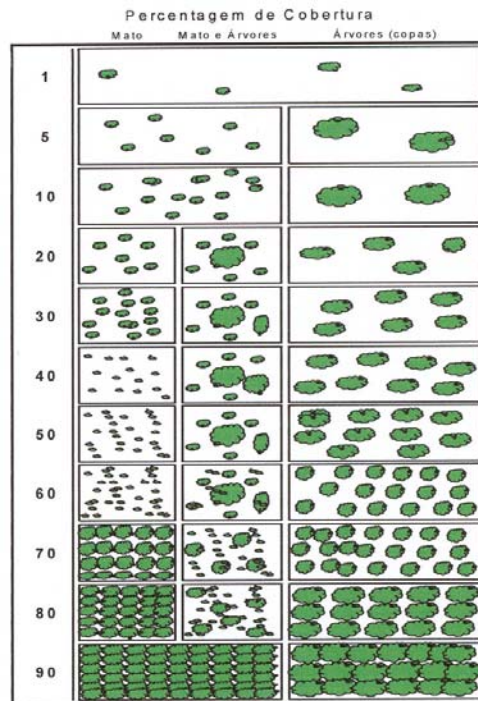
The 5 trees with the highest dbh were selected and the total height was evaluated. That means that for each sampling plot dominant height could later be evaluated.

The GPS coordinates of the centre of each IFN plot were recorded in a file. The name was registered in each file used for compiling fieldwork data.

In each IFN plot, the slope and aspect, using a clinometers and a bussola respectively, were measured.

In all plots, some vegetal material, namely leaves, branches and stem were collected from trees selected randomly for future chemical analysis. Vigorous and healthy materials were collected from the medium part of the crop; branch samples were obtained from the active part of the crop and the stem sample was removed using an increment borer. The leaves and the branches were kept inside a plastic bag and the main sample core was kept in a plastic tube. All the material collected was clearly labelled for correct identification.

Figure 1: Table of comparison to evaluate the crop density



Source: 12/07/2005 guideterrain.V16.en.v2, available at www.iefc.net.

Indicator C 1.2: Growing stock and dendrometric parameters

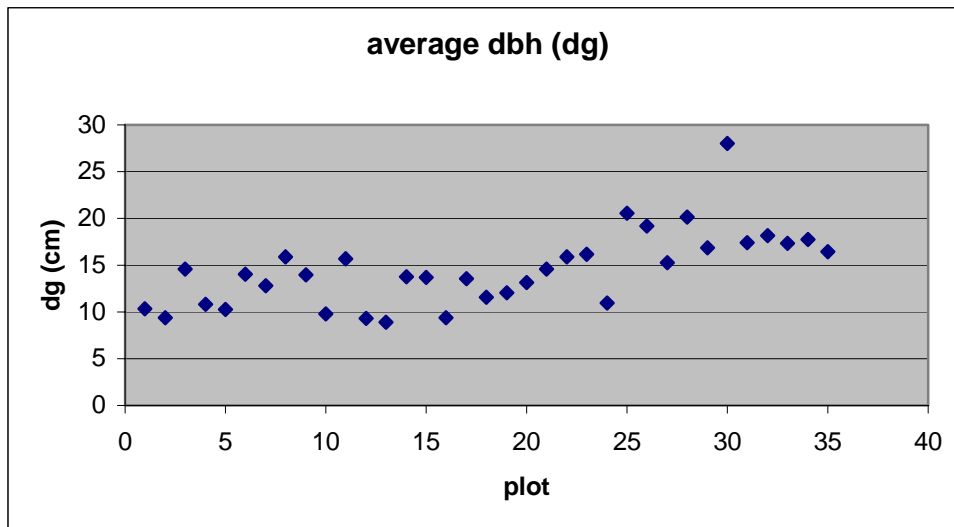
Data analysis

The medium quadratic diameter (dg), according to the following equation, and identify the two trees with dbh closest to dg , for further measurements.

$$dg = \sqrt{\frac{\sum d_i^2}{n}},$$

- d_i represents individual dbh;
- n represents the number of trees inside the plot.

Graphic 1 : Results of average dbh



Source: Estimation by UTAD research team

Having obtained the results for all dbh inside the plot it was then possible to estimate the basal area of each individual tree (g_i) and the basal area per hectare (G). This is a very important parameter which reflects the density of the stand.

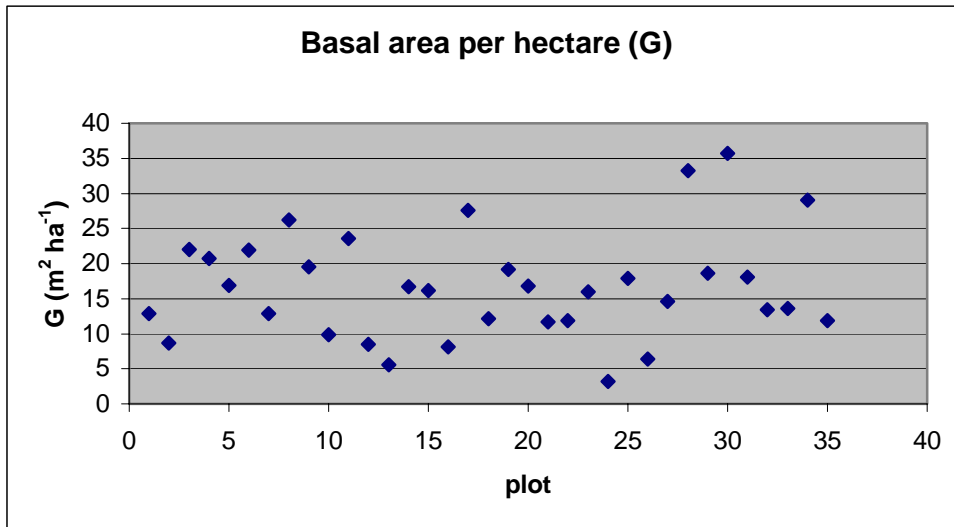
$$g_i = \frac{\pi}{4} d_i^2$$

$$G = \frac{\sum g_i}{\text{plot area}} 10000$$

- g_i represents the basal area of each individual tree;
- d_i is the dbh of each tree, and the plot area could be either 100 m² or 500 m². The two dimensions were used in this particular case.
- In one of these average trees a core of wood (up to the medulla) was extracted using an increment borer to assess the average age of the stand represented by that sampling plot.

Volume of *Eucalyptus globulus* was determined by means of diameter grouping with a proportional representation for diameter classes, named the Hossfeld method (see also Anuchin, 1970).

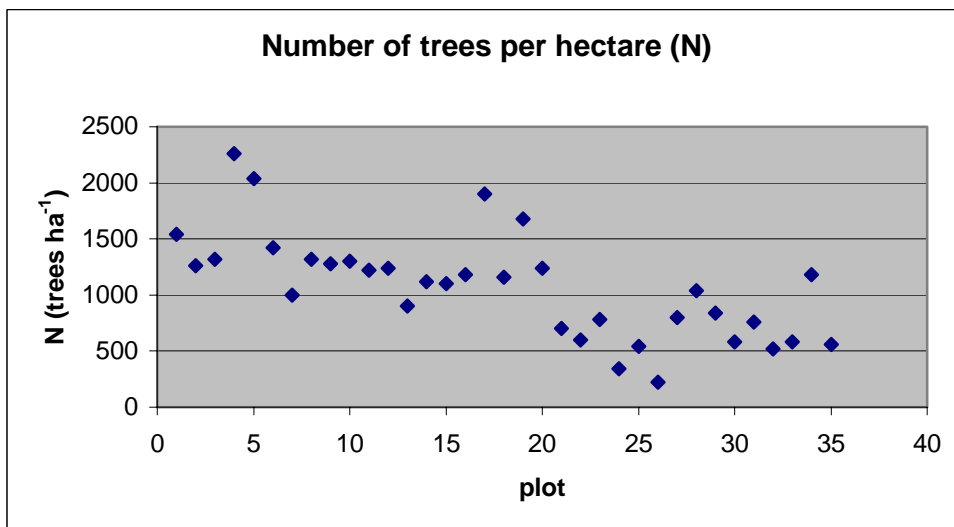
Graphic 2 : Results for basal area (G)



Source: Estimation by UTAD research team

The number of trees per hectare (N) could be estimated since all trees inside each sampling plot were measured and the extrapolation to the hectare could be done.

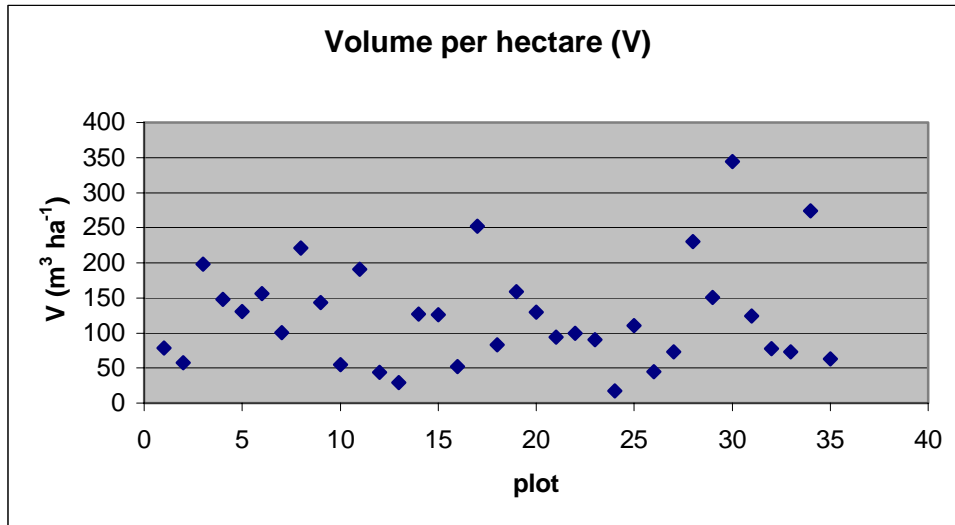
Graphic 3 : Results for the number of trees per hectare (N)



Source: Estimation by UTAD research team

Having the volume information from the sample trees inside each dbh class (since $(v = \frac{2 \pi}{3 \cdot 4} d^2 (L_{d/2} - L_d)Uh)$ it was possible to estimate the average volume values for each dbh class. Later, the volume per sampling plot was estimated. The extrapolations per hectare give the volume per hectare (V).

Graphic 4 : Results for volume (V)



Source: Estimation by UTAD research team

Table 3: Dendrometric data

	N (trees ha ⁻¹)	G (m ² ha ⁻¹)	V (m ³ ha ⁻¹)	Dg (cm)
Maximum	2260	35,73431	344,3832	28,00811
Average	1072	16,61699	124,2323	14,50282
Minimum	220	3,216802	17,0198	8,903208
std dev.	466,9349	7,564057	74,38258	4,008422

Source: Estimation by UTAD research team

As, at this stage the key variable was the volume per hectare, more attention was given on it. Results are now presenting considering forest stratus (*Eucalyptus globulus*, *Pinus pinaster* and a mixed *Eucalyptus globulus* x *Pinus pinaster*).

Table 4: Volume per type of stratum

Without considering other species than <i>Eucalyptus</i> and <i>Pinus pinaster</i>			
Stratum	nj	Average V (m ³ .ha ⁻¹)	Std dev (m ³ .ha ⁻¹)
<i>Eucalyptus</i>	23	126,8	50,4
<i>Pinus</i>	4	103,4	57,7
Mixed	8	137,1	98,1
	35		

Source: Estimation by UTAD research team

Table 5: Volume of other species

Considering other species than <i>Eucalyptus</i> and <i>Pinus pinaster</i>			
Stratum	nj	Average V (m ³ ha ⁻¹)	Std dev (m ³ ha ⁻¹)
<i>Eucalyptus</i>	23	127,3	50,2
<i>Pinus</i>	4	104,5	56,7
Mixed	8	137,4	98,6
	35		

Source: Estimation by UTAD research team

The previous tables show that forest in this area is mainly composed by monocultures of *Eucalyptus* and *Pinus pinaster*. Other species almost does not exist.

Indicator C 1.4: Carbon stock (expansion factors)

Data analysis

Fabião (1986) undertook research to estimate NPP in *Eucalyptus globulus* stands in the Portuguese context by means of regression modelling. He used seven study areas distributed throughout Portugal, although mainly located in coastal areas where *Eucalyptus globulus* stands are more frequent and the specie well adapted. The present research, FORSEE project, refers to stands located in the North of Portugal where the specie is also well adapted. The regression models available from Fabião (1986) for stands in a first rotation with a similar age can be then applied here. The regression models are presented in the following table.

Table 6 : *Eucalyptus globulus* biomass (B) equations selected from Fabião (1986)

Tree component	Equation	R ²	R ² _{adj}
Stem	Log (B)=-2.612+2.589log(dbh)	0.992	0.983
Branches	Log (B)=-6.989+3.157log(dbh)	0.964	0.920
Leaves	Log (B)=-4.902+2.524log(dbh)	0.976	0.945

Source: Fabião (1986)

Roots biomass for *Eucalyptus* was estimated using information from the research made by Fabião (1986) which states that roots biomass is about 12% of the aboveground biomass of the specie.

For *Pinus pinaster* it was used the regression models available from Lopes (2005). He estimated biomass equations for *Pinus pinaster* stands located in the North of Portugal. Those equations are presented in the following table:

Table 7 : *Pinus pinaster* biomass (B) equations selected from Lopes (2005)

Tree component	Equation	R ²	R ² _{adj}
Stem	Log(B) = 3.769 + 2.706log(dbh)	0.986	0.979
Crop	Log(B) = 2.911 + 2.130 log(dbh)	0.976	0.945
Root	Log(B) = 1.972 + 1.221 log(dbh)	0.937	0.935

Source: Lopes (2005)

Using the previous equations and also the volume results obtained from the previous indicator, the biomass expansion factors were calculated for forest in Sousa Valley. Results are presented in the following table:

Table 8 : Biomass expansion factors

<i>BEFs stand</i>	Euc	Euc pure+mixed	Maritime pine	Pure Maritime pine+mixed
Mean	0.627	0.649	0.539	0.543
Standard Error	0.015	0.017	0.003	0.007
Median	0.637	0.645	0.541	0.539
Standard Deviation	0.070	0.093	0.005	0.024
Sample Variance	0.005	0.009	0.000	0.001
Kurtosis	-0.986	2.169	1.926	5.449
Skewness	0.082	0.994	-1.502	2.225
Range	0.236	0.423	0.011	0.086
Minimum	0.522	0.522	0.531	0.521
Maximum	0.758	0.945	0.542	0.607
Sum	14.422	19.457	2.155	5.971
Count	23	30	4	11

Source: Estimation by UTAD research team

Indicator C 1.4.1: Carbon stock in the woody biomass

Data analysis

Using the previous biomass equations it was possible to estimate biomass for each individual tree inside the sampling plot. The sum of each partial biomass extrapolated to one hectare gave us the biomass estimations for each site. The average values of total biomass found were:

Table 9 : Average values of total biomass

Stratum	nj	Average biomass (ton ha ⁻¹)	std dev (ton ha ⁻¹)
<i>Eucalyptus</i>	23	81,3	36,4
<i>Pinus</i>	4	55,5	30,3
Mixed	8	98,7	99,7
	35		

Source: Estimation by UTAD research team

Considering the results of carbon content of dry biomass obtained from chemical analysis for this

study area, the balance carbon content, considering the proportion of each element, for both species was:

- *Pinus pinaster* 53,7 %
- *Eucalyptus* 54,8 %

Table 10 : Carbon in woody biomass in Sousa Valley

Stratum	nj	Average biomass (ton ha ⁻¹)	std dev (ton ha ⁻¹)
<i>Eucalyptus</i>	23	44.5	19.9
<i>Pinus</i>	4	29.8	16.3
Mixed	8	53.0	53.5
	35		

Source: Estimation by UTAD research team

Indicator C 1.4.3: Carbon stock in the deadwood

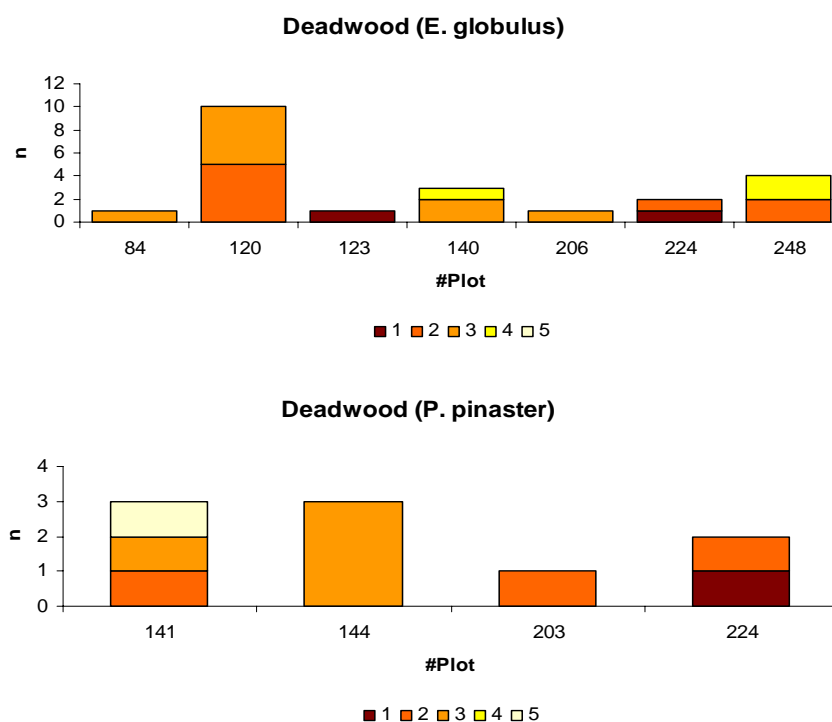
Data collection

The methodology for data collection was done according to the FORSEE field manual 12/07/2005guideterrain.V16.en.v2, pag. 45, available at www.iefc.net.

Data analysis: Logs

Logs were rare in the study area. Only in 31% of the sampling plots was noticed this type of deadwood. The following graphics show the number of logs found in the FORSEE transects.

Graphic 5 and 6: Number of logs found in the transects per type of stand



Source: Field sheets

Table 11 : Average and extreme biomass values for dead wood stock

Stratum	nj	Average biomass (ton ha ⁻¹)	std dev (ton ha ⁻¹)
<i>Eucalyptus</i>	7	3,62	3,80
<i>Pinus</i>	4	3,74	3,57
Mixed	-	-	-
	11		

Source: Estimation by UTAD research team

Assuming the same carbon contents presented previously, the carbon in wood stock for this study area is:

Table 12 : Carbon in wood stock

Stratum	nj	average biomass (ton ha ⁻¹)	std dev (ton ha ⁻¹)
<i>Eucalyptus</i>	7	1,98	2,08
<i>Pinus</i>	4	2,01	1,92
Mixed	-	-	-
	11		

Source: Estimation by UTAD research team

Conclusion

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 transects 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 transect 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.

Indicator C 1.4.4: Carbon in the litter stock

Data collection

Aboveground debris was measured using a 40x60 cm litter screen placed at random inside the IFN plot, according to the methodology proposed by Gower et al. (1997). Litter screens were deployed in January 2001 and litter was collected in May, July, September and December 2001. An iron rectangle of 40x60cm was used in fieldwork. The site where data was collected was marked by small groups of rocks to allow future identification as show the following figure.

Figure 2 : Example of permanent litter plots in Sousa Valley pilot zone

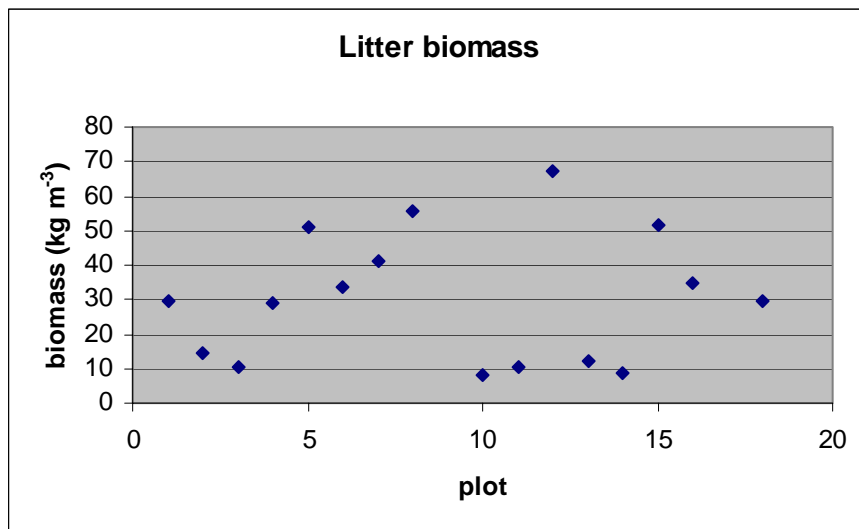


Source : UTAD

Data analysis

The following graphic shows the dispersion of litter biomass.

Graphic 6 : Dispersion of litter biomass



Source: Estimation by UTAD research team

According to the graphic there is a high heterogeneity of situations.

Average results show that, in average, in the 35 FORSEE plots there is $30.5 \pm 18.9 \text{ kg m}^{-3}$ of litter biomass. Assuming that 50% of that value is carbon, there is $15.25 \pm 9.5 \text{ kg m}^{-3}$ of carbon in the 35 FORSEE plots.

Indicator C 1.4.5: Carbon in the understory

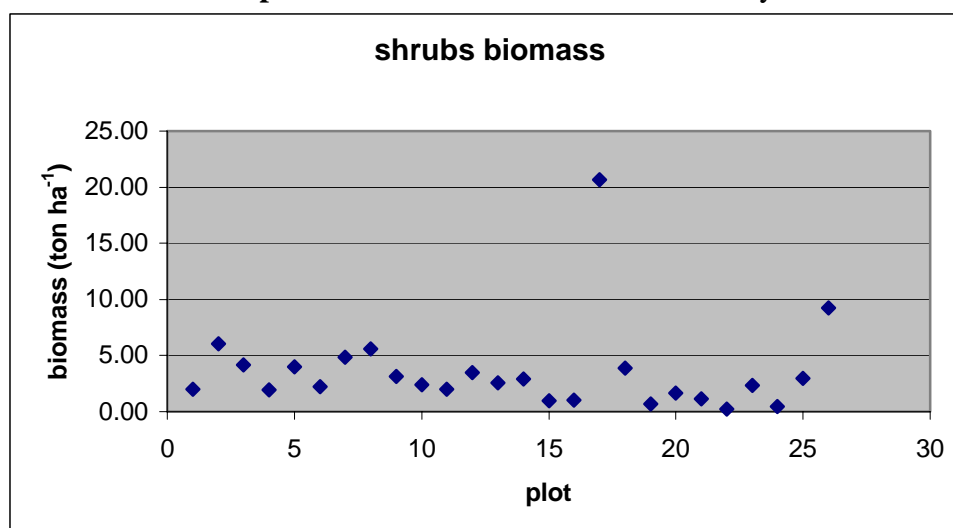
Data collection

Aboveground biomass in understory was measured through the use of the methodology proposed by Gower *et al.* (1997). Therefore, in June 2005, 1x1m plots were randomly located inside each plot. All aboveground vegetation tissue was removed, stored in a plastic bag and kept in a cold place. As soon as it was possible, vegetation was separated by the main species and weighed.

Data analysis

The samples were dried at 70°C for 3 or 4 days and after being completely dried were weighed to determine the dry biomass of each species in each FORSEE plot. That way, the estimation of the understory dry weight per hectare was obtained.

Graphic 7 : Biomass results for understory



Source: Estimation by UTAD research team

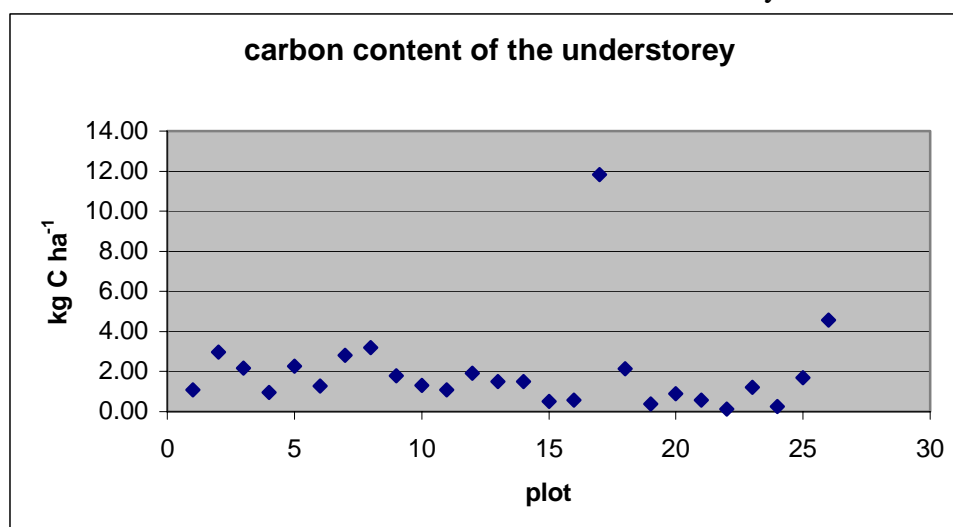
The main species found in FORSEE plots are the ones described in the following table. Chemical analysis gave the information related with the dry carbon content on them. Considering the proportion collected for each shrub species in the sub-sampling plots it was possible to estimate the carbon content in the understory.

Table 13 : Carbon content in the understory

Specie	Carbon content
<i>Ulex</i>	0,492
<i>Erica</i>	0,566
<i>Baccharis</i>	0,581
<i>Pteridium</i>	0,533
<i>Cytisus</i>	0,581

Source: Estimation by UTAD research team

Table 14 : Carbon content in the understorey



Source: UTAD

And the obtained figures showed that the average carbon content of the understorey, in our study area is $1.94 \pm 2.26 \text{ ton ha}^{-1}$.

II Criterion 2 – Forest Damages

Indicators C2.4.1 – Forest damages and C2.4.2 – Intensity of forest damages in Eucalyptus globulus

Data collection

Data collection was done according to the FORSEE field manual 12/07/2005guideterrain.V16.en.v2, page 36, available at www.iefc.net.

Characteristics of data collection:

Number of FORSEE devices: 35 devices (1 device = 1 IFN plot + 3 satellites)

Main types of forest stands: *Pinus pinaster* and *Eucalyptus globulus*

Field team: 1 junior specialist in forest health and two non specialized workers.

Number of days in the field: 15 days

Figure 3 : Example of FORSEE device

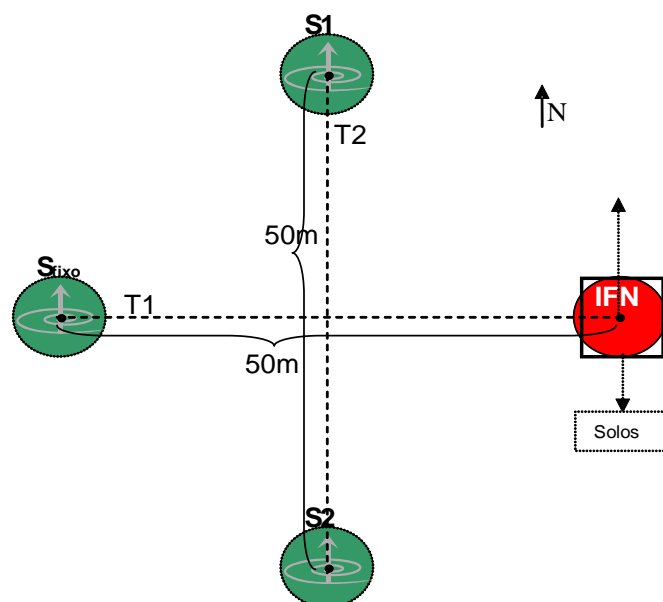


Table 15 : Description of the plots that form the inventory device

Code	Description	Proceedings
IFN	Inventory plot	Health evaluation in all the trees inside the plot;
S fix	Plot with fixed radius	Health evaluation in the 20 trees inside the satellite;
S1 and S2	Satellite 1 and satellite 2	In the satellite plots, health condition was verified in 20 trees through “daisy method” ¹ , considering a maximum radius of 12, 62 m, the same radius that in the inventory plot.

Source: FORSEE field manual 12/07/2005guideterrain.V16.en.v2 (www.iefc.net)

Variables evaluated:

1) Symptoms/signs

- Affected part
- Symptom/sign
- %

2) Agents

- Factor
- Specification
- %

3) Dendrometric variables at the tree level

- Specie
- Diameter

¹ **Daisy method:** Instead of doing the health evaluation of the trees in the satellites in spiral, as suggested in the FORSEE field guide (12/07/2005guideterrain.V16.en.v2), it was done the healthy evaluation with the daisy method.

- Height
- Social class

Data analysis

Data collected during the field work in the 35 FORSEE devices was recorded in field sheets and then organised in a digital database. Those data was presented in graphics and tables according to the forest specie, agents of damages, part of trees affected, types of damages and intensity of damages (in FORSEE Regional report, part 1, Synthesis). Later, it was done another analysis to compare the differences in the percentages of the variables evaluated in two different scenarios:

- 1) Considering forest health assessment in IFN plots + the satellites (35 IFN plots + 3x35 satellites);
- 2) Considering forest health assessment only in IFN plots (35 IFN plots).

Conclusion

1) There was a change in what was recommended by FORSEE field manual. Instead of doing forest health assessment in the pilot zone at the same time than the collection of dendrometric data, forest health was only assessed after the collection of dendrometric data in the 35 IFN plots. Therefore, after the first team collects dendrometric data in the IFN plots, a second team, which included a specialist in forest health assessment, came and established the satellites and the transects for logs inventory.

Portugal North team justifies this change for logistic reasons since the specialist on forest health was not part of the field team in charge of the collection of dendrometric data. It was also considered, as forest inventory and forest health assessment require two different levels of specialization, that it was faster to do first the collection of dendrometric data in the IFN plots and then the forest health assessment in all the 35 FORSEE devices (IFN plots + satellites);

2) Data was collected in 35 FORSEE devices (1 device= 1 IFN plot + 3 satellites). The analysis is done in the FORSEE Regional Report, Part 1 - Synthesis. According to the following tables and graphs, the differences of having the analysis done only in 35 IFN plots or in 35 IFN plots plus 3 satellites per each IFN plot are minimal. Since the forest health assessment requires costly human resources, if done in IFN plots + satellites more time will be needed and the costs will rise. However, as the results are similar it should be weighted if it is worth to do forest health assessment in IFN plots plus satellites or only in IFN plots.

Table 16 : *Eucalyptus globulus*

Agents causing damages	With satellites	Without satellites
B – defoliators	50%	49,90%
AB – causing yellow coloration	35%	37,90%
AB – wind	7,90%	7%
AB – forest fires	6,80%	5,10%
Parts of <i>Eucalyptus globulus</i> affected	With satellites	Without satellites
Branches	8%	6,90%
Leaves	74%	78,30%
Buds	11%	9,50%
Trunk	7%	5,30%
Damages in <i>Eucalyptus globulus</i>	With satellites	Without satellites
Lost or eaten buds	11%	9,50%
Leaves coloration	35%	37,70%
Stem in sloping position	0,10%	0,10%
Wounds in the trunk	7%	5,20%
Broken branches (<10 cm)	0,10%	0%
Broken branches (2-10 cm)	8%	6,90%
Partially lost or eaten leaves	39%	40,60%

Source : Field sheets

Figure 4 : Biotic and abiotic agents causing damages in *Eucalyptus globulus*

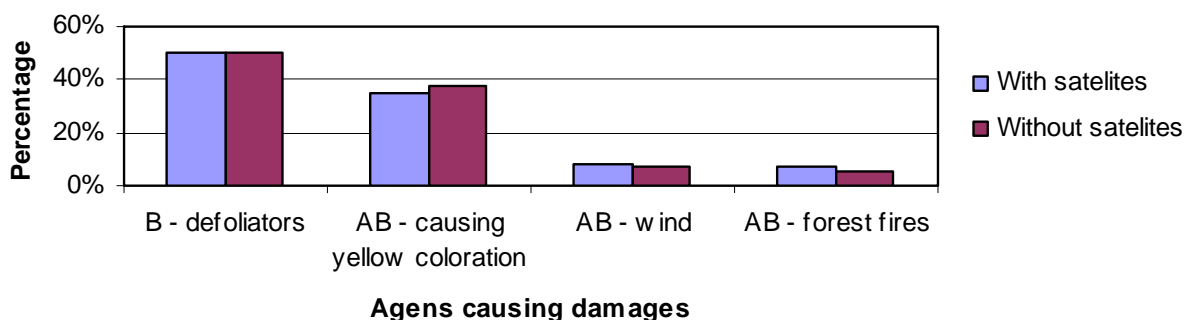


Figure 5 : Parts of *Eucalyptus globulus* affected

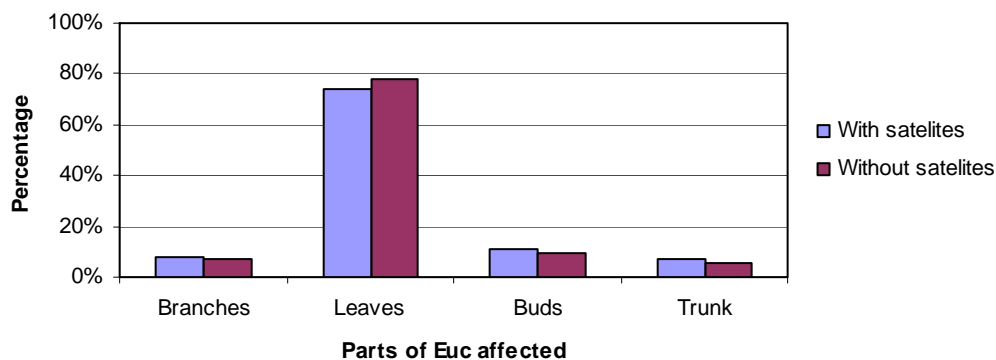


Figure 6 : Damages in *Eucalyptus globulus*

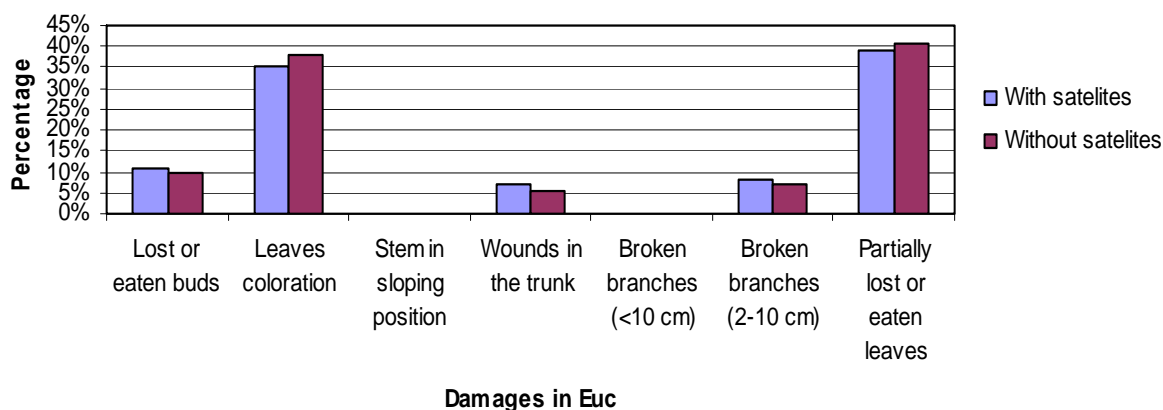


Table 17 : *Pinus pinaster*

Agents causing damages	With satellites	Without satellites
B – defoliators	2%	0,00%
AB – causing yellow coloration	58%	41,80%
AB – wind	27,40%	21%
AB – forest fires	27,20%	37,30%
Parts of Maritime pine affected	With satellites	Without satellites
Branches	27%	20,10%
Leaves	45%	42,80%
Buds	1%	0,00%
Trunk	27%	37,10%
Damages in Maritime Pine	With satellites	Without satellites
Lost or eaten buds	1%	0,00%
Discoloration	42%	42,80%
Other symptoms	2,50%	0,00%
Wounds in the trunk	27%	37,10%
Broken branches (2-10 cm)	27,20%	20%
Partially lost or eaten leaves	1%	0,00%

Source : Field sheets

Figure 7 : Biotic and abiotic agents causing damages in *Pinus pinaster*

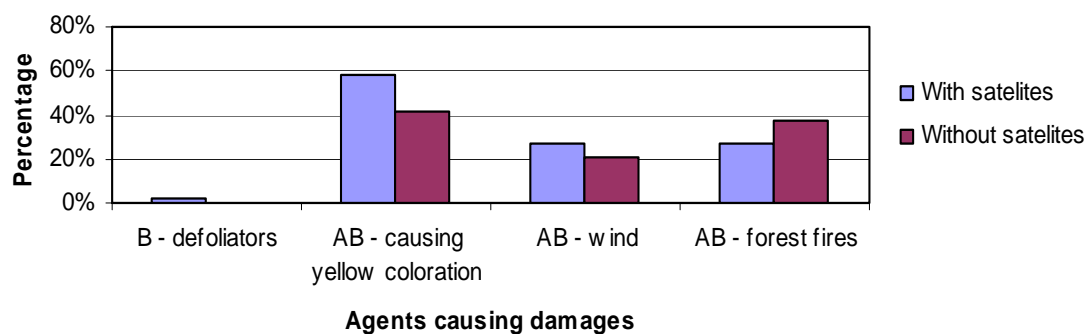


Figure 8 : Parts affected in *Pinus pinaster*

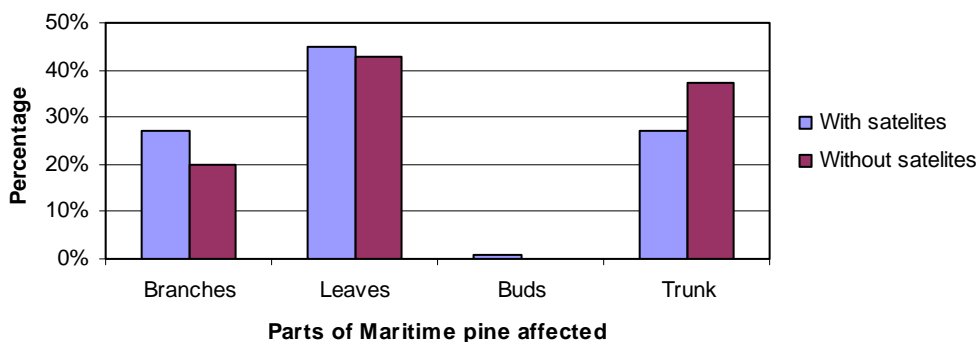
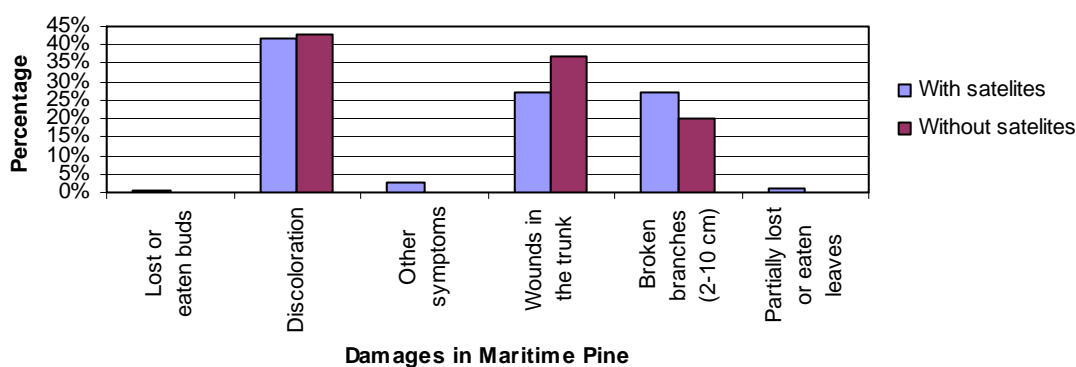


Figure 9 : Damages in *Pinus pinaster*



Indicator 2.4.3 – Area of shrubs and forest stands burnt in forest fires (new indicator)

Data collection

Data to build this indicator was collected from “*O país em números, Versão 2, Instituto Nacional de Estatística, 2004*”. This compilation records the area of shrubs and the area of stands burnt between 1980 and 2004.

Information about the risk of forests fires 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).

Data analysis

Data of the area of forest stands and shrubs burnt in the municipality of Paredes, where the FORSEE plots are located, and data of the area of forest stands and shrubs burnt in all Sousa Valley (6 municipalities) were presented in a graph in FORSEE Regional Report, Part 1 – Synthesis.

Conclusion

Given the gravity of forest fires in Portugal and as well as in Sousa Valley, one suggests to include this indicator in the list of FORSEE indicators.

III Criterion 3 – Forest Products

Indicator C3.1- Increment and fellings

Data collection

1) Data on forest inventory for 2002 was collected by the local FOO (AFVS) during the field work developed in under the Pilot Project of Forest Sustainable Management in Sousa Valley (*Programa Operacional da Região Norte, Eixo Prioritário 1, Medida 1.4 – Valorização e Promoção Regional Local*).

2) Data on forest inventory for 2005 was collected during the field work developed according to the FORSEE field manual (12/07/2005guideterrain.V16.en.v2, available at www.iefc.net), in 35 plots located in the Southern part of the municipality of Paredes;

3) Data on volume of all trees, living or dead measured over bark and to a minimum diameter of 10 cm that are felled during a given period, whether or not they are removed from forests was not available;

In this case, data available only refers the average volume of wood felled (Eucalyptus and Maritime pine) per year that is traded in the market. These data is not official and was provided by expert foresters linked to the pulp and paper industries and with high knowledge in Sousa Valley's wood market;

3) Data on the area of Eucalyptus and Maritime pine in Sousa Valley: IFN, 2005.

Data analysis

1) Net increment in Sousa Valley between 2002 and 2005 per hectare: UTAD estimatives according to what was explained previously;

2) Average volume harvested in Sousa Valley per hectare each year: With the area of Maritime pine and Eucalyptus stands in Sousa Valley in 2005 (NFI,2005) and the volume of Eucalyptus and Maritime pine harvested (and traded in the market) each year in Sousa Valley (source: local foresters) it was calculated the average volume harvested in Sousa Valley per hectare and each year:

2.1) Average volume of Eucalyptus harvested in Sousa Valley per hectare (m³/ha):

$$270000 \text{ m}^3 / 17099,51 \text{ ha} = 15,79 \text{ m}^3/\text{ha}$$

2.2) Average volume of Maritime pine harvested in Sousa Valley per hectare (m³/ha):

$$107500 \text{ m}^3 / 9499,72 \text{ ha} = 11,32 \text{ m}^3/\text{ha}$$

3) **Extraction rate:** volume harvested/net increment*100

3.1) Eucalyptus: Volume harvested (m³ ha⁻¹/year)/ Annual net increment (m³ ha⁻¹/year) *100 =

$$15,79 \text{ m}^3.\text{ha}^{-1} / 17,73 \text{ m}^3.\text{ha}^{-1} = 88,7 \%$$

3.2) Maritime pine: Volume harvested (m³ ha⁻¹/year)/ Annual net increment (m³ ha⁻¹/year) *100 =

$$11,32 \text{ m}^3.\text{ha}^{-1} / 13,9 \text{ m}^3.\text{ha}^{-1} = 81,4 \%$$

Indicator 3.2- Roundwood harvested (value and volume)

Data collection

In order to assess the **indicator 3.2 – Roundwood harvested (value and volume)** data on prices of wood of Eucalyptus and Maritime pine in 2006 and data on the volume of these species harvested (and traded in the market) each year was provided by foresters linked to the pulp and paper industries and with high knowledge in Sousa Valley's wood market.

It was also collected data on wood and prices bought and paid by one timber merchant in Sousa Valley. These data is recorded at AFVS database and was reorganized for the evaluation of this indicator.

Data analysis

1) Data on volume of wood harvested in Sousa Valley in 2006 was organised per forest specie and per type of destination and presented on a table at FORSEE Regional report, part 1, Synthesis;

2) Data of wood bought and price paid by one local timber merchant available at AFVS database was recorded according to the following characteristics:

- Forest specie;
- Volume of wood bought per month;
- Stumpage price and price of wood in the load;
- Wood origin (normal or burnt);
- Wood destination (sawnwood or pulpwood);
- Type of selling (in the stand or in the load);

- Municipality of Sousa Valley where the wood was bought;
- Month in which wood was bought.

To analyse this indicator, these data were organized and compiled according to:

- Volume of wood bought per year (by adding the wood bought per month);
- Type of destination and type of selling per specie. In FORSEE regional report, part 1, Synthesis, data were presented in graphs and in FORSEE data report, data previously compiled were presented in tables.

The average weighted stumpage price per cubic meter of wood over bark was calculated and presented in graphs according to the forest specie.

Indicator 3.3- Non wood products

Data collection

In order to assess the **indicator 3.3 – Non wood products** different data sources were used:

- 1) Number of beehives, number of beekeepers and number of honey holdings in Sousa Valley:** *Recenseamento Geral Agrícola de 1999 in O país em números, Versão 2, Instituto Nacional de Estatística, 2004.* These data was also available in the Regional Direction of Agriculture of Entre Douro e Minho (DRAEDM in Portuguese Initials), located in Penafiel.
- 2) Productivity per beehive:**
 - 2.1) In Portugal:** Programa Apícola, Portugal. 2004-2007;
 - 2.2) In Sousa Valley:** Local beekeepers.

Data analysis

Data on the number of beehives in Sousa Valley (given by INE) was multiplied by the productivity of honey per beehive in Sousa Valley (given by local beekeepers) and by the price paid by middle men per kg of honey to local beekeepers in Sousa Valley (price given by local beekeepers).

The value of production in Sousa Valley is: **2418 beehives x 20 Kg of honey per beehive x 1,5 €/Kg = 72540 €**

Indicator C3.5 – Forest under management plans

Data collection

Data about forest under management plans in Sousa Valley was available at the local forest owner's organisation – AFVS. These data comprise the area of forest planted and improved by non industrial private forest owners with the support of EU co-financed forest programmes.

The type of projects and the period of supporting are:

Forest development plan (1994-1999)- The FDP was a forest programme specific to Portugal, financed by the EU structural funds within the Common Support Framework for the period 1994/99 at about 75 % of the total public expenditure involved.

Regulation (EEC) 2080/92 (1992-1994) - Regulation (EEC) N° 2080/92 of 30 June 1992 was part of the accompanying measures of the CAP 1992 Reform. The preparatory work for its implementation in Portugal was developed between 1992 and 1994.

AGRO Programme (2000-2006) - The AGRO program was inserted in a strategy of agricultural and rural development in order to stimulate a solid alliance between the agriculture and the sustainable development of the rural lands in the environmental, economic and social perspectives.

RURIS programme (2000-2006) - This program is ruled by similar lines than the AGRO program with the difference that the public financing can only be asked when the objective is to convert agricultural land in forest land.

AGRIS programme (2000-2006) - The AGRIS Programme is included in a strategy of agricultural and forestry development. This measure comprises a various set of support and financed the activities between **50%** and **80%** of the total costs.

Data on the area of forest under management of the pulp and paper industries and which one considered to be under a forest management plan is also recorded in AFVS database and collected to evaluate this indicator.

Data analysis

To be financed by EU-forest programmes, forest owners have to implement a forest project and to follow a forest management plan. As most of the forest owners ask to the local FOO, AFVS to design the project and to draw the forest management plan, there is data on this topic available there.

From AFVS database it was collected the area of forest planted or improved by non industrial private forest owners in Sousa Valley under co-financed forest programmes.

The variables collected were the following:

- 1) Area of forest planted or improved;
- 2) Situation;
- 3) Specie;
- 4) Type of project (described above);

To assess the area under forest management plans it was only considered the area of forest projects already concluded or in development – situation defined as *Concluído* and *Em execução*. The

forest projects that for some reason had stopped to be implemented or that were cancelled were not considered in the analysis – situations defined as *Análise, Cancelado pelo IFADAP, Desistiu, Desconhecida, Em elaboração* and *Sem elementos*. Also the forest projects that do not have a defined situation were not considered in the analysis. The area of forest projects which the situation is not defined corresponds to **1027, 06 hectares**.

Data considered was organised in a table in order to have the area planted or improved per type of specie. To this data was added the area of *Eucalyptus globulus* under management of pulp and paper industries because it was considered that this area is under a forest management plan. The percentages per specie were also calculated taking into account the area of forest in Sousa Valley assessed by IFN 2005.

Indicator C3.6- Accessibility and C3.7- Harvestability

Data collection

Basic maps (road's map, slope's map and land use) needed to build the indicators **3.6** and **3.7** were available at the local forest owner's organisation.

These basic maps are:

- Map of land use for half of the municipality of Paredes and for half of the municipality of Penafiel was available at AFVS but can be bought in IGP – *Instituto Geográfico Português* (Portuguese Geographic Institute); Area of each polygon: 5000 m².
- Map of roads for half of the municipality of Paredes and for half of the municipality of Penafiel, available at AFVS but can be bought in IGP – *Instituto Geográfico Português* (Portuguese Geographic Institute); Scale: 1: 25 000.
- Map of slopes for half of the municipality of Paredes and for half of the municipality of Penafiel, available at AFVS but can be bought in IGP – *Instituto Geográfico Português* (Portuguese Geographical Institute); Scale: 1: 25 000.
- Land use map of 1995: The map of land use was built through the interpretation of the aerial photograph taken by CELPA – *Associação da Indústria Papeleira* (Association of the Paper Industry) in 1995. The photographs corresponding to half of the municipality of Paredes and half of the municipality of Penafiel were made available to AFVS by CELPA.

The road map and the map of slopes were bought by AFVS to the IGP – *Instituto Geográfico Português* (Portuguese Geographic Institute).

Indicator C3.6 – Accessibility

Data analysis

The **accessibility** is described as the net of roads that let the access to forest, measured in meters of roads per hectare. The analysis of this indicator only considered the land use classified as **Forest in 1995**.

The indicator was assessed using the road map and the land use map available at the local FOO for half of the municipalities of Paredes and Penafiel. This road map only classified the roads in highway, roads and paths.

Using *ArcView 9*, and with the support of the military map (military map) the roads of the road map were reclassified according to the C3 expert group protocol (available at www.iefc.net) 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.

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.

ArcView 9 calculated the density of roads in half of the municipality of Paredes in m/ha.

Indicator C3.7- Harvestability

Data collection

The indicator **harvestability** was assessed using the map built previously for the indicator accessibility to analyse the indicator C3.6 and the map of slopes.

ArcView 9 calculated the areas of each type of accessibility according to what was asked by the C3 expert group protocol (available at www.iefc.net).

The 4 types of accessibility are:

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 %.

Conclusion

Almost all the data needed to assess C3 indicators were available at the local forest owner's organisation (AFVS) or it was collected from local foresters, local timber merchants or local forest owners in some way linked with AFVS. For Portugal North region one concludes that the local FOO is a very important source of data and one suggests that the evaluation of C3 indicators should be done in partnership with this organisation.

IV Criterion 4 - Biodiversity

Indicator C4.1 – Trees species composition

Data collection

Land use of 1995: Aerial photograph of 1995 for the pilot zone was photo interpreted previously by AFVS team. Therefore, for half of two municipalities of Sousa Valley, Paredes and Penafiel, photo interpretation of the aerial photographs of 1995 was available at the local forest owners association (AFVS). The area covered by the photo interpretation of 1995 covers the area where the FORSEE 35 plots measured were implemented.

Land use of 1990: Aerial photograph of 1990 for Portugal North pilot zone was not available. The analyse that was going to be done using the aerial photograph of 1990 was substituted by COS 90 which is a map of land use done by IGP - *Instituto Geográfico Português* (Portuguese Geographic Institute) based on photos taken in August of 1990 and August of 1991. COS 90 is available for free at <http://snig.igeo.pt/cgibin/snig/Igd/importacao.cgi?cod=C471> (recovered at 10 April, 2007).

Data analysis

For half of the municipality of Paredes, where the 35 FORSEE plots were located, data on trees species composition was taken from the attribute tables of the digital map land use 1995 and the digital map of COS90. To the area of forest and to the type of stand recorded in the attribute table of the digital maps was added the number of species presented in each type of stand and the percentage of the corresponded forest area concerning the total forest area considered (area of forest in half of the municipality of Paredes in 1995).

The types of stands are defined as following:

Table 18 : Definition of the type of stands in photo interpretation 1995

Code	Level 1	Type of stands
FLEcEc	Forest	Pure eucalyptus
FLWqWq		Burnt areas or cut areas where the specie could not be identified
FLPbEc		Maritime pine (dominant) x eucalyptus
FLEcPb		Eucalyptus (dominant) x maritime pine
FLPbPb		Pure maritime pine
FLFdFd		Other broadleaves
FLPbFd		Maritime pine and other broadleaves
FLEcFd		Eucalyptus and other broadleaves

Source: AFVS. Relatório final do projecto-piloto de gestão florestal sustentável no Vale do Sousa. Programa Operacional da Região do Norte, Eixo prioritário 1, Medida 1.4 – Valorização e Promoção Regional Local, Paredes, Novembro de 2004

Table 19 : Definition of the type of stands in COS 90

Code	Type of stands
EE	Pure Eucalyptus
PP	Pure Maritime pine
FF	Other broadleaves
FR	Broadleaves x coniferous
PE	Maritime pine (dominant) and Eucalyptus
RF	Coniferous x broadleaves
PQ	Pure maritime pine and oaks
PF	Maritime pine and other broadleaves
EP	Eucalyptus (dominant) and Maritime pine
QQ	Oaks
EF	Eucalyptus and other broadleaves

Source: Direct communication of foresters in charge of the preparation of the forest management plans

Table 20 : Code definition

Code	Percentage of forest cover
0	Forest cover <10%
1	Forest cover between 10% and 30%
2	Forest cover between 30% and 50%
3	Forest cover >50%
4	Fire or cut areas
5	Urban green area or protection area
6	Spontaneous specie

Source: Direct communication of foresters in charge of the preparation of the forest management plans

Indicator C4.2 – Regeneration, substituted by Indicator 4.2.1 – Plantation

Data collection

Some data about the area of forest planted in Sousa Valley was available at the local forest owner's organisation – AFVS. These data is recorded in AFVS database and comprise the area of forest planted or improved by non industrial private forest owners with the support of EU co-financed forest programmes.

Data analysis

Area of species planted or improved by NIPFO that had implemented forest projects and the area of Eucalyptus under the management of pulp and paper industries were considered as area of forest planted in Sousa Valley. That area, recorded at AFVS database, previously organised for the indicator C3.5 – Forest under management plans, is presented in a table as well as the percentages corresponding to the area of forest specie concerning the total area of forest assessed by the IFN 2005.

Indicator C4.3 – Naturalness

Data collection

Data to analyse this indicator was taken from the National Forest Inventory of 2005 (NFI, 2005).

Data analysis

To evaluate this indicator it was taken into account the definition of Naturalness given by the C4 expert group protocol, available at www.iefc.net. Here, Naturalness is defined as the area of forests, undisturbed by man, semi-natural or planted but not under intensive management.

As undisturbed forest by man is inexistent in Sousa Valley, only data on the area of semi-natural forests, which are forests that are not under intensive management for a significant period of time, were available for Sousa Valley. That area was taken from the information about the area per type of stands in Sousa Valley recorded by IFN 2005.

It was considered that semi – natural forests 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*.

Indicator C4.4 – Introduced tree species

Data collection

Since AFVS database about the forest projects implemented in Sousa Valley by NIPFO also comprises data about the forest species, some information about introduced tree species could be assessed from there.

Data analysis

It was considered that introduced tree species are the ones that are not originated in Portugal or that were brought and established in the country in the latest 500 years. From AFVS database with the records of data about the forest projects implemented in Sousa Valley it was taken the area of species considered as introduced species that were planted or improved by NIFPO. The area of Eucalyptus under the management of pulp and paper industries was also considered.

Data is presented in a table in Regional report, part 1, Synthesis.

Indicator C4.5 Deadwood

Data collection

The methodology for data collection is described in FORSEE field manual 12/07/2005guideterrain.V16.en.v2, page 45, available at www.iefc.net.

Data analysis

UTAD estimated the volume of logs found in the transects and the volume of snags found in the FORSEE plots. That volume was extrapolated to the volume per hectare considering the total forest area of assessment as the one covered by half of the municipality of Paredes in 1995. This forest area was calculated by *ArcGis 9* and corresponds to 4956, 2 hectares.

V Criterion 5 – Forest soils

Indicators C5.3.1 - Carbon soil and water holding capacity and C5.3.2 - Nutritive status

Data collection

Soil samples were collected in the 35 IFN plots. Soil collection was not done according to the FORSEE field manual. Instead of the 10 samples recommended (see

12/07/2005guideterrain.V16.en.v2, page 57, available at www.iefc.net) it was only collected 3 samples per IFN in three different locations in the plot considering as having different visual characteristics. The collection was done in the soil deepness 0-30 cm and in the soil deepness 30-60 cm.

Data analysis

Soil analyses were done at UTAD laboratories. The method of extraction used was the Egner-Riehm method.

VI Criterion 6 – Socio-economic functions of forests

Indicator 6.01- Forest holdings

Data collection

1) Concepts used to collect and organize data for this indicator

Indicator definition: this indicator describes the distribution of the *number* and *area* of forest *holdings*, classified by type of management and size classes.

Forest holding: technical and economic unit possibly made of more than one piece of land satisfying the following conditions:

- i) area considered as forest according to the definition of the National Forest Inventory;
- ii) area submitted to one and the same management entity (who is not necessarily the same as the landowner);
- iii) area located in a well defined place.

This definition could be narrowed down by adding a new criterion concerning the minimum threshold of forest area below which a holding with forest would not be considered as a forest holding. The methodological choice made here is not to do it.

(**Source:** Report of the Expert Group of Criterion 6: Maintenance of other socio-economic and cultural functions and conditions of Forests, 2004, available at www.iefc.net).

Forest ownership units: set of forest land plots land belonging to the same owner.

Types of forest management:

- i) Non industrial private forest holdings
- ii) Industrial private forest holdings
- iii) Communal forest holdings (directly managed by the commoners or managed by delegation to other entities such as the Forest Services, or town councils)

iv) Public forest holdings (holdings which are State property and are managed by public authorities.

2) The issue of separation between ownership and management and the concept of forest holding adopted for the indicator

In the pilot zone, by far, the main case of separation between ownership and management concerns the forest holdings belonging to the pulp and paper companies. These holdings are on lands that are leased in to non industrial private forest owners. We have data on the following types of units:

- a) Forest land managed by the pulp and paper companies;
- b) Forest land managed by non industrial private forest owners (except the land leased out to pulp and paper companies);

Each pulp and paper company manages land spread out through different towns. The same happens with some NIPFO. However, since the management entity is the same, we considered as belonging to the same forest holding all pieces of land managed by the same entity: pulp and paper companies, or NIPFO.

3) Methodology and data shortcomings

Since resources available for this project were too short to run a survey of a representative sample of forest holdings, we adopted an exploratory approach consisting in using primary data that were collected by others, but not yet treated. All these data come from the files of the **Forest Owners' Association of the Sousa Valley (AFVS)**.

The choice of this kind of data was dictated by convenience reasons, as we have just said, but there is also a substantial reason to do so. Given the very high percentage of private forestry existing in Portugal, in general, and also in the pilot zone, and the fact that it is very fragmented and subject to a high risk of forest fires, **Sustainable Forest Management can hardly be achieved without some form of collective organization of forest owners**. AFVS is one example of this kind of organization. For the pilot zone AFVS is also the only active form of this kind of organization. So by looking at the size distribution of the holdings of AFVS members we are approaching the forest land that is more advanced in the process of moving towards SFM.

The data about forest holdings distribution in the files of AFVS is split in three sets with different degrees of representativeness and quality:

3.1) Forest holdings of all the members of the Forest Owners' Association of the Sousa Valley

The members of AFVS are distributed throughout the six municipalities belonging to the Sousa Valley. Using the data in the files of AFVS, this set has the following composition:

- a) total number of members: 500 in the year 2005; 493 were forest owners;
- b) total forest land: 11 116,4 hectares

This total forest land of the members of AFVS represents 32 % of the total forest land of the Sousa Valley. These forest holders are spread throughout the Sousa Valley, their holdings being **not necessarily contiguous** to each other.

Since the members of AFVS tend to be from the upper classes of size distribution, this is not a representative set of the forest holdings of the Sousa Valley.

Another shortcoming of these data is the fact that **the area for each member is the one that he declared** to manage when he joined the association. This declared area may not be the area he actually manages.

3.2) Forest holdings within the boundaries of the Forest Intervention Zone of Entre-Douro-e-Sousa

The Forest Intervention Zone of Entre-Douro-e-Sousa (ZIF EDS) is a territory of about 7000 ha of **contiguous** forest land in the southern part of the municipalities of Paredes and Penafiel where the AFVS is preparing a project of grouped forest management according to the legislation regulating the ZIFs.

The field work for the indicators in the other criteria was carried out in an area which is partially included in this ZIF, the rest being in an area contiguous to this ZIF.

For the forest holdings in this ZIF, AFVS collected some data about their area of **forest land as it is in the fiscal registries**. This is better than the area declared by the forest owner, mentioned for the previous set, but it is not necessarily the area each forest owner actually manages, because data on the fiscal registries was not measured by GPS or other accurate method of land measurement.

So far, AFVS collected these data for the following set of owners:

- a) total number of forest holders: 155 (in September 2006)
- b) total area of forest land collected: 3612,5 hectares (in September 2006)
- c) This total area of forests corresponds to 10 % (in June 2006) of the total area of forests of the Sousa Valley.

3.3) Forest holdings within the boundaries of the AGRIS 8 Project

In a small part of ZIF EDS, AFVS prepared a project of grouped forest management (AGRIS 8 Project). For the forest owners in this project, AFVS already collected **data on their forest land using GPS measurements** and collecting the **forest land as it is in the fiscal registries**. These data refer to an area of **contiguous** forest holdings with the following composition:

- a) number of forest owners: 511
- b) total area of forests: 618 ha

This total area of forests corresponds to 1, 74 % of the total area of the Sousa Valley.

Data analysis

Area of forest land that was considered to build the distribution of forest holdings

To build the indicator on forest holdings, it was selected 1 from the 6 municipalities of Sousa Valley. The municipality selected was Penafiel since it is the one for which the local FOO have more cadastral information collected through the sources described above (AFVS members, ZIF adherents, AGRIS 8 project).

In order to avoid data duplication it was used:

- a) Data on forest holdings belonging to AFVS members and located in the municipality of Penafiel;
- b) Data of forest holdings of ZIF members, but not members of AFVS and located in the municipality of Penafiel;
- c) Data of forest holdings under AGRIS 8 project, not belonging to AFVS members and located in Penafiel.

The information available covers about 58% of the forest land of the municipality of Penafiel. Data was organized and the **Lorenz curve** built as well as the **Gini coefficient**.

Table 21 : Area of forest holdings in Penafiel

Total forest area (IFN,1995) in Penafiel	Forest area with data on forest holdings distribution in Penafiel	% forest area in Penafiel with data on forest holdings distribution
9638 ha	5665,246 ha	58,78 %

Source: AFVS database

Indicator 6.03- Net revenue

Data collection

1) Concepts used to collect and organize data for this indicator

Indicator definition: net revenue of forest enterprises.

Net revenue: according to FAO (www.fao.org/docrep/005/y4001e/Y4001E08.htm, recovered in 2006), this includes all sources of income of the forest owner directly related to forestry, including subsidies and excluding taxes, net of costs.

2) The issue of separation between forest ownership and forest harvesting and marketing

All of the NIPFO existing in the pilot zone don't take care of the harvesting and marketing of their

forest products. So we don't have forest enterprises in the sense of firms which integrate forest management with harvesting and marketing of forest products.

Another feature of NIPFO in the pilot zone is that they **don't keep accounting records** of their forest operations.

Because of what we said in the previous section, the only possible source of data on the net revenue of forest holdings in the pilot zone is data estimated **by experts with knowledge on local forestry conditions**.

3) *The items of cost and revenues*

The experts we called upon for this work are the local foresters of pulp and paper industries who have a long experience of forest management in the area. They know the costs of forest operation as soil preparation, plantation or maintenance as well as the revenues coming from the wood selling of the two most important species in this region: Eucalyptus and Maritime pine.

The cost and revenue items estimated are the following:

Table 22 : Costs and revenues items estimated

Revenues	
Revenues of the selling of wood (actualized)	
Costs	
Silvicultural costs	Soil preparation (includes creation of infrastructures for management and fire prevention)
	Planting (includes labour, plants, fertilization)
	Shrub cleaning
	Fertilization
	Harvest
	Cut, wood's piling up and wood transportation
Administrative costs	
Costs of fire surveillance	
The rents of the forest land	
Gross margin on sales (margin after variable costs)	

Revenues from non timber forest products were not estimated.

Data analysis

1) Costs and revenues per hectare of an active forest owner (data collected from foresters working for the pulp and paper industries)

Specie: *Eucalyptus globulus*

Area: 1 ha

Age of cut: 12 years

Average productivity: 15 m³/ha/year

Number of rotations: 3

Average price at mill's gate (m³ ob): 32,50 € in 2006

Table 23 : Estimation of costs and revenues per hectare in *Eucalyptus globulus* (1st rotation)

COSTS		
Year 0	Soil preparation costs (750 €) Include construction of infrastructures for management and fire prevention	1350 €
	Planting costs (600 €) Include plantation (labour + 1400 plants/ha) and fertilization (labour + slow fertilization + deep fertilization)	
Year 2	Shrub cleaning	150 €
Year 3	Fertilization (N, K, P) 300 kg/ha (fertilizer + labour)	80 €
Year 6	Shrub cleaning	150 €
Year 12 [total harvested: annual increment (15 m ³ ob/ha/year) X 12 years = 180 m ³ ob/ha]	Harvesting costs (6 €/m ³ ob)	19 €/m ³ ob/ha x 180 m ³ ob/ha = 3420 €
	Wood's piling up (5 €/m ³ ob)	
	Transportation costs to the paper mill for an average distance of 100 km (8 €/m ³ ob)	
REVENUES		
REVENUE		32,50 €/m ³ ob x 180 m ³ ob = 5850 €

Table 24 : Estimation of costs and revenues per hectare in *Eucalyptus globulus* (2.nd rotation)

COSTS		
Year 2-3	Twigs selection	100 €
Year 12 [total harvested: annual increment (14,25 m ³ ob/ha/year ²) X 12 years = 171 m ³ ob/ha]	Harvesting costs (6 €/m ³ ob)	19 €/m ³ ob x 171 m ³ ob/ha = 3249 €
	Wood's piling up (5 €/m ³ ob)	
	Transportation costs to the paper mill for an average distance of 100 km (8 €/m ³ ob)	
REVENUES		
REVENUE		32,50 €x 171 m ³ ob = 5557,5 €

Table 25 : Estimation of costs and revenues per hectare in *Eucalyptus globulus* (3.rd rotation)

COSTS		
Year 2-3	Twigs selection	100 €
Year 12 [total harvested: annual increment (14,25 m ³ ob/ha/year ³) X 12 years = 171 m ³ ob/ha]	Harvesting costs (6 €/m ³ ob)	19 €/m ³ ob x 171 m ³ ob/ha = 3249 €
	Wood's piling up (5 €/m ³ ob)	
	Transportation costs to the paper mill for an average distance of 100 km (8 €/m ³ ob)	
REVENUES		
REVENUE at mill's gate		32,50 €x 171 m ³ ob/ha m ³ = 5557,5 €

Table 26 : Other costs

Administrative costs	10% of the revenues
Costs of fire surveillance	20-25 €/ha/year
Expected losses due to fires	30% of the revenues
Land rents	50-60 €/ha/year

Source: Foresters working for the pulp and paper industries

² Decrease of productivity (5%)

³ Decrease of productivity (5%)

Specie: *Pinus pinaster*

Area: 1 ha

Final cut: 45 years

Average productivity: 2 m³/ha/year

Average price at mill's gate (m³ ob) in 2006: 32, 50 €

Table 27 : Estimation of costs and revenues per hectare in *Pinus pinaster*

COSTS		
Year 0	Soil preparation costs (750 €) Includes construction of infrastructures for management and fire prevention	1350 €
	Planting costs (600 €) Includes plantation (labour + 1400 plants/ha) and fertilization (labour + slow fertilization + deep fertilization)	
Year 2-3	Shrub cleaning	150 €
Year 12	Shrub cleaning	150 €
Year 16 [total harvested: 50 m ³ ob/ha]	1 st thinning (harvest costs + costs of wood piling up + transportation costs to the paper mill)	19 €x 50 m ³ ob =950 €
Year 22 [total harvested: 80 m ³ ob/ha]	2 nd thinning (harvest costs + costs of wood piling up + transportation costs to the paper mill)	19 €x 80 m ³ ob = 1520 €
Year 45 [total harvested: 80 m ³ ob/ha]	Final cut (harvest costs + costs of wood piling up + transportation costs to the paper mill)	19 €/m ³ ob x 80 m ³ ob/ha = 1520 €
REVENUES		
Year 16 [total harvested: 50 m ³ ob/ha]	1 st thinning (harvest revenues)	32,50 €x 50 m ³ ob = 1625 €
Year 22 [total harvested: 80 m ³ ob/ha]	2 nd thinning (harvest revenues)	32,50 €x 80 m ³ ob = 2600 €
Year 45 [total harvested: 80 m ³ ob/ha]	Final cut	32,50 €x 80 m ³ ob = 2600 €

Table 28 : Other costs

Administrative costs	10% of the expected value
Costs of fire surveillance	20-25 €/ha/ano
Expected losses due to fires	30% of the expected value

Source: Foresters working for the pulp and paper industries

Indicator 6.04- Expenditure for services

Data collection

a) Concepts used to collect and organize data for this indicator

Expenditure for services: amount of annual public expenditures to support the production of forest environmental services (carbon storage, protection of forest landscape quality, soil protection, water retention, ground water protection and water purification, biodiversity and habitat protection, etc.), if possible, according to the Classification of Environmental Protection Activities 2000 adopted by EUROSTAT.

b) Identification of the Environmental Protection Activities

According to the Report of the Expert Group of Criterion 6, from the list of classes included in the Classification of Environmental Protection Activities - version 2000 - adopted by EUROSTAT, the classes more likely to include forest environmental services are the following ones:

Table 29 : Classes considered to include environmental services

ID	Code Number	Level	EN Description
30	4	1	Protection and remediation of soil, groundwater and surface water*
31	4.1	2	Prevention of pollutant infiltration
32	4.2	2	Cleaning up of soil and water bodies
33	4.3	2	Protection of soil from erosion and other physical degradation
34	4.4	2	Prevention and remediation of soil salinity
35	4.5	2	Measurement, control, laboratories and the like
36	4.6	2	Other activities
48	6	1	Protection of biodiversity and landscapes*
49	6.1	2	Protection and rehabilitation of species and habitats
50	6.2	2	Protection of natural and semi-natural landscapes
51	6.3	2	Measurement, control, laboratories and the like
52	6.4	2	Other activities
58	8	1	Research and development*
59	8.1	2	Protection of ambient air and climate
60	8.1.1	3	Protection of ambient air
61	8.1.2	3	Protection of atmosphere and climate
62	8.2	2	Protection of water
63	8.3	2	Waste
64	8.4	2	Protection of soil and groundwater
65	8.5	2	Abatement of noise and vibration
66	8.6	2	Protection of species and habitats
67	8.7	2	Protection against radiation
68	8.8	2	Other research on the environment

Source: C6 Expert group report

c) Sources

Transfers from the Ministry of Agriculture to the municipalities

AGRIS Programme

The AGRIS Programme is part of the Rural Development Plan. This programme provides matching grants to the municipalities ranging between **50%** and **80%** of the total costs.

It is divided in 8 actions and 16 sub-actions.

The actions and sub actions related to forest for which the municipalities are eligible are the following:

Table 30: Actions and sub-actions related from AGRIS programme

Action 3 – Sustainable Management and Ecologic Stability of Forests	3.1 – Implementation of Forest Owners Organizations 3.2 – Support to Forest contractors 3.3 – Support to the provision of services to forestry 3.4 – Prevention of risks caused by non biotic and biotic agents 3.5 – Improvement and Conservation of Forest Spaces with public interest
Action 7 – Protection of Environment and Rural Heritage	7.1 – Conservation of Rural Heritage and landscape 7.2 – Conservation of Environment and Natural Resources

Source: <http://www.ifadap.min-agricultura.pt/ifadap/incentivos/agris/mainAGRIS.html>
(accessed on 14/06/06)

Data on the amount of funds coming from the AGRIS programme was collected directly from the 6 municipalities of Sousa Valley;

Table 31: Contacts of the town councils of Sousa Valley

Municipality	Address	Phone and Fax	Departament
Penafiel	Praça do Município, 4560-481 Penafiel	00351 255710700;00351 255711066	Technical Forest Office
Paredes	Parque José Guilherme, 4580-130 Paredes	00351 255776713; 00351 255782155	Technical Forest Office
Felgueiras	Praça da República, 4610-116 Felgueiras	00351 255318000; 00351 255318170	Technical Forest Office
Castelo de Paiva	Largo do Conde – Sobrado, 4550-102 Castelo de Paiva	00351 255689500; 00351 255699660	Technical Forest Office
Lousada	Praça Dr. Francisco Sá Carneiro Apartado 19, 4624-909 Lousada	00351 255820500; 00351 255820550	Technical Forest Office
Paços de Ferreira	Praça da República, 4590-527 Paços de Ferreira	00351 255860700; 00351 255861420	Technical Forest Office

Permanent Forest Fund (Fundo Florestal Permanente)

Besides the AGRIS programme as a funding source for forest protection projects, there is also the Permanent Forest Fund (FFP in Portuguese initials), created in 2004. This fund aims to support the sustainable forest management and includes 5 areas. The area benefiting the municipalities is Area 1- Prevention and protection of forests against fires. This finances projects similar to those supported by Sub action 3.4 of AGRIS. It also supports the recruitment of foresters for the municipalities staff.

The projects are supported by matching grants ranging from **85%** to **100%** of the total cost of the project.

Data was found in

<http://www.ifadap.minagricultura.pt/ifadap/incentivos/ffp/listagem.html#area%202> (accessed on 14/06/06).

Expenditures of the Ministry of Agriculture with the management of the fire surveillance towers in Sousa Valley

In 1990, was officially created the National Network of Fire Surveillance Towers, (*RNPV - Rede Nacional de Postos de Vigia* (<http://scrif.igeo.pt/servicos/pvigia/>, accessed in 2006) in order to promote the quick detection of forest fires, as well as to support fire fighting operations. In Continental Portugal there are 237 fire surveillance towers managed by the Ministry of Agriculture, Environment, municipalities and private entities.

The sources for this information were:

- <http://scrif.igeo.pt/servicos/pvigia/>
- *Local foresters*
- *Municipalities*

Transfers from the Ministry of Interior to the local FOO, AFVS

Data was collected directly from the local FOO, AFVS.

Data analysis

Transfers from the Ministry of Agriculture to the municipalities

a) *AGRIS programme*: The amount of funds coming from AGRIS programme for fire prevention was obtained directly from the 6 municipalities of Sousa Valley;

b) *FFP*: The amount of funds coming from Forest Permanent Fund (*FFP – Fundo Florestal Permanente*) was obtained from IFADAP's website: <http://www.ifadap.min->

agricultura.pt/ifadap/incentivos/ffp/listagem.html#area%202 (accessed in 2006).

Expenditures with fire surveillance towers: In Sousa Valley, there are 4 fire surveillance towers located in the municipalities of Castelo de Paiva, Lousada, Paredes and Penafiel. These towers are under the responsibility of the Ministry of Agriculture and are in activity during the Summer (4 months). In 2005, each tower employs 4 persons, in average, by tournaments of 8 hours each. The wage per month of these workers is about 600 Euros: 4 towers x 4 persons x 600 Euros x 3 months = 28 800 €

Indicator 6.05- Forest sector workforce

Data collection

a) Concepts used to collect and organize data for this indicator

Definition of the indicator: number of persons and labour input in forest sector classified by:

- a) Gender and age group;
- b) Education;
- c) Job characteristics.

According to the expert group report, we used the concept of **forest cluster**, instead of the concept of forest sector. This concept is broader because it includes the following components:

- 1-Direct employment: activities directly related with the forest sector;
- 2-Indirect employment: industries and services related with inputs or outputs of the forest sector.

b) Activities of the forest cluster

The detailed list of these activities making up the forest cluster is presented in the following table 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.

Table 32: Economic activities included in the forest cluster

CAE	Designation
01251	Beekeeping
01252	Other animal production
01501	Hunting and game propagation
01502	Services related with hunting and game propagation
02011	Forestry
02012	Forest logging
02020	Services related with forestry and forest logging
05012	River fishing
020101	Sawmills
020102	Impregnation of wood
020201	Manufacture of panels of wood particles
020202	Manufacture of panels of wood fibres
020203	Manufacture of veneer sheets, plywood, laminboard and other panels
020301	Parquet flooring
020302	Carpentry
0204	Manufacture of wood package
020511	Manufacture of wooden coffins
020512	Manufacture of others wood products
020521	Manufacture of basketwork and wickerwork
020522	Cork industry
021110	Production of pulp
021120	Manufacture of paper and cardboard (except grooved)
021210	Manufacture of paper and grooved cardboard and paper and card board package
021211	Manufacture of paper and grooved cardboard (includes packages)
021212	Manufacture of other paper and cardboard package
21220	Manufacture of household and sanitary goods and toilet requisites
021230	Manufacture of paper stationery
021240	Manufacture of wallpaper
021250	Manufacture of articles of paper pulp, paper and cardboard, n.s
024630	Manufacture of essential oils
029320	Manufacture of machinery and tractors, to the agriculture, cattle breeding and silviculture
029550	Manufacture of machinery for paper and paper board production
029601	Manufacture of weapons for hunting, sport and personal defence
036110	Manufacture of chairs and seats
036120	Manufacture of office and trade furniture
036130	Manufacture of kitchen furniture
036141	Manufacture of wood furniture for other purposes
051130	Wholesalers of wood and construction materials
051150	Furniture wholesalers, household articles and ironmongery
051220	Wholesalers of flowers and plants
051562	Wholesalers of cork
051531	Wholesalers of wood and by products
052485	Retail of sport articles, camping, hunting and recreation
052486	Retail of flowers, plants and seeds for gardens

Source: *Classificação Portuguesa das Actividades Económicas – CAE – Rev. 2, 1992*

c) Data sources

SISED database

SISED database is kept by the Ministry of Labour. These data come from a document called “Quadros de Pessoal”. This is a document which has to be filled out by every firm with **5 workers or more**, containing the following information reported to the month of October:

- number of workers in the firm broken down by gender, age, qualification, education, occupation and seniority;
- number of hours of work;
- wages paid.

The data reported in FORSEE report were obtained directly from the Ministry. They refer to the six municipalities of the Sousa Valley for the year 2003.

Table 33 : Contacts for SISED database

Address	Phone and Fax	E-mails
DGEEP – Direcção – Geral de Estudos, Estatística e Planeamento Rua Rodrigo da Fonseca, nº 55 1250-190 Lisboa	Phone: 00351 213822300 Fax: 00351 213822401	E-mail 1: dados@dgeep.mtss.gov.pt E-mail 2: jose.malveiro@dgeep.mtss.gov.pt

National Institute of Statistics (data not considered)

Upon request, the National Institute of Statistics provides data on the **number of enterprises** by classes of size, in terms of numbers of workers, but no direct data on the number of workers for each size class. In spite of this, we used these data to get another estimate about employment by calculating the employment for each size class based on the middle of the interval of each class.

The data delivered by the institute refer to 2005.

Table 34 : Contacts of INE

Address	Phone and Fax	E-mails
Instituto Nacional de Estatística Departamento de Difusão e Clientes Unidade de Pesquisa e Informação Av. António José de Almeida, 2 1000-043 Lisboa	Customers service: Phone 1: 808 201 808 Phone 2: 226 050 748 (other telephonic networks) Fax: 00351 218426364	E-mail 1: infoline@ine.pt E-mail 2: rosario.barroso@ine.pt

Business Association of Paços de Ferreira

The business associations are another possible source of data on local employment. Sometimes they carry out surveys of their members in order to obtain data on the number of workers employed.

The contacts of the business associations that are visited for this projects are the following:

Table 35 : Contacts of the business associations

Municipality	Address	E-mail
Penafiel	AEP – Associação Empresarial de Penafiel Rua D. António Ferreira Gomes, Milhundos 4560-232 Penafiel Phone: 255718020	form.aep.acip.@netc.pt
Paços de Ferreira	Associação Empresarial de Paços de Ferreira Parque de Exposições da Capital do Móvel 4594-909 Paços de Ferreira Phone: 255862114/6	aepf@capitaldomovel.pt
Paredes	ACICP – Associação Comercial e Industrial do Concelho de Paredes Rua Dr. José Mendes Moreira 4580-135 Paredes Phone: 25577737	

Local sources

The foresters at the Forest Owners' Association of Sousa Valley gave the contacts of timber merchants and forest contractors, technical forest offices of Sousa Valley municipalities and Association of hunters. These contacts permitted to have access to more detailed data on employment and confront it with the official statistics.

Data analysis

Data on employment, sent in Excel files by DGEEP is presented in a table and also in graphs according to:

- 1) Type of forest activity;
- 2) Geographic repartition of the employment;
- 3) Age, gender, qualification of the workers and wages;
- 4) Professional categories of the workers.

Data coming from *local sources* was organised and presented in a table together with the data from SISED database.

Indicator 6.06- Occupational safety and health

Data collection

a) Concepts used to collect and organize data for this indicator

Indicator definition: this indicator defines the frequency of occupational accidents and occupational diseases in forestry.

Occupational accident: is an unexpected accident occurring during the working time and caused by inherent or related moral or physical hazards.

The following types of accidents are included:

- Accidents occurred during a car trip, a public transportation trip or a circulation trip to achieve a task concerning with one's employment;
- Car accidents during the working time;
- Poisoning;
- Voluntary actions of other people;
- Aggressions or falls in a public place or in any mean of transportation during a working trip.

Definition adopted by FORSEE Project in Portugal North: for this project it was considered an **occupational accident** the one that causes injuries that force forest workers to stop working more than one week.

The indicator is given in number of accidents per thousand of forest workers.

b) Data sources

The production of statistical information about occupational safety and health is based on the compensation system (*Sistema de reparação*) managed by Insurance Companies (*Companhias de Seguros*), regulated by the Law N.º 100/97, of 13th September, and by the Law N.º 143/99, of 30th April.

Before 2005, only the enterprises with more than 100 workers reported these occupational accidents for the official statistics. The occupational accidents in forestry were aggregated with those agriculture and livestock production.

In Sousa Valley the forest related enterprises where occupational accidents are more likely to happen are those involved in harvesting and timber transportation. This corresponds to the following classes in the classification of economic activities:

Table 36 : Forestry and forest related activities

02011	Forestry
02012	Forest harvesting
02020	Services related to forestry and forest harvesting

In Sousa Valley these services are provided mostly by small enterprises with less than 100 workers. So their accidents are not included in official data at least until 2005.

d) Method of data collection

The method of data collection was to inquire by **phone** and by **letter** the small enterprises which provide those services in the six municipalities of Sousa Valley.

- Timber merchants and forest contractors;
- Forest Owners Organisations;
- Other enterprises providing forestry related services (In the analysis and data collection it was also considered AFVS as an organisation that provides forestry services having for that 10 forest sappers, and one pulp and paper company).

Contacts of timber merchants and forest contractors: local sources refer a number between 50 and 80 timber merchants/forest contractors acting in Sousa Valley. Not all of them were contacted since their contacts were not available. The Forest Owners Association of Sousa Valley (AFVS) was one of the sources of contacts of timber merchants and forest contractors. AFVS provided 11 contacts.

Other source was INE database. This database records some addresses and phone numbers of 10 small enterprises in Sousa Valley.

The contacts are listed in the table below:

Table 37: Contacts of timber merchants and forest contractors in Sousa Valley

Timber merchant/Forest contractor	Address	Phone number
Source: AFVS		
Manuel Correia Vieira	Serradêlo, Raiva	91533582
José Amílcar Lourenço	Rua Pedro Julião n° 148, Vermoim, 4470-349 Maia	917515630
Luís Oliveira	Perozelo, Penafiel	964095733
Joaquim Augusto Ribeiro	Ribeiro, Carvalhos, Croca. 4560-061 Penafiel	917831153
Horácio de Sousa Queirós	Macieira da Lixa	255482742; 916241740
Jerónimo do Carmo Lourenço	Canelas	255614835
José Maria Soares da Costa	Canelas	255613466
Ernesto Duarte da Fonseca	Ânsia, Real, Castelo de Paiva	255698290/ 934226717
Fernando Conceição Cruz (MADEICAMPO)	Campo, Valongo, S. Miguel de Paredes, Penafiel	224112639/ 917593231
Belmiro Oliveira	Perozelo, Penafiel	919758449
Manuel da Conceição Cruz	Lages. São Miguel de Paredes. 4575-300 Entre-os-Rios. Penafiel	917568971
Source: INE		
Planitrata unipessoal Lda	Lugar de Quinta de Baixo, 4620-172 Lousada	-
Atla, Agricultura e Tempos Livres Associados Lda	Casa da Vila de Busto Penamaior	(not considered)
Sousa Queirós, Unipessoal Lda	Boavista – Macieira da Lixa, 4615 Macieira da Lixa	
Madeiras Damien Lda	Zona industrial de Fiães – Seroa, 4590 Paços de Ferreira ⁴	
Paulo Sérgio R. De Jesus, Unipessoal Lda	Ribeiro de Sá – Santa Maria de Sardoura, 4550 Castelo de Paiva	
Lopes & Sousa Lda	Peirão, Maraíso, 4550-468 Paraíso	255762898; 965026691
Madeiças – Exploração florestal Lda	Lugar de Lages, 4575 – 300 Paredes, PNF	
Demolidora Guilhofense, Lda	Lugar da Póvoa, 4560-131 Guilhufe	
M Cruz & Soares Lda	Lages, Entre-os-Rios, 4575-218 Entre-os-rios	255616117

Questions asked by phone and by letter

The timber merchants and forest contractors for whom phone numbers were available were reached by phone. The timber merchants and forest contractors for whom phone contacts were not available are approached by letter.

Questions asked by phone:

- a. How many forest workers does your enterprise employ?

- b. How many occupational accidents happened with your workers between 2003 and 2006?
- c. How many other timber merchants and forest contractors do you think there are in Sousa Valley?

Questions asked by letter:

- 1- How many forest workers does your enterprise employ?
- 2- How many occupational accidents happened in 2003?
- 3- How many occupational accidents happened in 2004?
- 4- How many occupational accidents happened in 2005?
- 5- How many occupational accidents happened in 2006?

Results of phone interviews

From the 11 contacts given by AFVS, 9 answered our phone call and these 8 were also able to provide information about other 6 timber merchants.

From the 10 contacts obtained from INE, 2 were in the AFVS list, 2 were contacted by phone and 5 were contacted by letter. 1 was not considered.

Data analysis

Data presented in the table report occupational accidents occurred in Forestry and Forest harvesting in the period 2003-2006 in the 6 municipalities of Sousa Valley, mainly for the forest workers employed by forest contractors and timber merchants.

The number of occupational accidents is given per 100 forest workers and it is divided in two categories: **serious accidents** and **small accidents**.

An accident was considered as a serious one when the injuries had to be treated in the hospital, forcing the worker to be inactive for more than 8 days or even for the rest of his life.

Wounds, muscular distensions or scratches treated on the spot were considered as small accidents. For this type of accidents most of the timber merchants and forest contractors did not give a precise number, even though they admitted their existence. Some of them assured that these small accidents do not put workers out of work for more than 1 week.

⁴ The letter didn't reach the address

Indicator 6.10- Accessibility for recreation

Data collection

a) Concepts used to collect and organize data for this indicator

Indicator description - Area of forest and other wooded land where the public has the right of access for recreational purposes, with an indication of intensity of use.

b) Data sources

The sources of data were the foresters working in the forest offices of the municipalities of Sousa Valley and the foresters of the Forest Owner's Association of Sousa Valley.

To collect the data we took advantage of the information given during the personal contacts with the foresters for constructing indicator C6.04 – Expenditure for services.

Data analysis

The forest staff in the city councils identified the sites with recreational potential, with their GPS coordinates and denomination. These foresters and the ones working at the Forest Owners' Association of Sousa Valley (AFVS) were asked for a classification of these sites in terms of frequency of visits by tourists. The classes of frequency used were the following:

- Frequently visited;
- Occasionally visited;
- Hardly ever visited.

The foresters identified the following types of recreational places in the forests and other wooded land:

- Parks suitable for picnics and landscape watching;
- Parks suitable for walking and running;
- Wharfs used as fluvial beach and also for picnics;
- Shooting fields where hunters and shooters practise shooting;
- Camping;
- Pedestrian paths.

Data is presented in a digital map, with the forest recreational sites classified according to the type of frequency. In FORSEE Data report it is presented a table with the GPS coordinates.

Indicator 6.12- Total economic value of forests

Data collection and data analysis

This indicator was evaluated using some data coming from the other indicators completed with additional data and estimates that are reported in detail in Part 1 of this regional report. Here we mention only the contacts that were used to have data on gaming and hunting.

Table 38 : Associations of hunters in Sousa Valley

Associations	Municipality	Phone	Mobile	Contact person
Associação Caça e Pesca Vale do Rio Arda	Castelo de Paiva	255762830	969087461	Sr. Tavares
Clube de Caça e Pesca de Castelo	Castelo de Paiva	255690555	963931940	Sr. Fernando
Zona Caça Municipal de Felgueiras	Felgueiras	255318000		
Associação de Caçadores Solidários de Felgueiras	Felgueiras			
Associação de Caçadores de Marina	Felgueiras			
Associação de Caçadores da Cidade da Lixa	Felgueiras			
Clube de Caçadores Felgueirense	Felgueiras			
Leite Marinho & Filhos - Construção Imobiliária Lda	Felgueiras	255310300		
Associação de Caçadores de Lousada	Lousada		917343338	
Associação de Caçadores do Outeiro	Lousada			
Clube de Caçadores da Quinta dos Ingleses	Lousada			
Clube de Caça e Pesca de Freamunde	Paços de Ferreira	255879153		
Clube de Caça e Pesca de Paredes	Paredes		936366154	
Clube de Caça e pesca do Vale do Sousa	Paredes	224331579	939322447	Sr. Lobo
Associação de Caçadores e Pescadores da Serra da Boneca	Penafiel		966963111	
Associação de Caçadores de Vale do Tâmega	Penafiel	255941028	936252103	Sr. Cesário
Clube de Caçadores de Canelas	Penafiel	255613687	937020936	Sr. Pinto

Source : FENCAÇA

Conclusion

Data needed for these indicators was obtained due, in most cases, to the intensive cooperation with the local Forest Owners' Association (AFVS – Associação Florestal do Vale do Sousa), other local institutions (foresters working for pulp and paper companies, city councils and others) and individuals with local knowledge on the activities at stake.

Official statistical sources were not available in most cases, or have bad coverage of the population they are suppose to represent.

The results presented in this report show that it is possible to go a long way through cooperation between research institutions and these local institutions. So investing in improving this interface pays off in terms of getting a better knowledge of the sector forest and, through this better knowledge, contribute to improve forest management.

In regions where small scale private forestry prevails, as is the case in this pilote zone, the effects of that kind of investment in capacity building at the local level may happen faster if they are centred on forest owners' associations with a good record of providing forest management services to their members.

Another interface that has to be improved is between the official statistical institutions, the research institutions and those local organizations. The quality of official data will improve and the local organizations with responsibilities in forest management will have better access to the data they need to fulfil their missions.

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