

FORSEE Project

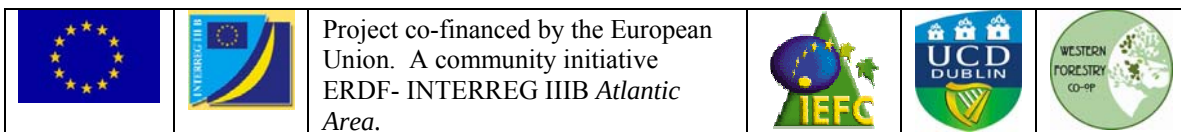
***A network of pilot zones to test and improve the indicators
of sustainable forest management at regional level in the
Atlantic Europe area.***

***Final Regional Report
Ireland***

***Part 1 – Synthesis
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December 2006***



FORSEE Project: www.iefc.net



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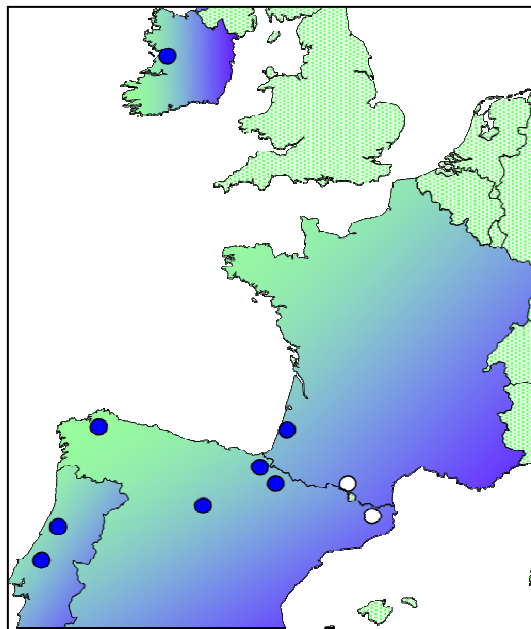
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1. FORSEE Project

Since sustainable development for the forests of the Atlantic Area cannot be conceived without sustainable management of forest resources, the Pan-European Forestry Certification system (PEFC) makes it possible for consumers to ensure that the wood product they purchase comes from a sustainable managed forest. However, the criteria of certification have not been evaluated in a real forest site. The objective of the FORSEE project was to test and improve the indicators of sustainable forest management at regional level through a network of pilot zones in the INTERREG IIIB Atlantic Area. The framework for SFM has been developed in the context of the Ministerial Conference on the Protection of Forests in Europe (MCPFE) and sets out Pan-European criteria, indicators and operational level guidelines for Sustainable Forest Management (SFM). These criteria and indicators developed for SFM are recognised as an important tool for forest managers and for evaluating SFM in the context of national reporting and certification schemes. However it is recognised that these indicators often prove to be difficult to implement on the ground and often a situation may arise where not necessarily the best indicators are used due to a lack of resources and reference tools but often the indicators where data is most convenient.

The FORSEE project aims to consolidate this process of certification by validating the criteria and indicators in regional pilot zones in four European countries namely, Spain, France, Portugal and Ireland (Fig. 1).

Figure 1: FORSEE Pilot zones in the European Atlantic area.



It is envisaged that the results of this study will make it possible to supply the participating regions with methods, tools and competencies for the evaluation and promotion of the sustainable management of forests. It will thus contribute to the promotion and exchange of forestry practices which respect the environment through a network of pilot zones.

In each of the pilot zones a regional specific study was undertaken selected from the Pan-European criteria (Table 1).

Table 1: Regional scientific studies.

Country	Region	Dominant Tree Species	Regional Scientific Study
Ireland	North Mayo	<i>Picea sitchensis</i>	C1: Carbon stocks
France	Aquitaine	<i>Pinus radiata</i>	C4: Biodiversity
Spain	Navarra	<i>Fagus sylvatica</i>	C1: Carbon storage
	Euskadi	<i>Pinus radiata</i>	C1: Soil protection
	Castille y Leon	<i>Populus</i>	C2: Forest health
	Galicia	<i>Pinus radiata</i> ; <i>Eucalyptus globulus</i>	C1: Carbon storage
Portugal	Portugal North	<i>Pinus radiata</i> ; <i>Eucalyptus globulus</i>	C6: Socioeconomics
	Portugal Central	<i>Pinus radiata</i> ; <i>Eucalyptus globulus</i>	C1: Carbon storage

1.1 Objectives

The objectives within the FORSEE project are:

- To evaluate, monitor and promote sustainable forest management.
- To validate the criteria and indicators.
- To evaluate the cost of the indicators.
- To structure a network of experts or organisations within the framework of the project.
- The reinforcement of the credibility of the certification system based on reliable indicators.

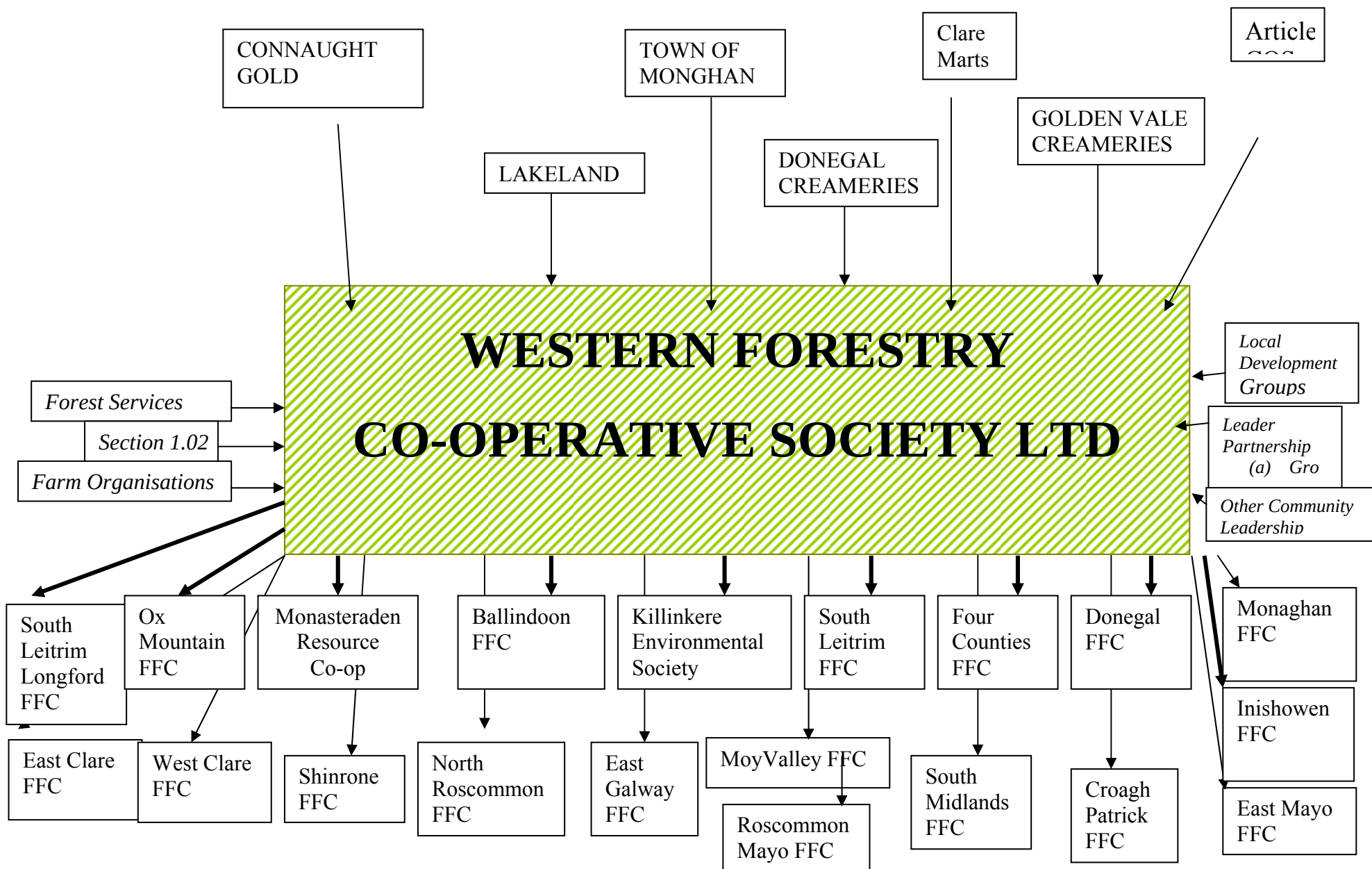
1.2 Organisation at Regional Level

Private forestry or farm woodlots are relatively new in Ireland. Prior to 1980 private forestry was mainly found on the larger estates of the remaining ascendancy classes. It only amounted to 5% of the entire forest estate which itself only accounted for 5% of the entire land cover (i.e. state owned woodland in 1980 amounted to 300,000ha and private owned woodland 15,000ha).

When research in the 1970's showed that wet mineral soils, which were predominate on farms in western areas, was highly productive for certain tree species, a campaign for farm afforestation commenced. The co-operative movement had for a century been ensuring equitable treatment for all farmers and had been the vehicle through which almost every innovation to Irish farming had been introduced during that period. Accordingly the 7 main dairy co-operatives in the western region set up the Western Forestry Co-operative Society in 1985 to provide services and back-up support for farm forestry. Each of the 7 agricultural co-operatives involved in the setting up of the Western Forestry Co-operative Society, have a number of branches with each nominating a farmer member to sit on the main board. At each branch level there is a local advisory committee made up of approximately 20 elected farmers.

The Western Forestry Co-operative Society has organised the establishment of 20 farmer owned forestry co-operatives which are affiliated to it. These were setup around established rural communities groups. They are serviced by 5 professional foresters with the aid of development staff. The total membership of the 20 forestry co-operatives is some 2,600 forest owners who have afforested some 16,000 ha in 3,500 woodland plots (some farmers have a number of woodland plots on their farms).

Farm Forestry Co-operative Structure



2. The Tested Indicators

Indicators tested within the Overall Framework of the FORSEE Project on the Irish Pilot Zone.

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles	1.1	Forest Area	Area of forest and other wooded land, classified by forest type and by availability for wood supply, and share of forest and other wooded land in total land area	1.1	1
	1.2	Growing Stock	Growing stock on forest and other wooded land, classified by forest type and by availability for wood supply.	1.2	2
	1.4	Carbon stock	Carbon stock	1.4.1 Carbon stock in the woody biomass 1.4.2 Carbon in the soils 1.4.3 Carbon in the deadwood stock 1.4.4 Carbon in the litter stock 1.4.5 Carbon in the understorey	1

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C2: Maintenance of forest ecosystem health and vitality	2.4	Forest Damage	Forests and other wooded land with damage classified by primary damaging agent (abiotic, biotic and human induced) and by forest type.	2.4.1 Nature of the damage 2.4.2 Damage Intensity 2.4.3 Damage type by diameter class	1

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C3: Maintenance and encouragement of Productive functions of forest (wood and non-wood)	3.1	Increment and felling	Balance between net annual increment and annual fellings of wood on forest available for wood supply.	3.1	2
	3.2	Roundwood harvested	Value and quantity of marketed roundwood	3.2	2
	3.3	Non-wood products	Value and quantity of marketed non-wood goods from forest and other wooded land.	4.2	2
	3.5	Forests under management plans	Proportion of forest and other wooded land, classified by number of tree species occurring and by forest type.	3.5	1
	3.6	Accessibility		3.6	1
	3.7	Harvestability		3.6	1

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C4: Maintenance, conservation and enhancement of Biological diversity in forest ecosystems	4.1	Tree species composition	Area of forest and other wooded land, classified by number of tree species occurring and by forest type.	4.1	1
	4.2	Regeneration	Area of regeneration within even-aged stands and uneven-aged stands, classified by regeneration type.	4.2	1
	4.3	Naturalness	Area of forest and other wooded land, classified by “undisturbed by man”, by “semi-natural” or by plantations, each by forest type.	4.3	1
	4.4	Introduced tree species	Area of forest and other wooded land dominated by introduced tree species.	4.4	1
	4.5	Deadwood	Volume of standing deadwood and of lying deadwood on forest and other wooded land classified by forest type.	4.5	2
	4.7	Landscape pattern	Landscape-level spatial pattern of forest cover	4.7	2

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C5: Maintenance and appropriate enhancement of protective functions in forest management (most notably soil and water)	5.1.1	% and length of stream with appropriate riparian buffer.	Area of forest and other wooded land designated to preserve water resources	5.1.1	1
	5.1.2	Potential erosion risk	Area of forest and other wooded land designated to prevent soil erosion.	5.1.2	2
	5.1.3	Road/Trail Density in riparian areas.		5.1.3	3
	5.3.1	Carbon soil stock and water holding capacity		5.3.1	1
	5.3.2	Nutritive status/total depth-water table depth		5.3.2	3
	5.3.3	Total nutrient stocks & nutrient balance		5.3.3	3
	5.3.4	Fast visual assessment of soil disturbance		5.3.4	3
	5.4.1	Soil disturbance related to standard forest management activities		5.4.1	3
	5.4.2	Physical characteristics of soil disturbance categories		5.4.2	3

Criteria	No.	Indicator	Complete text	ID in process	Priority for evaluation on the pilot zone
C6: Maintenance of other socio- economic functions and conditions	6.01:	Forest Holdings	Number of forest holdings, classified by ownership categories and size classes.	6.01:	1
	6.03:	Net Revenue	Net revenue of forest enterprise.	6.03:	1
	6.04:	Expenditure for service	Total expenditures for long-term sustainable services from forests.	6.04:	1
	6.05:	Forest sector workforce	Number of persons employed and labour input in the forest sector, classified by gender and age group, education and job characteristics.	6.05:	1
	6.06:	Occupational safety and health	Frequency of occupational accidents and occupational diseases in forestry.	6.06:	2
	6.10:	Accessibility for recreation	Area of forest and other wooded land where the public has a right of access for recreational purposes and indication of intensity of use.	6.10:	2
	6.12	Total economic value of forest production.		6.12	2

2.1 Overall View

Introduction:

The Pan-European criteria and indicators of sustainable forest management (SFM) are an important tool for forest policy. The criteria and indicators have gradually developed over time in order to utilise best available research and information. However an evaluation system such as the Pan-European criteria and indicators can be difficult to apply at a national and regional level. Following from the Third Ministerial Conference on the Protection of Forests in Europe (Lisbon 1998) Ireland is committed, in perpetuity, to the sustainable management of its forests in order to pass them on to future generations in a much improved and environmentally enhanced form. The first step towards this was the publication of the Irish National Forest Standard (INFS). It provides the framework within which the development and evaluation of SFM can take place. The INFS identifies criteria to define the essential elements of SFM and indicators which provide a basis for assessing forest or forest industry conditions for each criterion and indicator. The implementation of SFM within Ireland is supported not only through the INFS but also through the Code of Best Forest Practice and a suite of environmental guidelines (relating to water quality, landscape, archaeology, biodiversity and harvesting). The Code of Best Forest Practice sets out best practice in all stages of the forest management cycle, from seed selection through to establishment, maintenance and harvesting.

The strategic plan for the development of the forestry sector in Ireland has set an ambitious target to expand the national forest estate over the next 30 years from 9% to 17% of the land area. This represents a real challenge for the forest industry to establish these forests using best practice. As most afforestation in Ireland is grant aided, strict adherence to environmental guidelines and operational standards is required.

The need to define and develop common tools with which to monitor forest management has been well documented. European criteria and indicators were developed to gather and assess information on sustainable forest management. These criteria describe different aspects of sustainability at a conceptual level. They represent sets of conditions or processes by which forest characteristics and services may be judged. Associated indicators serve to define the nature of the criteria and show how they are measured. Two types of indicators are used; qualitative indicators which illustrate the

implementation of national policy instruments and quantitative indicators which show changes over time for a criterion and measure progress towards a specified objective. When measured over time, indicators can demonstrate trends toward or away from sustainable forest management, aiding forest managers with the necessary information and tools to make the right decisions.

Through the FORSEE project a network of pilot zones was used to test and improve the indicators of sustainable forest management at a regional level in the Atlantic Europe area. This network of pilot zones enabled a cross communication of expertise from each of the pilot zone regions and encouraged interaction between organisations from the different sectors namely research and development, environment, economics and socio-economics, which would contribute to the development of better certification management systems. The project also included an evaluation of the operational costs of the indicators in order to provide a framework to ascertain the impacts these costs may impose on the evaluation process.

Ireland Pilot Zone (North Mayo)

This study was undertaken with the administrative boundary of county Mayo, located along the western seaboard of Ireland. The pilot zone area was defined as North Mayo (Figure 1) encompassing an area of 243,000 ha of which 37,365ha is classified as forest land. Within this region the landscape ranges from relatively flat farmed fields in the east to quartzite peaks along the Atlantic coastline.

The pilot zone, as with the majority of the west coast of Ireland, experiences annual rainfall in excess of 1140mm per year, and mean temperatures in January of 5.7 °C and in July of 14 °C (Collins and Cummins 1996). The predominant soil type is classified as Histosol.

Coniferous plantations are the most common forest type in Mayo with very little broadleaf forests primarily due to exposure and poor soil conditions. The timber industry in County Mayo has developed largely around two main species; Lodgepole pine (*Pinus contorta*) and Sitka spruce (*Picea sitchensis*). The Strategic Plan for the Development of the Forest Industry in Ireland (1996) identified that the national forest estate would need to increase to 17% of the land area in order to reach a scale of timber harvesting large

enough to support a range of processing industries (its currently at 10%). The Indicative Forestry Strategy for County Mayo (2003) identified 167,000 ha (30% of the land area) as “preferred” areas for forestry with a primarily economic objective. Should these targets be met, forestry in north Mayo will significantly increase resulting in important implications for sustainable forest management.

Currently the greatest single financial benefit forestry provides to Mayo is the grant and premium scheme payments provided by the Forest Service (with the support of the EU). The total value of afforestation grants and premiums to the Mayo economy during the period 1995-2003 was €28.15 million. Total direct employment in forest activities in Mayo is estimated to be in the region of 350 people.

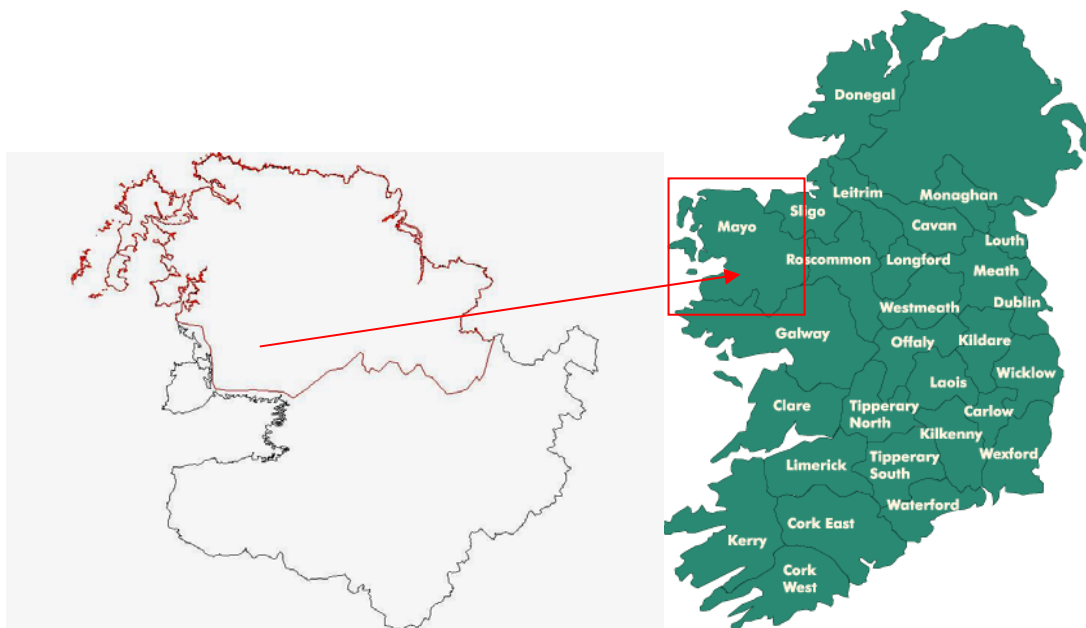


Figure 2: North Mayo Pilot zone

2.2 Values of the indicators estimated on the FORSEE Irish pilot zone

Criteria	Indicator	Title	Level	Year	Value	Unit
Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles						
1	1.1	Forest Area	Pilot zone	2005	37,350	Ha
1	1.2	Growing Stock	Pilot zone	2005	5,230,302	m ³
1	1.4	Carbon Stock	Pilot zone	2005	0.19	MtC
1	1.4.1	C stock in woody biomass	Pilot zone	2005	0.3	MtC
1	1.4.2	C stock in soils	Pilot zone	2005	0.11	MtC
1	1.4.3	C stock in deadwood	Pilot zone	2005	0	MtC
1	1.4.5	C stock in understorey	Pilot zone	2005	0.03	MtC
Maintenance of forest ecosystem health and vitality						
2	2.4.1	Nature of the damages	Pilot zone	2005	62% without damage	%
2	2.4.2	Damage Intensity	Pilot zone	2005	40% defoliation	%
Maintenance, conservation and enhancement of Biological diversity in forest ecosystems						
4	4.1 & 4.4	Tree species composition and introduced tree species	Pilot zone	2005	93% exotic conifers	%
4	4.3	Naturalness	Pilot zone	2005	82% plantation forest	%

2.3 Results by Indicator

a). Criterion 1: Maintenance and appropriate enhancement of forest resources and their contribution to global carbon cycles

Estimating the carbon stocks in the Irish pilot zone region is of particular interest as a large proportion of the forest area has been planted since 1990 and is therefore eligible for offsetting national greenhouse gas emissions under the Kyoto Protocol.

The pilot zone selected has one of the highest rates of afforestation since 1990 in Ireland. Approximately 33% of the forest area found in the pilot zone has been established since 1990, 3% higher than the national average.

Utilisation of the forest carbon as a long term sink is a feasible option in this region due to difficulty in harvesting the stands brought about by the predominant soil conditions. Additionally the current structure of the grant and premium payments is such that following clearfell it is compulsory under national legislation to replant the area. However no grants are available to assist in reforestation. This might encourage farmers to maintain their stands as sinks, should they receive the carbon value for their crops.

The key requirement to enable the development of carbon stock estimates is data from a repeated national forest inventory (NFI). Due to Ireland's relatively young and small national percentage of forest cover, NFI was not a priority, the first NFI was begun only in 2005. This has resulted in a significant gap in the ability to develop national (or regional) carbon stock estimates. The first all inclusive NFI was undertaken during the life of this project and the data made available to enable the development of C stock methodologies and estimates of the five recognised carbon pools (woody biomass, soils, deadwood stock, litter stock and understorey) for 2005.

The work undertaken to develop a methodology for estimating carbon stocks lead to a critical analysis of the NFI data and the undertaking of field research to develop biomass functions for the dominant trees and to estimate the understorey biomass stock in typical forest types of the region. This enabled a high confidence in the development of above and belowground biomass stocks.

The two main weaknesses to the development of carbon stock and stock change estimates are related to the lack of soils data and a repeated NFI. Organic soils are the major soil type in the region. While it is generally agreed that draining organic soil leads to aerobic

conditions and the subsequent release of significant amounts of carbon very few studies have been undertaken in this area to quantify any such release. Additionally, without tree increment data, modelling techniques are required which cannot be verified until the second round of the NFI is complete.

However, significant advancements have been made in developing more robust estimates based on national data since the inception of the FORSEE project and the pilot zone carbon stock estimates developed here are testament to that.

Indicator 1.1: Forest Area

Costs:

Section 1.01

ethod 1

NFI

definition

Article II.

otal €4588

Marginal

€88

Shared

€4500

Cost/ha

€0.13

Section 2.01

ethod 2

FAO

definition

Total €4588

Marginal

€88

Shared

€4500

Cost/ha

€0.13

These costs

include:

Data processing
Purchase maps
Computer software

Results:

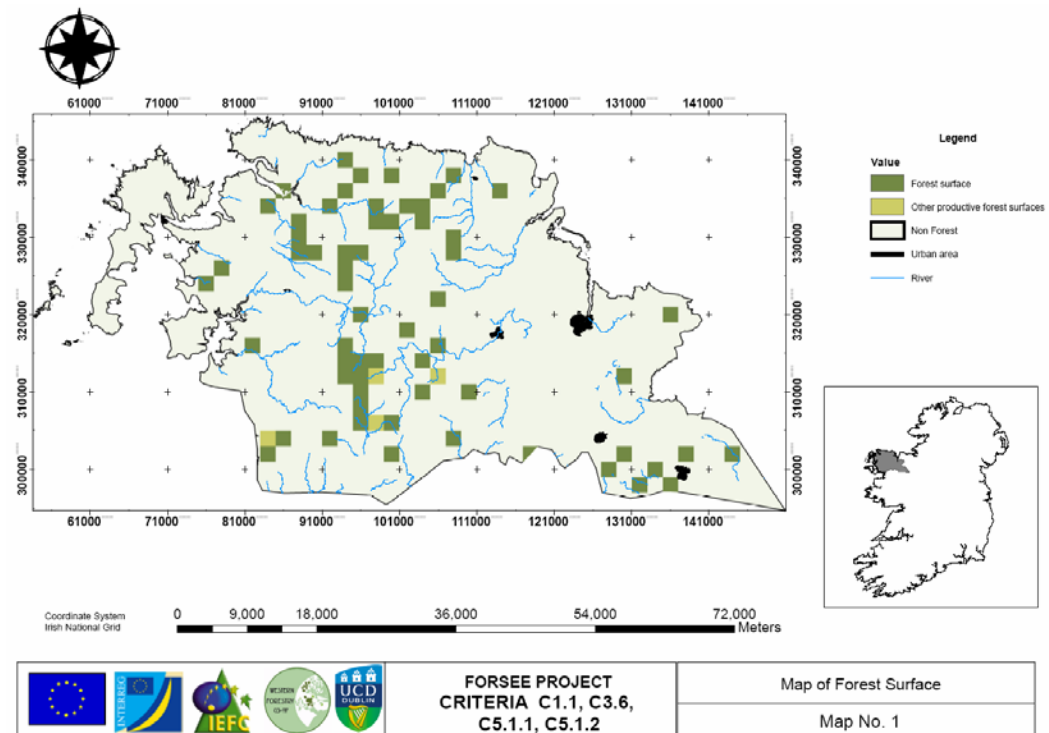


Table 1.1a : Map of the Forest Surface

Surface Attribute	Area (ha)
Forest Surface	35220
Other productive forest surfaces	2130
Other surfaces	205650
Total	243000

Remarks:

The forest area of the pilot zone was found to be 37350 ha, equivalent to 15% of the total land area and is well above the national average of 10%. Very little of the forest area is classified as other productive forest areas as almost 100% of the forest area in the pilot zone is plantation forestry. The remaining area is classified into agricultural land, urban land and peatland areas. Due to the soil conditions in the area, set aside land would not establish itself as regenerated forest. On the regional scale (County Mayo), the forest surface has increased at a reasonably steady rate since 1990, however annual afforestation rates (Table 1.1b) declined in 2003, due to national budgetary changes. On average the forest surface in the region increased by 1150 ha per year.

Table 1.1b: Annual planting rates in County Mayo from 1990 to 2003.

Yr	Ha
1990	2027
1991	1585
1992	1006
1993	1079
1994	1840
1995	1199
1996	1298
1997	795
1998	1094
1999	841
2000	929
2001	556
2002	914
2003	924

A comparison between the NFI forest definition (20% crown cover and 0.1ha) and the FAO forest definition (20% crown cover, 0.5ha area) in both the pilot zone and the region revealed less than 0.5% difference in the calculated forest area.

Problems and Improvements**Remarks and Conclusions:**

The forest surface in the pilot zone region has experienced a steady growth in forest area since 1990, resulting in a land use change to forestry of approximately 3.5% in the past 15 years. Forest definitions can vary for national purposes and international reporting requirements such as to the FAO. When comparing Ireland's NFI definition with the FAO definition thresholds it was found that area and width varied (Table 1.1c).

Table 1.1c: Comparison of forest definition thresholds between Irelands NFI and FAO reporting

Definition	Area (ha)	Crown Cover (%)	Width (m)
FAO	0.5	20	40
Irish NFI	0.1	20	20

This reduction in area resulted in less than 0.5% difference in forest area between an 'FAO forest' and a 'NFI forest' in the pilot zone area. Ireland has opted to report forest area to the Kyoto Protocol using the NFI definition.

The choice of such a small area threshold has implications for reporting C stocks particularly the geo-referencing requirement under the terms of the Marrakesh accords for Kyoto reporting of afforestation activities. Tracking changes in such small forest parcels can be difficult from aerial or satellites pictures due to the resolution constraints. However, Ireland will not only have to rely on remote sensing to track forest area changes. Due to the grants and premiums scheme and the paper work that is required to implement it, each grant funded forest area planted (which currently accounts for 99% of all private planting) is recorded with a geo-referenced boundary.

Project co-financed by European Union. A community initiative ERDF- INTERREG the IIB Atlantic Area.



Indicator 1.2: Forest Growth

Costs:

Total
€4720
Marginal
€220
Shared
€4500
Total
Cost/ha
€0.13

These costs
include:

Data processing

Purchase maps

Computer
software

Results:

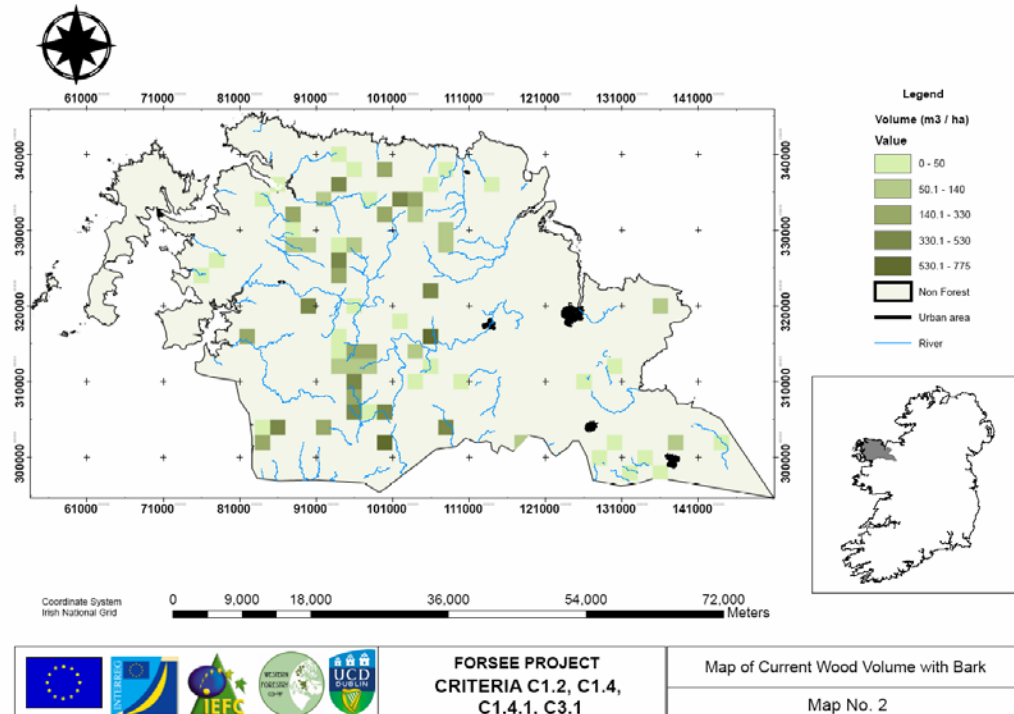


Table 1.2a: Map of Current Wood Volume

Volume Class (m ³)	Area (ha)
0-50	15250
50.1 - 140	7360
140.1 - 330	5780
330.1 - 530	5780
530.1 - 775	1050

Current wood volume was calculated stump to tip using generalised models for *Picea sitchensis* developed from the Irish NFI. In the absence of other national volume models, the two models were assumed to be relevant to all other species in the pilot zone area;

The models were applied to small trees (Equation 1);

Tree with DBH > 12cm

$$V = \rho_0 + \rho_1 \times DBH^{\rho_2} \times H^{\rho_3} \quad (1)$$

And large trees (Equation 2);

Trees with DBH ≤ 12cm

$$V = \rho_1 \times DBH^{\rho_2} \times H^{\rho_3} \quad (2)$$

Table 1.2a: Volume Equation Parameters

Equation	ρ_0	ρ_1	ρ_2	ρ_3
1	-0.0164	0.000094	1.72	1.017
2	-	0.00005	1.9089	1.0063

	Remarks: The generated map indicates that 43% of the forest area has a volume less than 50m ³ / ha. This low volume is a result of a significant proportion of young stands in the pilot zone. The map shows that volume varies across the area, however there is a predominance of low volume stands in the south eastern area of the pilot zone. These stands can be found on more productive soils and show a move of forestry into these areas in recent years, in line with national policy. The new NFI data is capable of generating volume equations for trees of less than merchantable timber volume, albeit with an increase relative error due to the inherent variability of smaller tree characteristics.				
Problems and Improvements					
One particular weakness of this analysis is the application of a volume model for <i>Picea sitchensis</i> to all the species in the region. This was the case due to the lack of national models for any of the other species planted in the pilot zone. In an attempt to estimate the potential impact such an assumption would have on the reported total volume for the region, species specific volume equations were taken from literature (Table 1.2b) for comparison.					
Table 1.2b: Volume Equations taken from Zianis et. al., 2005					
Species	Form	a	b	c	Country
<i>Larix</i>	D ^a xH ^c x(exp(c))	1.87	1.01	-2.87	Netherlands
<i>Quercus</i>	D ^a xH ^c x(exp(c))	2.003	0.859	-2.864	Netherlands
<i>Betula</i>	a+bxD ² xH ^c	-0.009	0.000	0.750	UK
<i>Fraxinus</i>	axD ^b xH ^c	-0.063	1.924	0.887	Sweden
<i>Picea sitchensis</i>	D ^a xH ^c x(exp(c))	1.784	1.134	-2.909	Netherlands
<i>Pinus contorta</i>	D ^a xH ^c x(exp(c))	1.893	0.987	-2.886	Netherlands
<i>Acer</i>	a+bxD ² xH ^c	-0.013	0.000	0.750	UK
This analysis indicated an overall 6% variation between using the national <i>Picea sitchensis</i> equation for all species and using non-national species specific equations. The development of nationally specific volume equations for all species would improve confidence in the volume estimates.					
Remarks and Conclusions:					
The forest resource in the pilot zone area has a predominantly small volume. However the map indicates that the low volume stands are not concentrated in any particular part of the pilot area but are well-distributed across it.					
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.					

Indicator 1.4: Carbon

Costs:

Total Cost
€45664
Marginal
€88
Shared
€45576
Total
Cost/ha
€1.30

These costs
include:

Fieldwork
associated
with biomass
functions and
understorey

Site
Description

Data
processing

Purchase
maps

Computer
software

Results:

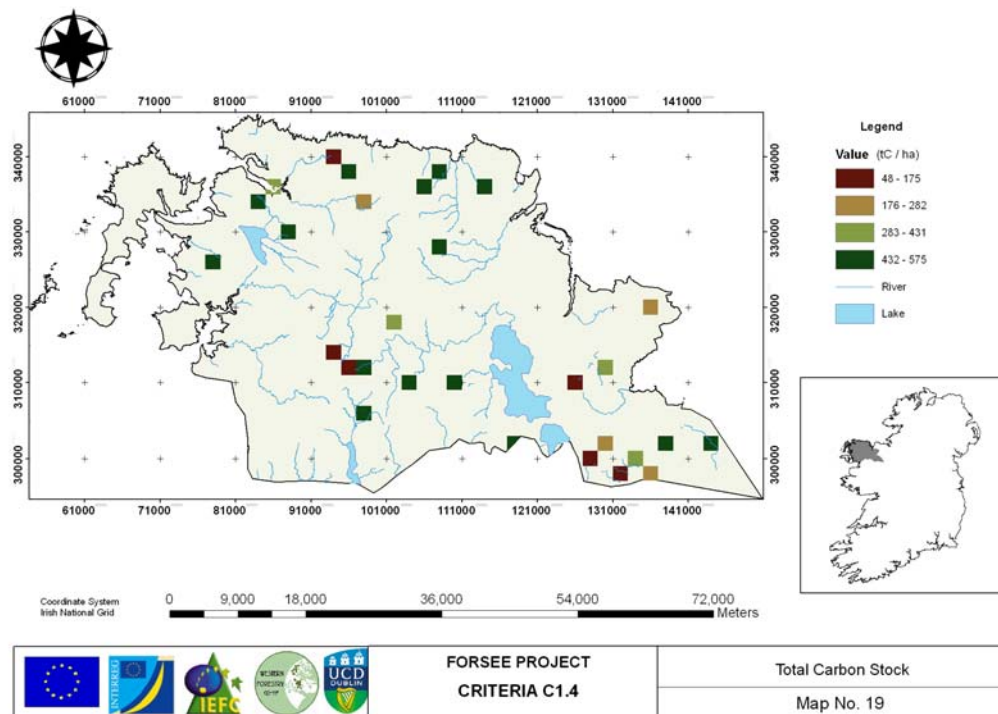


Table 1.4a: Total Carbon Stock

Carbon Stock (tC/ha)	Area (ha)
48 – 175	2400
176 - 282	1600
283 – 431	1600
432 – 575	6000

Remarks:

The carbon stock calculated for 2005 in all post 1990 plots in the pilot zone region ranges from 48 – 575 tC / ha. This large range was due to the high frequency of organic soils, which in some cases accounted for more than 98% of the total C stock reported for the plot.

Problems and Improvements

There are a number of areas that could benefit from increased research and data collection and these are dealt with under the specific areas below.

Remarks and Conclusions:				
The total carbon stock estimates are inclusive of woody biomass, both above and belowground, as well as soil organic carbon, litter, deadwood, and understorey. The data collected as part of the FORSEE project greatly improved the ability to report carbon stock in the pilot zone as outlined below.				
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIB Atlantic Area.				

Indicator 1.4.1 Carbon Stock in the Woody Biomass

Costs:

Total Cost
€35676
Marginal
Cost
€31176
Shared Cost
€4500
Cost/ha
€1.01

These costs
include:

Fieldwork
associated
with biomass
functions and
understorey

Site
Description

Data
processing

Purchase
maps

Computer
software

Results:

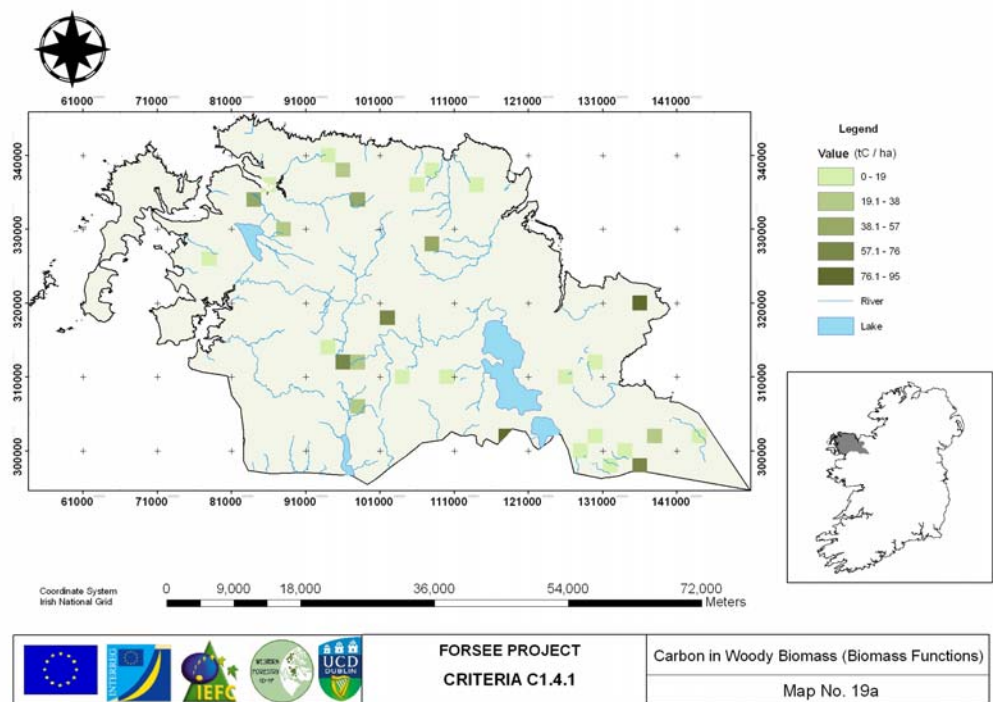


Table 1.4.1a: Woody Biomass Carbon in Post 1990 Forests

Carbon Stock (tC / ha)	Area (ha)
0-1	2680
1.1 – 5	3120
5.1 – 20	890
20.1 – 40	1340
40 – 95	3570

	Remarks: The total post 1990 woody biomass carbon stock in the pilot zone was found to be 0.30 Mt C. The carbon stock in the woody biomass varied significantly between NFI plots, largely due to the diverse age structure of the forest in the pilot zone. The carbon stock reported here was developed through the use of NFI data and regionally specific biomass functions developed from field work in the pilot zone. A comparison between calculating C stocks using biomass functions or stand volume and biomass expansion factors (BEF) found that applying stand volume and biomass expansion factors lead to a significantly lower (25%) woody biomass carbon stock estimate for the region. This is due largely to applying a BEF to small trees, which generally have a higher biomass allocation to branches and foliage compared to stem. Trees above merchantable timber volume invest more biomass in the stem than branches and foliage.
Problems and Improvements	
National equations are available for <i>Picea sitchensis</i> and <i>Pinus contorta</i>, however there is a reliance on equations from the literature for the remaining species. While these make up a small proportion of the total (>15%), the values could be improved by additional research to develop national equations for species such as <i>Larix</i> and <i>Betula</i>.	
Remarks and Conclusions:	
The use of biomass functions is a more accurate approach for young trees, especially in this case where biomass functions specific to the region were developed.	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.	

Indicator 1.4.2 Carbon Stock in the Soil

Costs:

Total
€4764

Marginal
€264

Shared
€4500

Total
Cost/ha
€0.14

These costs
include:

Fieldwork
associated
with biomass
functions and
understorey

Site
Description

Data
processing

Purchase
maps

Computer
software

Results:

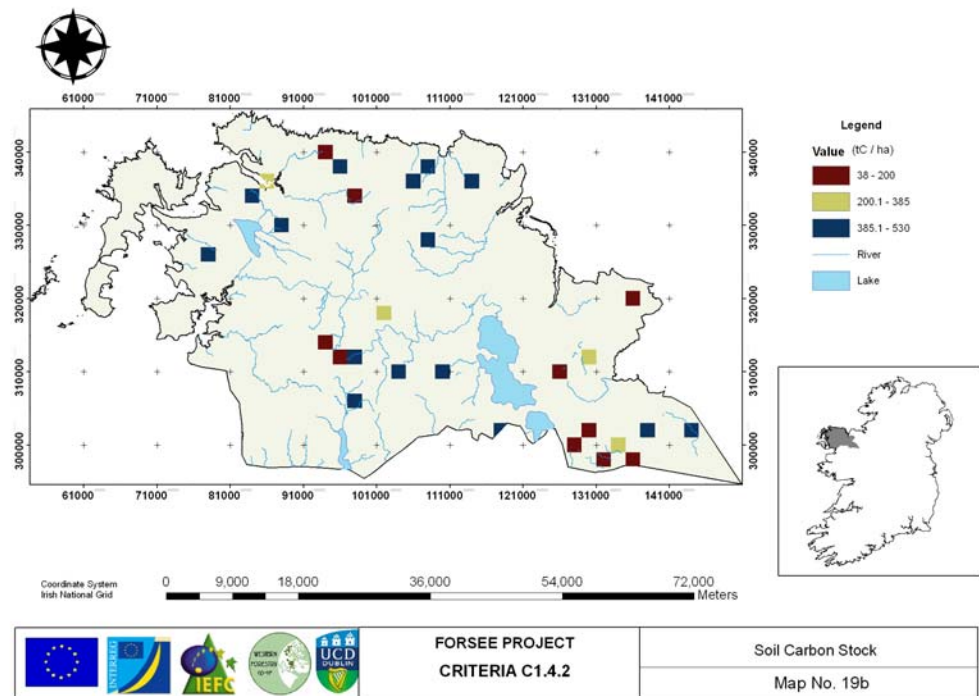


Table 1.4.2a: Soil Carbon in Post 1990 Forests

Carbon Stock (tC / ha)	Area (ha)
38 – 200	4000
200.1 – 385	1600
385.1 – 530	6000

Remarks:

The large area of organic soil dominated the carbon stock in the pilot zone area. The carbon stock was calculated based on the bulk density and % organic content of the various soil associations Table 1.4.2b (McGettigan and Aherne, 2005) as well as the soil depth recorded in the NFI.

Table 1.4.2b: Soil Associations Characteristics

(i) Soil Association	Bulk density	% Organic Carbon
Blanket Peat	0.100	52.2
Brown Podzolics	1.252	3.5
Gleys	1.324	2.6
Lithosols	0.200	23.8
Podzols	1.446	1.3
Shallow Brown Earths nad Rendzinas	1.091	5.8
Grey Brown Podzolics	0.100	52.2

Recording soil depth in Ireland's new NFI monitoring program enabled the stock to be estimated and the intention to continue the NFI program on a five year repetitive cycle will mean that peat depth is monitored at these sites on an ongoing basis.

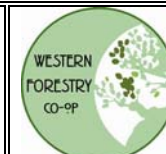
Problems and Improvements

Measurement of bulk density and organic carbon content at each NFI plot location would improve the estimates of soil stock. In IPCC reporting however, carbon stock changes in drained organic soils should be reported as an emissions factor (t C/ha/yr). More research needs to be undertaken in Ireland to develop emission factors for organic soil drained for forestry.

Remarks and Conclusions:

The soil carbon stock in the pilot zone is very significant. Large carbon losses from drained organic soils are likely if drainage converts the soil to anaerobic conditions. Significant research is required to enable estimates of stock change in the future from national specific emissions factors.

Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.



Indicator 1.4.3 Carbon Stock in the Deadwood				
Costs: Total €4544 Marginal €44 Shared €4500 Cost/ha €0.13 These costs include: <table><tr><td>Data processing</td></tr><tr><td>Purchase maps</td></tr><tr><td>Computer software</td></tr></table>	Data processing	Purchase maps	Computer software	Results: Data available from the NFI plots in the pilot zone indicated the absence of deadwood within post 1990 stands. This carbon pool was subsequently reported as zero in C stock estimates. Remarks: This carbon pool increases with stand age and forest management practices such as thinning. Therefore this carbon pool is likely to be more prominent in the future. The NFI protocol records the presence of branches, stumps and dead logs in plots. Where stumps or logs are found, the quantity is noted and physical features such as diameter, height (length) and decay status recorded. These features would enable carbon stock to be determined when used in combination with density values, which correspond to the decay class noted.
Data processing				
Purchase maps				
Computer software				
Problems and Improvements				
Remarks and Conclusions:				
This carbon pool made no contribution to the overall carbon stock in the pilot zone.				
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.				
   				

Indicator 1.4.4 Carbon Stock in the Litter

Costs:

Total
€4544

Marginal
€44

Shared
€4500

Total
cost/ha
€0.13

These costs
include:

Data processing
Purchase maps
Computer software

Results:

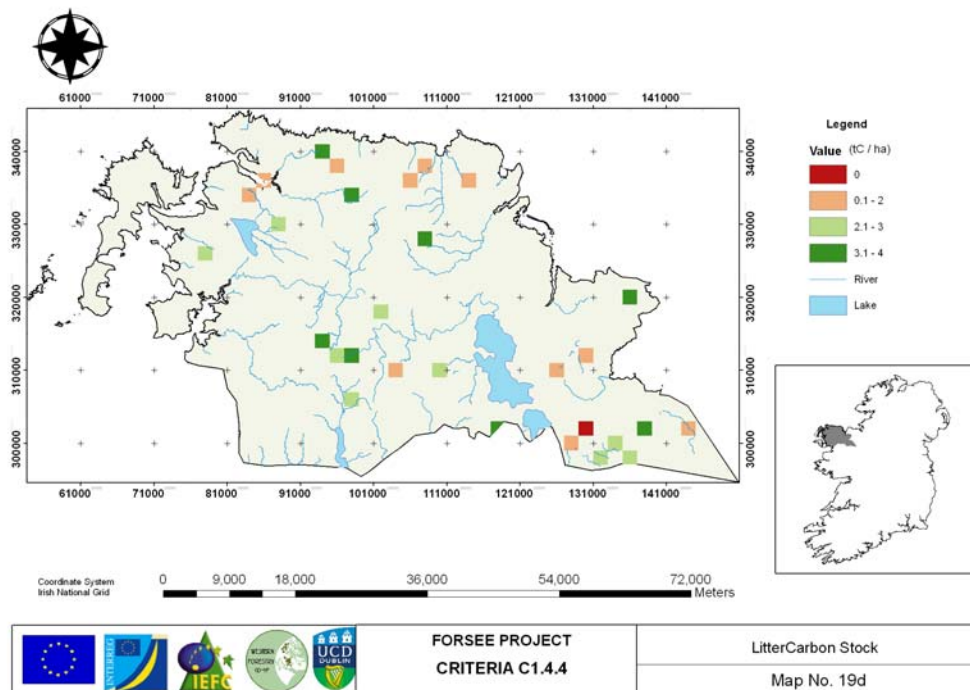


Table 1.4.4a: Litter Carbon in Post 1990 Forests

Carbon Stock (tC / ha)	Area (ha)
0	400
0.1 – 2	4400
2.1 – 3	3600
3.1 – 4	3200

Remarks:

When soil carbon is excluded, the litter carbon stock in the region accounted on average for 14% of the total carbon stock (i.e. of woody biomass, litter and understorey) across all the NFI plots in the pilot zone. The litter stock estimate was based on the known age of the stand and the IPCC default litter accumulation factor for coniferous forests (i.e. 0.25 tC/ha/yr).

Problems and Improvements

The IPCC value applied is an average over 20 years of forest development. As most of the post 1990 forests considered in the region were yet to close canopy, it is thought that applying this value might overestimate the litter in young forests. However, without a detailed litter accumulation study in the forests of the pilot zone, it was considered the best available factor to apply.

Remarks and Conclusions:				
The stock estimate of the litter is likely to be an overestimate. More work on litter accumulation rates in young forests would greatly improve our estimates of this pool.				
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB <i>Atlantic Area</i> .				

Indicator 1.4.5 Carbon Stock in the Understorey

Costs:

Total
€13916

Marginal
€9416

Shared
€4500

Total
cost/ha
€ 0.40

These costs
include:

Fieldwork to
generate
functions.

Site
Description

Data
processing

Purchase
maps

Computer
software

Results:

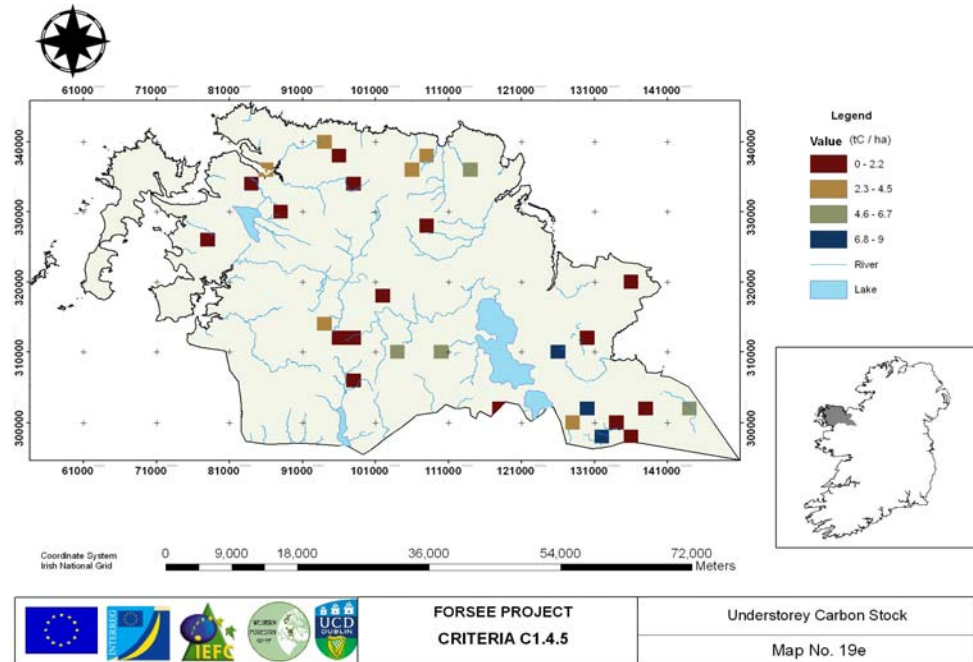


Table 1.4.5a: Understorey Carbon in Post 1990 Forests

Carbon Stock (tC / ha)	Area (ha)
0 – 2.2	6400
2.3 – 4.5	2400
4.6 – 6.7	1600
6.8 – 9	1200

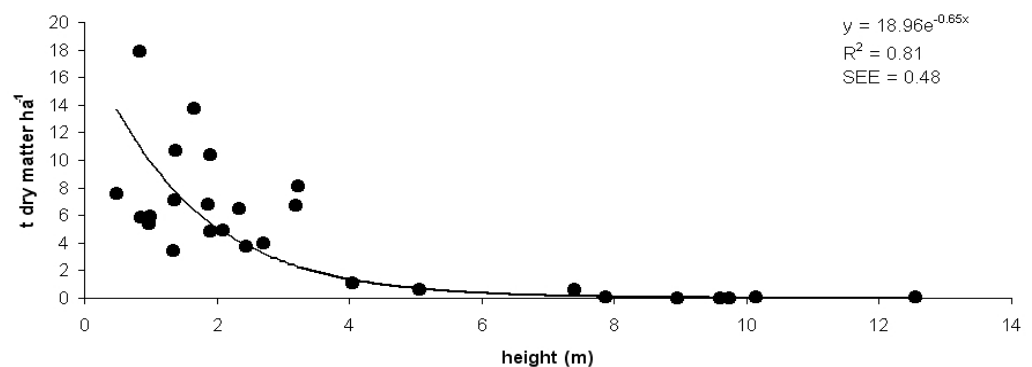


Figure 1.4.5a: Understorey biomass relation with tree height

	Remarks: Understorey biomass contributed significantly to the overall carbon stock calculated when the soil pool is excluded. On average contributing 29% to the combined woody biomass, litter and understorey components. This was expected due to the young age of the plantations. The understorey, which generally consists of peatland vegetation (i.e. heather, grasses, moss) or agricultural grasslands is not removed prior to planting and experiences disturbance associated with the installation of drains. The vegetation can recover well in the few years following establishment, until the stand starts to reach canopy closure when trees start to dominate, which was shown in the understorey biomass function developed.
Problems and Improvements	
There is significant variation in understorey stock estimates in stands with small trees. More research into these stands looking at other factors such as drainage and peat depth might increase the confidence in the results.	
Remarks and Conclusions:	
The understorey biomass was significant in the pilot zone and in 40% of the cases was greater than that estimated in the woody biomass.	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.	

b). Criterion 2: Maintenance of forest ecosystem health and vitality

Forest ecosystem health and vitality is essential for both the ongoing growth of our forests and to ensure that they continue to deliver the full range of benefits and important environmental functions.

Irish forests are among the healthiest in Europe with relatively few serious pests or diseases. This can be attributed to our island status, relative newness of the forest estate and the strict enforcement by the Forest Service of EU plant health regulations. Forest Service policy is to maintain a healthy forest environment by ensuring good management, identifying risks and maintaining a sustained commitment to measures that prevent the entry and establishment of destructive forest pests and diseases (Anon. (a), 2000). There are twelve significant threats to Irish forests listed in the Forest Service forest protection guidelines classified under biotic-: competing vegetation, livestock, deer, rabbit, hare, grey squirrel, bank vole, large pine weevil and “Fomes” butt rot and abiotic-: fire, wind and late spring frost (Anon, 2002). Abiotic agents may occasionally cause severe damage to forest ecosystems in the form of damaging storms and fire, which destroys approximately 200 ha of forest per annum (Anon. (b), 2000). However both biotic and abiotic agents cause little permanent damage in most Irish forests.

Forests are susceptible to a range of attacks from pests and diseases at different stages of their lifecycle. Apart from endemic problems there is also a significant threat from exotic forest pests and diseases. Endemic pests and diseases can become aggressive and epidemic if ecological circumstances change. Harmful insect and fungal activity may be triggered by forest management activities such as clearfelling. The principal forest disease occurring in Ireland is *Heterobasidion annosum* (formerly *Fomes annosum*) (Anon. (a), 2000) which causes root and butt rot. This disease was not detected in any of the FORSEE plots which could be attributed to the fact that the soils were mainly peat soils and *Heterobasidion annosum* is associated with relatively dry fertile and old woodland soils. The age class of the trees (0-20 years) and that 95% of the plots were first rotation forests (it is more likely to infect trees by means of airborne spores which infect freshly cut stump surfaces produced during harvest) may also be a contributing factor to the absence of *Heterobasidion annosum* in the pilot zone. The principal forest

pest occurring in Ireland is the large pine weevil (*Hylobius abietis*). Again this pest is more of a threat in reforestation sites as the young breed in stumps. It was not detected in any of the FORSEE plots. Defoliation however, which was the major damage type recorded in the plots, was often caused by the defoliating insect the green spruce aphid (*Elatobium abietinum*) and was most common in Sitka spruce (*Picea sitchensis*) plantations.

Ireland's largely "man-made" plantation forests consist primarily of exotic conifer species. *Picea sitchensis* and *Pinus contorta* together make up 94% of the stand species composition in the pilot zone, map 5. This low species diversity has made the forest resource more susceptible to significant damage by introduced harmful organisms.

Due to our humid climate, fire damage is not a serious threat to Irish forests. In 2005, the number of fires recorded by Coillte Teo (state forestry board) was 16 occurrences and 66 ha of forest were lost. Reduction was mainly due to favourable weather conditions and the implementation of a national fire plan (Anon, 2005). There are no figures available at present for fire damage in the private sector but indications from Forest Service personnel are that it would be very small. There was no damage from fire recorded in the 41 FORSEE plots.

Coillte Teo conducts annual monitoring of forest condition as part of an EU-wide study to provide quantitative data on the vitality of the European Union's forests. Irish Level 1 plots form part of a network of 6,000 plots across Europe for monitoring forest health. Irish results from the EU Level 1 forest health survey demonstrate that the overall health and vitality of the state forests is good. Results to date show that trees have recovered well from damage caused by an outbreak of the green spruce aphid in 2002.

Strong winds and harsh weather conditions (late spring frosts) also play a role in the condition of Irish forests (Anon, 2005).

2.4.1. Nature of the Damages

Costs:

Pilot zone:
(35220 ha)
41 plots
3309 trees

Total Cost
€12393.00
Shared Cost
€10193.00
Marginal Cost
€2200
Total Cost/ha
€0.35

These cost
include:

Measure DBH
Site Description
Record the damages
Record the intensity of the damages
Identify the damage agent
Transects
Record the affected part
Data processing of the forest health
Travel to the plots
Time finding & installing the plots
Prepare sampling plan
Purchase maps of the plots
Organise the data collection points
Computer & software for forest health

Results:

Figure 2.4.1a: Proportion of Trees with and without damages.

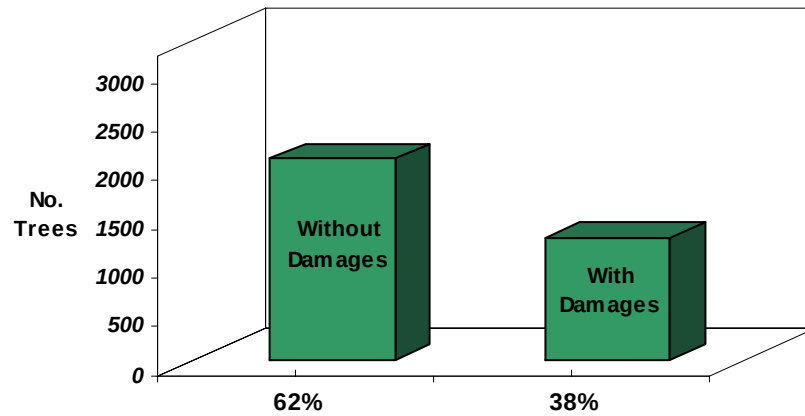


Figure 2.4.1b: Type of damages:

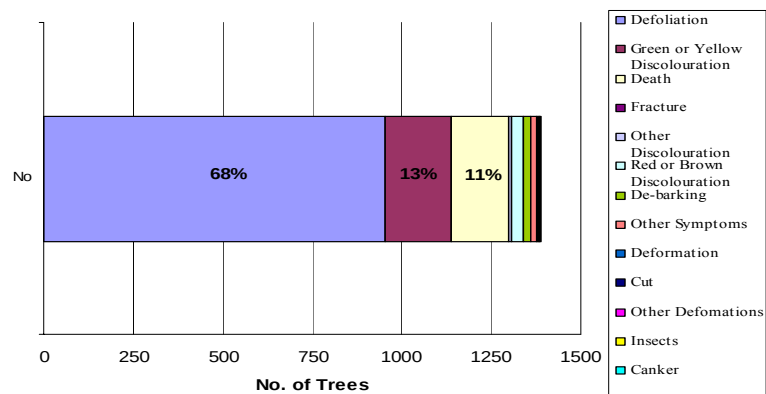


Figure 2.4.1c: Parts of the tree affected by the damages:

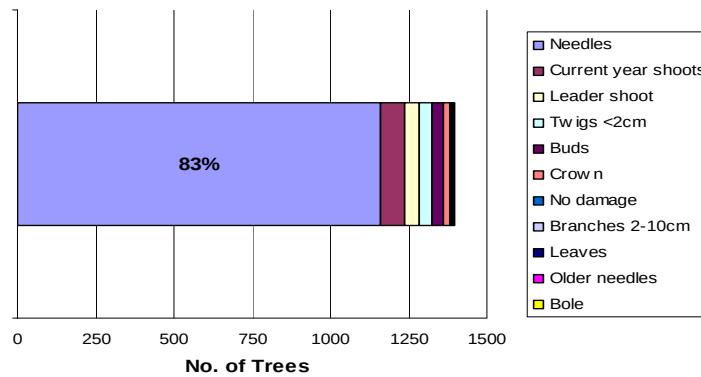
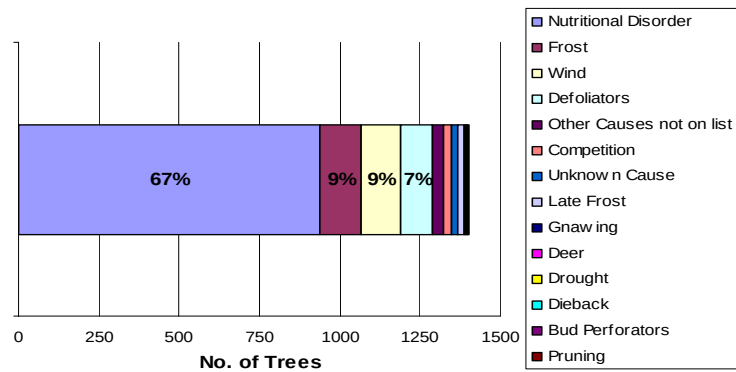


Figure 2.4.1d: Main Agents responsible for tree damages:



Remarks:

Figure 2.4.1a shows that 38% of the trees surveyed were damaged. The other figures (Figs. 2.4.1a-d) present the type of damage, part of the tree affected by the damage and the main agent responsible for the damage. The main type of damage, by a large margin (68%) was defoliation. This could be related to the fact that the forest sites were all post 1988, in the 0-20 age class. Tree damage due to frost and wind can be related to tree age. As the crop matures and closes canopy needle damage due to exposure and frost are less likely. In figure 2.4.1c you can see that 83% of the affected part of the tree was the needles, as would be expected with defoliation. In figure 2.4.1d the main agent responsible for the damages was nutritional disorders which would relate to the high percentage of needle damage and would be an indication of low soil fertility. The other two main agents responsible for the damages were frost and wind, which would be associated with the main affected part (needles) and the age of the trees.

Problems and Improvements			
The main problem with identifying forest health in young trees is that the damages observed at the time of field assessment could be transient in nature. Young trees pre-canopy closure, are more susceptible to damage by exposure (wind and frost) which is dependent on annual weather conditions. Therefore damage assessment of the same trees the following year may show complete recovery. This makes it difficult to make an accurate assessment of forest health in young trees and its relationship to sustainability. Therefore the assessment of trees within one age class may present a limited picture of forest health. This does not however affect the reliability of the indicator only a possible limitation of the sampling strategy.			
Remarks and Conclusions:			
This indicator (when assessed in all age-classes) would be very useful for assessing the main forest health issues within a region, pilot zone, country and greatly improves the knowledge of forest health which may not be assessed at such an intensity. Indications from the results show that the forests in the pilot zone are affected by low soil fertility and exposure.			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.			

Indicator 2.4.2: Damage Intensity

Costs:

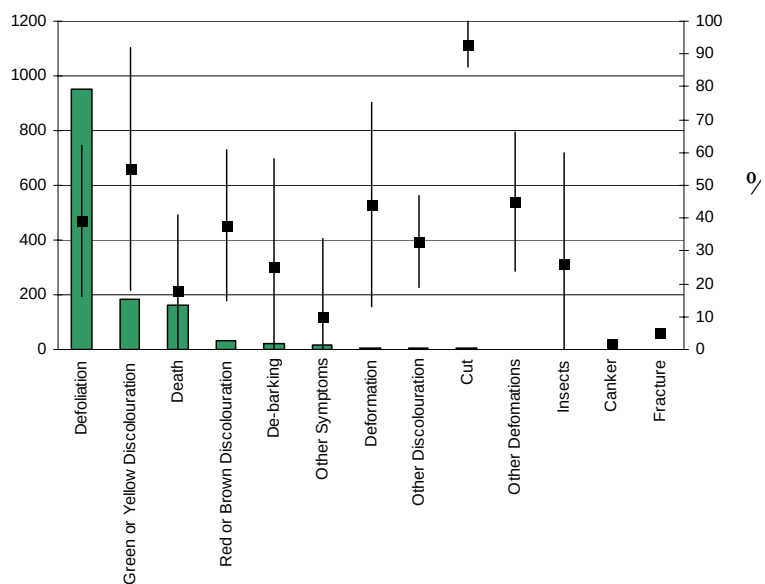
Total Cost
€12147
Shared Cost
€10152
Marginal Cost
€1995
Total Cost/ha
€0.34

These cost
include:

Record the damages
Record the intensity of the damages
Record the affected part

Results:

Figure 2.4.2a: Intensity of the damage.



Data processing of the forest health Travel to the plots Time finding & installing the plots Prepare sampling plan Purchase maps of the plots Organise the data collection points Computer & software for forest health	Remarks: In figure 6 it can be seen that although the main damage type was defoliation, the mean level of defoliation was quite high (39%) in comparison to levels recorded by Coillte in their forest health plots where mean defoliation was in Irish Level 1* plots was 14.9% in 2004 and 15.9% in 2005 and defoliation in both years was similar to the long-term average of 15.6% (Anon, 2005). This would indicate that defoliation is a concern. This information is useful to give a more accurate description of the intensity level of the different damage types. Green or yellow discolouration, the second major damage type in the pilot zone, had a mean discolouration of 55% which is quite high and would have implications for tree growth. Mean discolouration figures in level 1 Irish plots for 2004 and 2005 were 5.2% and 6.4% respectively and were lower than the long-term average of 7.9%. Death to the branches and shoots had a mean level of 20% and would not be a major concern. * Irish Level 1 plots form part of a network of 6,000 plots across Europe for monitoring forest health.
Problems and Improvements	
Again the analysis was mainly on trees within one age class (0-20) and therefore has limitations for both the intensity level and the type of damage.	
Remarks and Conclusions:	
The damage intensity has been useful in assessing the level of damage to the trees and therefore gives a more accurate representation of forest health in the region. This is a useful tool for forest managers.	
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB Atlantic Area.	  

Indicator 2.4.3: Damage Type by Diameter Class

Costs:

Total Cost
€12352.00
Shared Cost
€12762.00
Marginal Cost
€-410
Total Cost/ha
€0.35

These cost
include:

Measure DBH
Record the damages
Identify the damage agent
Data processing of the forest health
Travel to the plots
Time finding & installing the plots
Prepare sampling plan
Purchase maps of the plots
Organise the data collection points
Computer & software for forest health

Results:

Figure 2.4.3a: Number of Trees Damaged by diameter class.

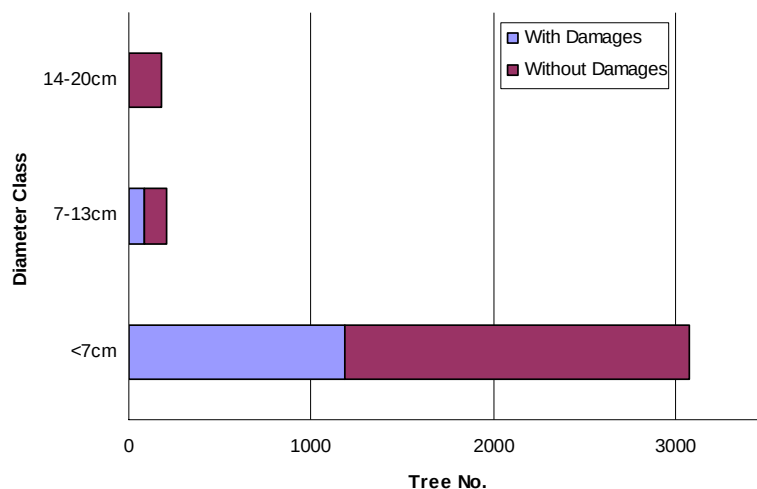
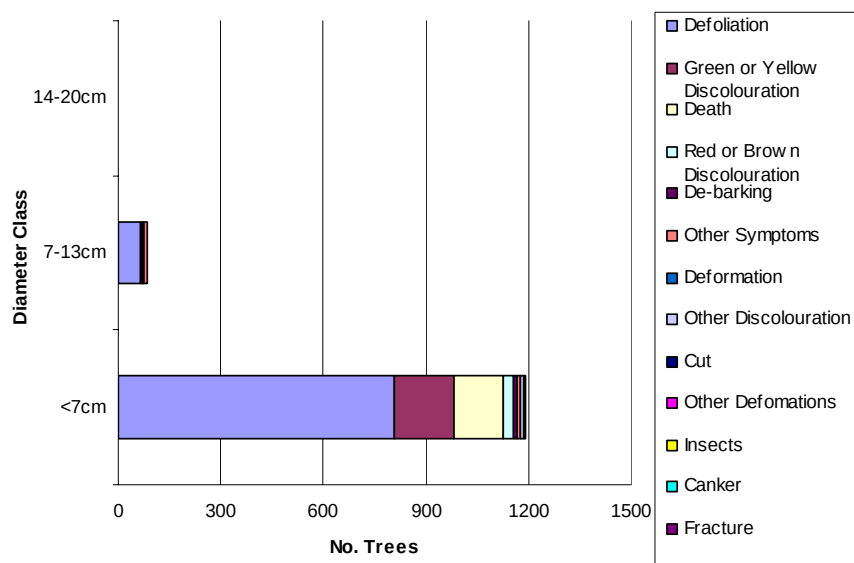


Figure 2.4.3b: No of trees damaged classified by damage type per diameter class.



	Remarks: Most of the trees recording damages fell into the less than merchantable timber class (<7cm). In the 7-13cm (pulpwood) diameter class it was nearly 50/50 with and without damages. Interestingly in the 14-20cm (sawlog) diameter class there was no damage to any of the trees albeit the amount of trees in the class was low. Where the trees were classified by damage type per diameter class in figure 8 the results show that again the damages were mainly in the <7cm diameter class, with defoliation being the major damage which would be typical in young trees. Green or yellow discolouration in the needles was most prevalent in the <7cm diameter class and again would be expected in both young trees and trees of low volumes. Death to the branches and shoots was the third major damage to occur in the pilot zone which together with defoliation amounted to >80% of the damages in the <7cm diameter class and all three damages are typical of young trees which have not yet closed canopy are therefore susceptible to damage by both biotic (insect, nutritional disorder) and abiotic (wind, frost) factors.
Problems and Improvements	
Remarks and Conclusions:	
The results indicate the problems associated with young trees. The fact that defoliation and discolouration were the major damage types recorded, it could therefore be perceived that this would effect the capacity of the trees to increase in volume, however when trees are young they have a stronger ability to recover from damage disorders and therefore the usefulness of this information in young trees could be questionable.	
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB Atlantic Area.	  

Criterion 3: Maintenance and encouragement of productive functions of forest (wood and non-wood).

Ireland's current timber production is 2.7 million m³ per annum. This is forecasted to increase to 5 million m³ per annum by 2035 if annual afforestation targets by the private sector are met (20,000 ha/annum). To ensure that reserves are conserved while still maintaining a satisfactory flow of products, harvesting must not therefore exceed long-term productive capacity in order for it to remain sustainable. The concept of sustained yield (ensuring that the rate of timber removal from the forest does not exceed increment) is central to this criterion. There was no thinning or clearfell in any of the FORSEE sites in the pilot zone as 95% of the forests were in the age class 0-20 years and the remaining 5% was old estate woodland.

Almost 80% of Irish forests are coniferous plantations, with Sitka spruce (*Picea sitchensis*) and Lodgepole pine (*Pinus contorta*) being the dominant species. Spruce and pine have the potential to produce a wide range of non-wood forest products such as essential oils, tannin and Lodgepole pine for boughs for foliage. In addition to the non-wood forest products there is also the potential to harvest mushrooms, herbs, shrubs and flowers from the forest. Recreation, hunting and tourism benefits are also a potential non-wood benefit from the forest. The forest foliage industry in Ireland was first established in the 1960's and it has increased to over 150 ha specifically for foliage production (Collier et al, 2004). Lodgepole pine (*Pinus contorta*) is being harvested for wreaths to supply large supermarket chains in the UK.

Forest recreation in Ireland is not as well developed as the rest of Europe, owing in part to the newness of the forest estate. There are only two forest tourist facilities in the country, owned and managed by the state forestry board (Coillte Teo.). All mushrooms produced in Ireland are presently cultivated indoors, however there is potential to grow them in Irish forests but this has not yet been developed.

Indicator 3.1: Increment and Fellings

Costs:

Total Cost
€2224
Shared Cost
€1371
Marginal Cost
€853
Total Cost/ha
€0.06

These cost
include:

Fieldwork
Survey
Site Description
Transects
Data Analysis
Data processing
Travel to the plots
Time travelling to the plots
Time finding & installing the plots
Prepare sampling plan
Purchase maps
Organise the data collection points
Computer & software

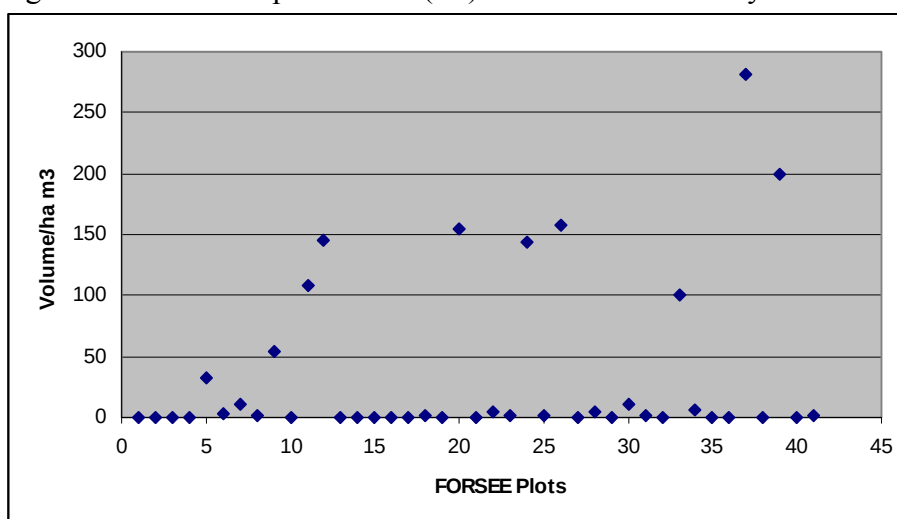
Results:

Table 3.1: Current wood volume

Volume Class (m ³ /ha)	Area (ha)
0-50	15250
50.1 - 140	7360
140.1 - 330	5780
330.1 - 530	5780
530.1 - 775	1050

(source NFI, 2005)

Figure 3.1a: Volume per hectare (m³) in the FORSEE study sites.



Remarks:

Due to the relatively young Irish forest estate and the small percentage forest cover, the first all inclusive national forest inventory (NFI) only commenced in 2005. Preliminary results from analysis of inventory data in table 3.1 shows that 43% of the forest area has a current wood volume less than 50 m³/ha. This could indicate that the forest estate in the pilot zone is quite young. As the volume class increases the volume/ha decreases which would also be an indication of how young the forest area is in the pilot zone. In figure 3.1a of the FORSEE study sites, half of the plots have a volume of less than 1m³/ha. This again would be indicative of a young forest estate.

Problems and Improvements			
The lack of national and private sector data for annual increment in this indicator is a disadvantage.			
Remarks and Conclusions:			
The absence of published data from the national forest inventory (NFI) and a subsequent NFI infers that it is very difficult to accurately estimate annual increment in both the forests of the pilot zone and nationally.			
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB <i>Atlantic Area</i> .			

Indicator 3.2: Roundwood Harvested

Costs:

Total Cost
€450
Total Cost/ha
€0.01

These cost
include:

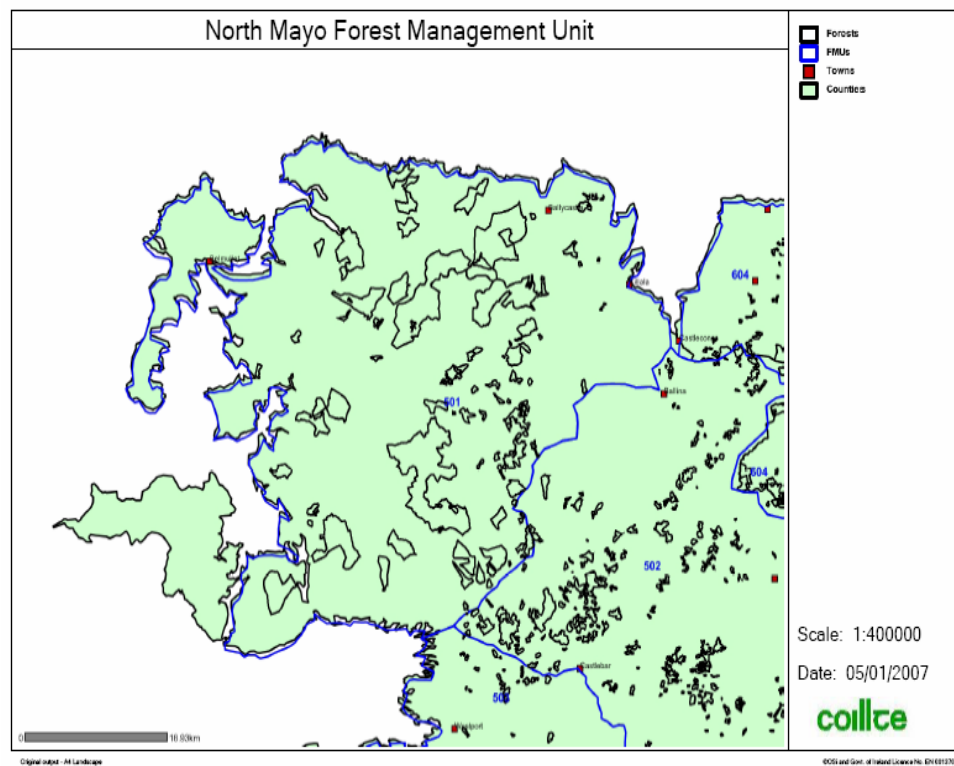
Data Analysis
Data processing
Computer & software

Results:

Table 3.2: Volume (m³) of timber harvested in the Coillte Teo North Mayo forest management unit 2003-2005.

	2003	2004	2005
2nd & Subsequent thinning	137	28	132
Pre-mature clearfells	73963	127121	128111
Clearfell	11540	0	1639
Windblow	7929	515	3216
Total (m³)	93569	127664	133098

Figure 3.2a: Map showing Coillte Teo North Mayo Forest Management Unit.



	Remarks: There is no data available for roundwood harvested in the private sector in the pilot zone. The Forest Service regulate the control of felling nationally by a process of issuing felling licenses, however this does not provide any figures for roundwood harvested. In the absence of data for roundwood harvested in the private sector, discussions with the Forest Service inspector for the pilot zone area concluded that there was no roundwood harvested during 2006 (Kavanagh, 2006). In the survey completed on the forest owners of the FORSEE plots there was no roundwood harvested in any of their forests. The only income generated from timber sales was for firewood production and this amounted to €900 (2 owners) in total for 2005. The only information available on roundwood harvested in the pilot zone is from the state forestry Coillte Teo. In their North Mayo FMU (forest management unit) it can be seen that there were no 1st thinnings in the period 2003-2005. Lodgepole pine accounts for 70% of the species area in the FMU, reflecting the poor productive capacity of the peat soils and often why it is not economical to thin. The North Mayo FMU is a sensitive natural environment, particularly in relation to fisheries, water quality and the landscape and therefore Coillte manages the majority of area and the pine crops for pulpwood production which can be seen in Table 3.2 where for the years 2003, 2004 and 2005, 79%, 99% and 96% respectively of the total volume was harvested as pre-mature clearfells.
Problems and Improvements	
The main problem had been accessing data on roundwood harvested by the private sector in Ireland. This data is not available. However a report published on the forecast of roundwood production from the forests of Ireland 2001-2015 (Gallagher and O'Carroll, 2001) does provide some information for the private sector but has limitations in that it is a desk study forecast.	
Remarks and Conclusions:	
With the amount of land planted by the private sector over the last 25 years this identifies a gap in information in the forestry sector.	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.	  

Indicator 3.3: Non Wood Products																
Costs: Total Cost €508 Shared Cost €308 Marginal Cost €200 Total Cost/ha €0.01 These cost include: <table><tr><td>Survey</td></tr><tr><td>Data Analysis</td></tr><tr><td>Data processing</td></tr><tr><td>Travel to the plots</td></tr><tr><td>Time travelling to the plots</td></tr><tr><td>Time finding forest owners</td></tr><tr><td>Prepare sampling plan</td></tr><tr><td>Organise data collection</td></tr><tr><td>Computer</td></tr></table>	Survey	Data Analysis	Data processing	Travel to the plots	Time travelling to the plots	Time finding forest owners	Prepare sampling plan	Organise data collection	Computer	Results: Table 3.3: Results from the FORSEE survey of woodland owners on non wood forest revenue. <table><tr><th>Woodland Type</th><th>Non wood product</th><th>Value</th></tr><tr><td>Broadleaf High Forest</td><td>Woodcock shoot</td><td>€2000/annum</td></tr></table> (n = 35)	Woodland Type	Non wood product	Value	Broadleaf High Forest	Woodcock shoot	€2000/annum
	Survey															
Data Analysis																
Data processing																
Travel to the plots																
Time travelling to the plots																
Time finding forest owners																
Prepare sampling plan																
Organise data collection																
Computer																
Woodland Type	Non wood product	Value														
Broadleaf High Forest	Woodcock shoot	€2000/annum														
	Remarks: Only one of the FORSEE study sites surveyed had received revenue from non wood products. This was an annual woodcock shoot over two days. This forest is old estate woodland with a diverse range of mixed broadleaves and conifers. All the other forest sites were less than 20 years old and as yet the non wood products sector is not providing any additional income to private woodland owners. It could be that its potential has not yet been explored sufficiently.															
Problems and Improvements																
The lack of regional and national information on non wood forest products posed a problem in the quantification of this indicator. Overall there is currently a lack of information available to the private sector explaining the potential benefits of non wood products from their forests.																

Remarks and Conclusions:			
The forest estate in Ireland is young and has a lack of forest culture/tradition in comparison to our European counterparts. However, according to a research project commissioned by COFORD into markets for non wood forest products it was concluded that tourism and forest foliage would be the most competitive non wood products under Irish forest conditions (Collier et al., 2004). These income avenues are currently not been realised to their full potential.			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.			

Indicator 3.5: Forest Under Management Plans

Costs:

Total Cost
€4984
Shared Cost
€4808
Marginal Cost
€176
Total Cost/ha
€0.14

These cost
include:

Fieldwork
Survey
Site Description
Data Analysis
Data processing
Travel to the plots
Time travelling to the plots
Time finding & installing the plots
Prepare sampling plan
Purchase maps
Organise the data collection points
Computer & software

Results:

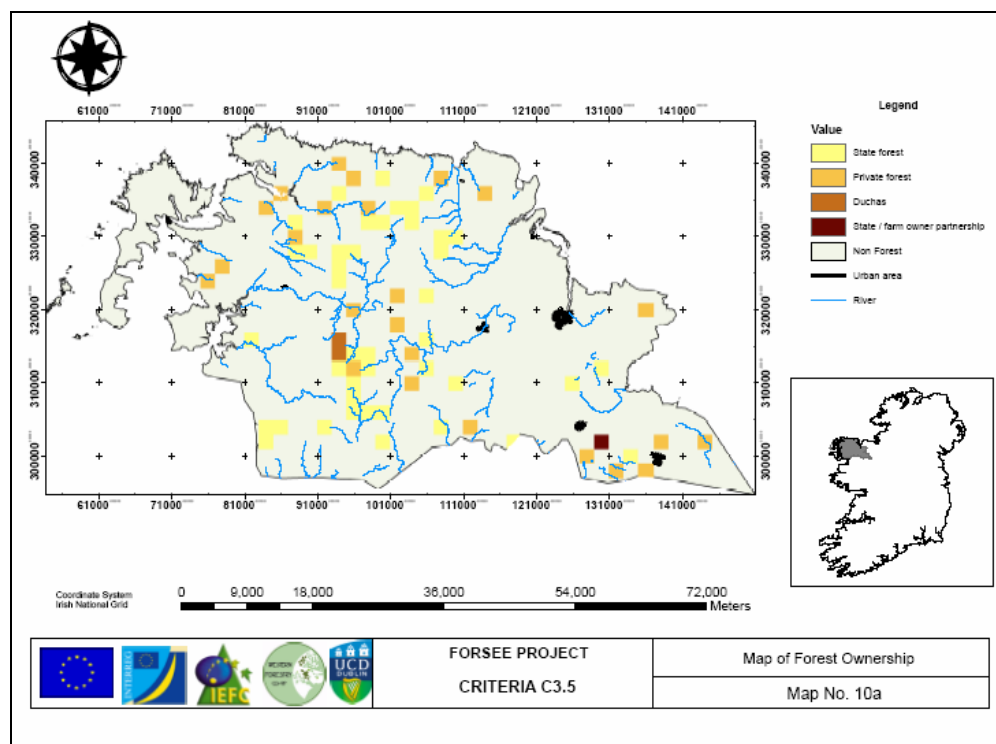


Table3.5a: Forest Ownership

Property Ownership Class	Area (ha)
State forest	20820
Private forest	12800
Duchas (Heritage) forest	1070
State/Farm owner partnership	530
Total	35220

Table 3.5b: Forest under management plans (a subset from the FORSEE survey of forest owners when asked if they had a forest management plan for their woodland).

Forest Man Plan	%
Yes	9%
No	91%

(n = 35)

	Remarks: The state forestry (Coillte Teo) accounts for 59% of forest ownership in the pilot zone. They have FSC (Forest stewardship council) certification and it can be therefore assumed that their forests are under management plans. The private sector accounts for 32% of forest ownership. In a subset survey of forests under management plans from the FORSEE survey completed on the forest owners it was found that only 9% of the forest owners had a forest management plan. There is a standardised forest management plan as part of the afforestation grant scheme which must be submitted for all sites greater than 10 hectares (>5 ha for all broadleaf sites) in order to receive the second installment of the afforestation grant. A template of this plan is in the forestry schemes manual (Anon, 2003). Of the 9% (or 3 forest owners) who had a forest management plan only one of these was independently sourced by the forest owner. The other two forest owners management plans were the Forest Service template in order to comply with the afforestation grant scheme. Duchas owned forests (Heritage Council) account for 3% of forest cover in the pilot zone and its forests are managed to develop and maintain the highest standards of conservation management and education, while facilitating sustainable recreational use (i.e. they are not exploited for commercial timber).
Problems and Improvements	
Apart from forest certification schemes and larger sites in the afforestation grant scheme there is currently no requirement for private forest owners to have a forest management plan. This could be improved through greater awareness of the benefits of a forest management plan by the Forest Service through existing support services (organisations, co-ops, associations) to highlight the benefits of forward planning.	
Remarks and Conclusions:	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.	

Indicator 3.6 & 3.7: Accessibility and Harvestability

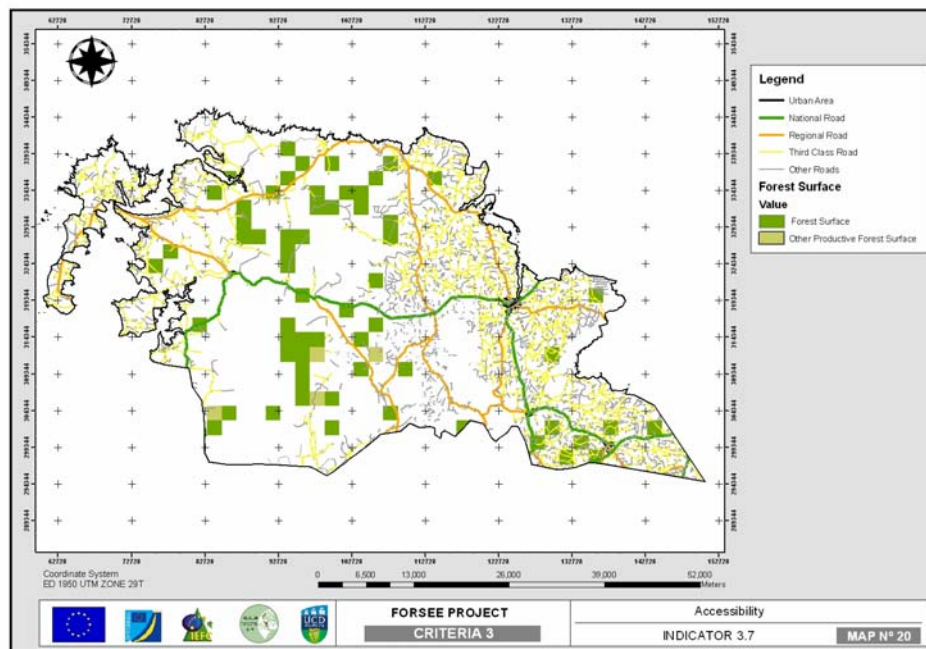
Costs:

Total Cost
€5002
Shared Cost
€4500
Marginal Cost
€502
Total Cost/ha
€0.14

These cost
include:

Data
Analysis
Data
processing
Purchase
maps
Computer
& software

Results:



Source: Ordnance Survey Ireland

Table 3.6: Roading Density

m road / ha	Area (ha)
0	19680
0.1 – 10	4540
10.1 – 29.9	7070
30 – 80	6060
Total	37350

	Remarks: Traditionally forestry in Ireland was confined to poor agricultural land in mountainous areas, often inaccessible by road. This is notable in the roads map above where it can be seen that a large proportion of the forest blocks occur in the centre of the pilot zone where in certain areas it can be seen that there is a complete absence of regional and third class roads. The regional and third class roads that do exist are not interconnected in this part of the pilot zone, which will increase the length of the haulage routes to main urban areas. This is further outlined in Table 3.6 where 53% of the forest area has roading density of 0m/ha.
Problems and Improvements	
This will pose problems with harvestability and transportation that is yet to be resolved. To access the harvestability of the forests of the pilot zone this was not feasible due to an absence of slope's data.	
Remarks and Conclusions:	
Results from this indicator highlighted the inaccessibility of the majority of forests in the pilot zone and the subsequent increase in haulage lengths.	
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB Atlantic Area.	  

Criterion 4: Maintenance, conservation and enhancement of Biological diversity in forest ecosystems

Biological diversity or biodiversity is the variability among all living organisms. Nature conservation is about recognising, understanding and conserving biodiversity. Forests are among the most diverse and complex ecosystems and are important sources of biodiversity providing a habitat for a multitude of flora and fauna.

Plantation forests are undisturbed for periods of time during their rotation and are host to a wide range of flora and fauna. Most plantation forests in Ireland are managed under a clearfelling regime and therefore have very distinct stages of development from the afforestation or planting stage to thicket, thinning, clearfell and reforestation. Forest biodiversity can be affected by both the growth stage of the forest cycle and the forest type. The majority of the plantation forests in Ireland are coniferous, mainly Sitka spruce and Lodgepole pine. The biota of these forests differs from each other and from other forest types such as broadleaf forests.

Results from a research project completed in 2006 on biodiversity in Irish forests (BIOFOREST www.bioforest.ucc.ie) showed that plantation forests can support diverse species assemblages over the forest cycle, but these contain a large proportion of generalist species and few species of conservation importance. However, mature stands develop a characteristic woodland flora and support forest specialist spiders and hoverflies. In terms of species richness a comparison between the ash and spruce component of stands in a non-intimate mixture found no overall difference in diversity between the two, but that each component supported different species assemblages. On a plantation scale, overall biodiversity was significantly increased by having ash as a component of a predominantly spruce forest. Key issues for forestry management are the importance of thinning in opening up the forest canopy, the retention of standing and fallen dead trees as well as the retention of scrub habitat (Smith et al, 2006).

Indicator 4.1 & 4.4: Tree Species Composition and Introduced Tree Species

Costs:

Total Cost
€4782
Shared Cost
€4500
Marginal Cost
€282
Total Cost/ha
€0.14

These cost
include:

Data Analysis
Data processing
Purchase maps
Computer & software

Results:

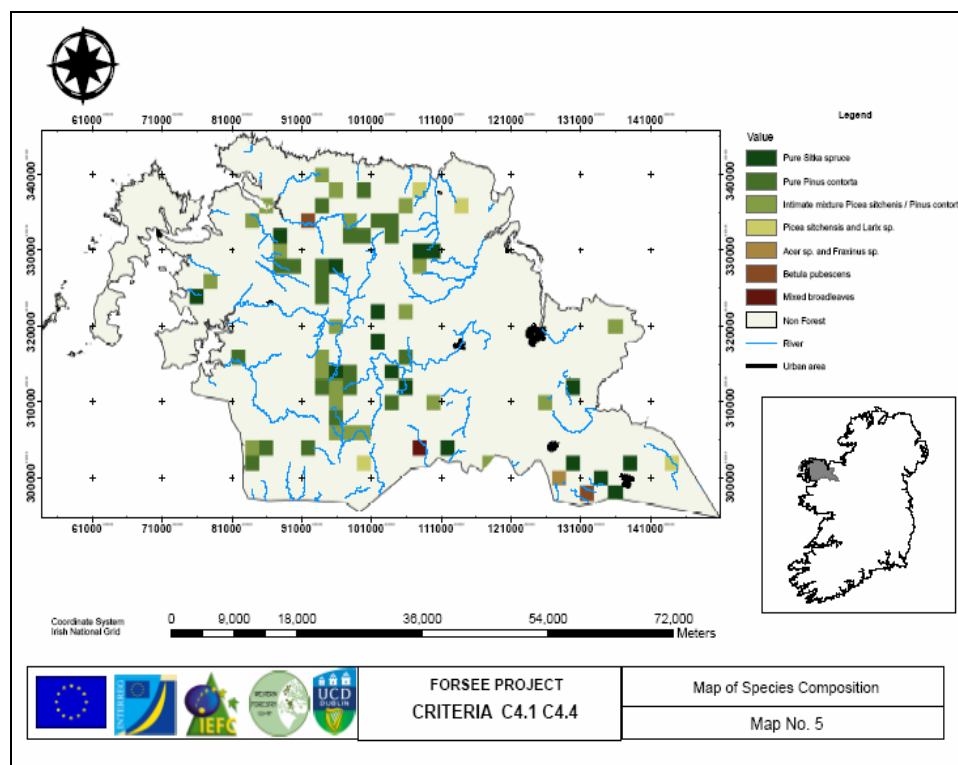


Table4.1: Tree Species Composition in the Pilot Zone

Stand Composition Class	Area (ha)
Pure Picea sitchensis	6940
Pure Pinus contorta	11740
Intimate mixture Picea sitchensis/ Pinus contorta	12270
Picea sitchensis and Larix sp.	2140
Acer sp. and Fraxinus sp.	530
Betula pubescens	1070
Mixed broadleaves	530
Total	35220

Source: NFI data 2005

	Remarks: Tree species composition in the pilot zone is dominated mainly by exotic conifers. These exotic conifers account for some 93% of the species area of the pilot zone. Pure <i>Pinus contorta</i> stands and intimate mixtures of <i>Pinus contorta</i> and <i>Picea sitchensis</i> account for 68% of the tree species composition in the pilot zone and this, as referred to in indicator 3.2, would be indicative of the poor productive capacity of the peat soils planted in the pilot zone. Ireland's forest cover was reduced to 1% of the total land area at the turn of the 20th century. To redress this situation a state forestry programme was initiated in 1907 to recreate a forest resource that would provide a sustainable supply of home grown timber. In 1904 planting trials were established at the Avondale estate in County Wicklow where over 40 different native and non-native species were established. It was on the basis of these trials that the advantages of introduced tree species, particularly conifers from the Pacific Northwest were proven (Horgan et al, 2004). The use of introduced tree species has permitted the establishment of forests on sites and under conditions that would have not been possible with the limited number of native Irish tree species. In 1948 the Irish government initiated an afforestation programme with a target of planting 10,000 hectares per year (Hickie, 1990). However, government policy at the time stated that land fit for agricultural purposes was not desirable for acquisition for afforestation. A maximum price was fixed at such a figure as to render its sale to the department as an uneconomic transaction (Farrell, 1983). This limit pushed the afforestation of land to the mainly infertile blanket peat on hill land and along the western seaboard. <i>Picea sitchensis</i> proved to be the most successful introduced tree species, best adapted to the poor soils and climate, while at the same time producing a quality white wood with many end uses. It was so successful that it formed 85% of the annual planting programme in the early 1990's and composed 57% of the national forest estate in 2001 (Horgan et al, 2004). Pure stands of <i>Picea sitchensis</i> in the pilot zone are smaller than the national average at just 20%. This is reflective of the poor nature of the soils in the pilot zone which were more suited to pure stands of <i>Pinus contorta</i> (33%) or in intimate mixture with <i>Picea sitchensis</i> (35%). The mixed broadleaves stands in the pilot zone are composed of both native and non-native tree species. Only stands of <i>Betula pubescens</i>, which account for 3% of the species area, could be classified as not being introduced. Approximately 21% of the national forest estate is estimated to be broadleaves.
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Problems and Improvements			
Remarks and Conclusions:			
Conservation of the natural environment is very important and in recent years Irish forestry has made many changes in order to enhance biodiversity at both local and regional level. This was notable in 1996 when the Forest Service introduced a requirement that at least 20% of all afforestation sites must be planted with diverse species (i.e. other than <i>Picea sitchensis</i> and <i>Pinus contorta</i>); that all afforestation sites must leave 15% of the site area for biodiversity enhancement (open spaces, habitats, scrub areas) and that 10% of the site area should be afforested with broadleaves where appropriate (Anon, 2003). The Forest Biodiversity Guidelines (Anon (c), 2000) describes a range of measures intended to cover all situations relating to forestry and biodiversity and how best to conserve and enhance biodiversity in Irish forests through appropriate planning, conservation and management.			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.			

Indicator 4.3 Naturalness

Costs:

Total Cost
€4804
Shared Cost
€4500
Marginal Cost
€304
Total Cost/ha
€0.14

These cost
include:

Data Analysis
Data processing
Purchase maps
Computer & software

Results:

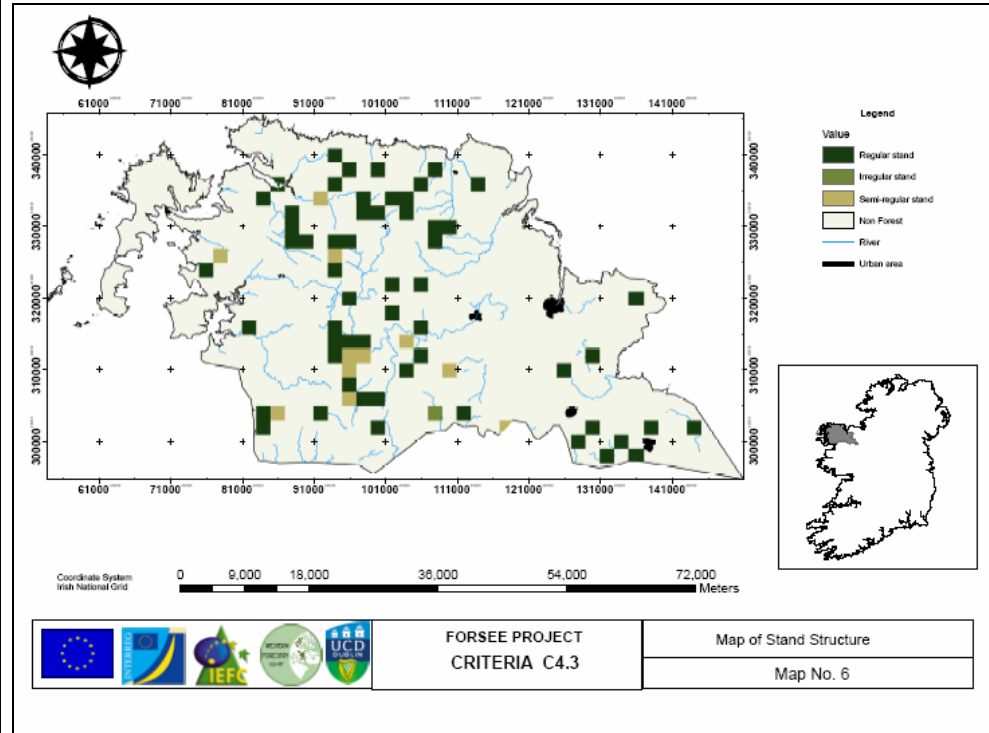


Table 4.3: Stand Structure in the Pilot zone

Stand Structure Class	Area (ha)
Regular	28820
Irregular	530
Semi regular	5870
Total	35220

Source: NFI data 2005.

Remarks:

Stand structure in the pilot zone is predominantly regular (plantation) at 82%, reflecting the intensively managed coniferous nature of plantation forestry in the pilot zone. Irregular or natural forests only account for 1.5% of the stand structure class in the pilot zone which is agreeable with the tree species composition (Table 4.1). Semi-regular (semi-natural) stands account for 16.5%.

Problems and Improvements			
Stand structure in the pilot zone is reflective of intensively managed plantation forestry. Irregular or natural forest cover is very low. The climate, exposure, soil type and topography conditions of the pilot zone make it difficult for broadleaf forestry and are more suited to coniferous plantation forestry			
Remarks and Conclusions:			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area.</i>			

Indicator 4.5: Deadwood							
Costs: Total €198 Cost/ha €0.56 cents/ha These costs include: <table><tr><td>Data Analysis</td></tr><tr><td>Data processing</td></tr><tr><td>Computer & software</td></tr></table>	Data Analysis	Data processing	Computer & software	Results:			
	Data Analysis						
	Data processing						
	Computer & software						
	Table 4.5: Deadwood data in Pilot zone. (Source NFI 2005)						
	Plot Number	Branches	Deadlogs	Stumps			
		<i>% Cover</i>	<i>Distribution</i> [*]	<i>Number</i> <i>Decay Status</i> ⁺			
	1	51-75%	R				
	2	1-5%	UT				
	3	1-5%	R	6 SW (17%) [#] SH (17%) RW (66%)			
	4	1-5%	R				
	5	26-50%	R	3 SW (100%)			
	6	6-25%	R				
	7	>1%	R				
	8	6-25%	R				
	9	1-5%	UT				
	10	1-5%	R				
	11	6-25%	R				
	12	6-25%	R				
	13	1-5%	R				
14	>1%	R					
15	6-25%	R					
16	1-5%	R	3 SH (100%)				
17	6-25%	P	2 SW				
18	26-50%	R					
19	6-25%	R					
20	6-25%	I	3 SH (66%) HS (34%)				
21	6-25%	R					
22	26-50%	UT					
23	6-25%	R	9 SW (87%) RW (13%)				
24	6-25%	R	3 RW (100%)				
25	1-5%	R	1 RW (100%)				
26	6-25%	UT					
27	1-5%	R	1 SH (100%)				
28	51-75%	P	4 SW (100%)				
29	6-25%	UT					
30	1-5%	UT					
32	6-25%	R					
[*] I = Deadwood Islands, P = Deadwood Piles, R = Deadwood Randomly Distributed, UT = Deadwood Under Threshold Diameter (i.e. 7cm) ⁺ SW = Solid Wood, SH = Rotten Sapwood / Solid Heartwood, HS = Rotten Heartwood / Solid Sapwood, RW = Rotten Wood [#] Percentage of stumps listed under each decay class							

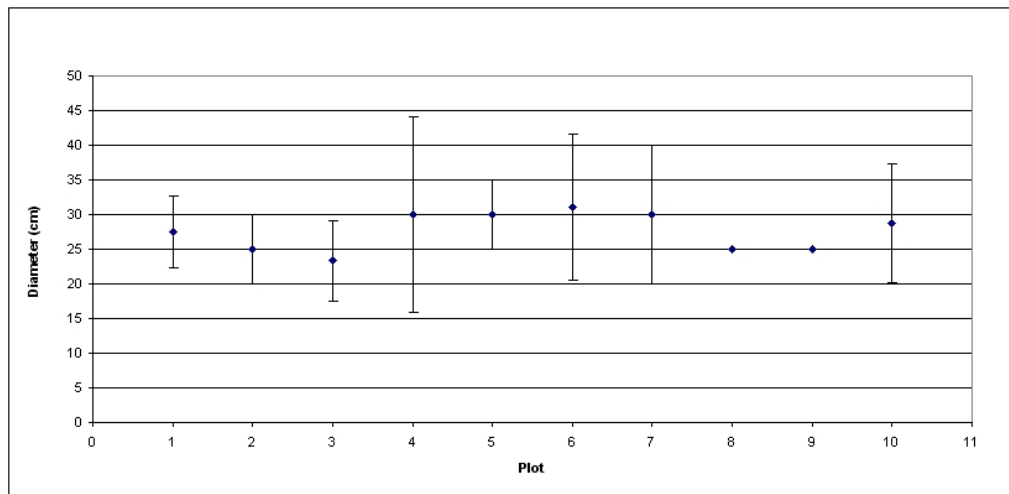


Figure a) Mean stump diameter. Bars represent one standard deviation either side of the mean

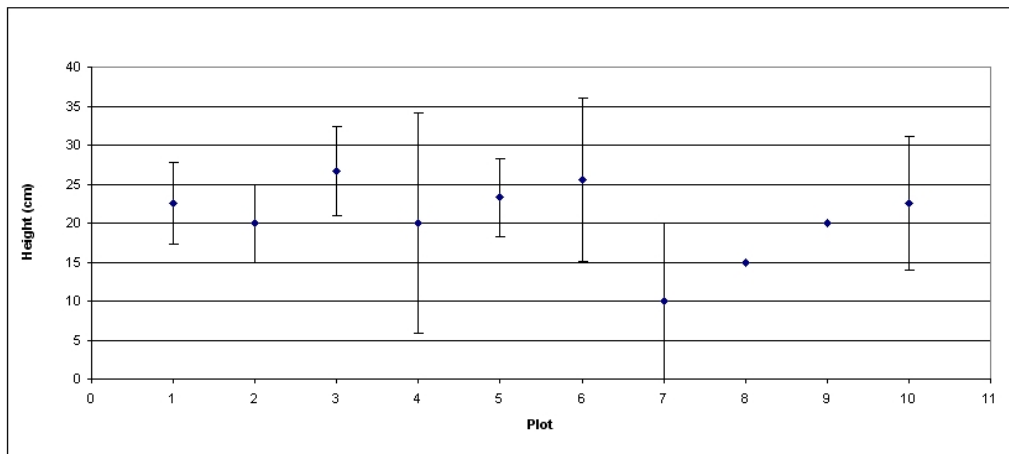


Figure b) Mean stump height. Bars represent one standard deviation either side of the mean

Remarks:

Approximately 46% of the NFI plots in the pilot zone recorded deadwood. All of these plots were in stands over 14 years old (i.e. all planted prior to 1990). Additionally 71% of those plots recording deadwood were found in State Forests. It was found that the NFI data provided substantial information about the type and distribution of deadwood in the plots. Branchwood cover was found mostly ranging between 1-5% (32% of the plots) and between 6 – 25% (45% of the plots). The distribution of deadlogs over the reporting threshold value of 7cm diameter was primarily random (88% of the plots). For stumps over the reporting threshold of 20cm diameter a stump height and diameter is recorded (Figures a and b) as well as a decay status.

Problems and Improvements				
Remarks and Conclusions:				
This information would be very useful in combination with volume models and research to link decay status to density to develop carbon stocks on this pool.				
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.				

e). Criterion 5: Maintenance and appropriate enhancement of protective functions in forest management (most notably soil and water)

The importance of forests in protecting soil and water has been recognised for many years. Forests play a key role in the conservation and protection of surface and subsurface waters. Forests act as filters for pollution and provide habitats for many aquatic and riparian species. The maintenance of soil structure is a key element in achieving sustainable forest management. However, forest management activities can modify forest soils through disturbance, erosion, and compaction of the soils and eutrophication, acidification and sedimentation of surface waters. When improperly carried out, forestry activities such as ground cultivation, drainage, fertiliser application and road construction can have negative effects on water quality. In order to ensure that terrestrial and aquatic systems are protected it is important that the appropriate soil and water quality indicators are carefully monitored. The use of management techniques to protect soil and water can minimise these impacts.

The Irish Forest Service has implemented national guidelines aimed at mitigating any negative impacts on soils and water quality. These include the Forestry and Water Quality Guidelines (Anon. (d), 2000) and Forest Harvesting and the Environment Guidelines (Anon. (f), 2000) and take into consideration different soils types, slope, sensitivity to erosion and underlying geology. These guidelines can provide an effective measure of soil and water conservation, provided they are periodically updated and supported by ongoing long-term research and the best available scientific knowledge. The Code of Best Forest Practice (Anon (b), 2000) was developed to ensure that forest operations in Ireland are carried out in a manner which meets high environmental, social and economic standards. Within the Code, the best practice operational aspects of ground preparation, drainage and road construction are outlined.

A significant portion of Irish forestry plantations are on organic soils of low nutrient status. Wet soils, particularly peat soils can be compacted and rutted by machinery during thinning and clearfell operations, which can adversely impact on soil stability and tree growth. Soil displacement can occur at harvesting with a consequent loss of organic matter and fertility. Forest drainage operations can create pathways for losses of soil

nutrients and sediment to watercourses. The low fertility of peat soils requires fertilisation for successful forest establishment. This has led to concerns over nutrient losses to surface waters and downstream impacts.

Indicator 5.1.1: % and length of stream with appropriate riparian buffer																	
Costs: Total Cost €650 Cost/ha €0.02 These costs include: <table><tr><td>Data Analysis</td></tr><tr><td>Data processing</td></tr><tr><td>Travel to plots</td></tr><tr><td>Time travelling to the plots</td></tr><tr><td>Computer</td></tr></table>		Data Analysis	Data processing	Travel to plots	Time travelling to the plots	Computer	Results: Table 5.1.1: Streams/ivers with appropriate riparian buffer zones in the FORSEE study sites. <table><tr><td></td><td>% of FORSEE Study Sites</td><td>Appropriate Riparian Buffer (10m)</td></tr><tr><td>Stream / River Present</td><td>49%</td><td>62%</td></tr><tr><td>No Stream / River Present</td><td>51%</td><td></td></tr></table> (n = 41)			% of FORSEE Study Sites	Appropriate Riparian Buffer (10m)	Stream / River Present	49%	62%	No Stream / River Present	51%	
Data Analysis																	
Data processing																	
Travel to plots																	
Time travelling to the plots																	
Computer																	
	% of FORSEE Study Sites	Appropriate Riparian Buffer (10m)															
Stream / River Present	49%	62%															
No Stream / River Present	51%																
Remarks: Table 5.1.1. indicates that streams and rivers are a important part of the forest ecosystem with 49% of the FORSEE study sites having a river or a stream either along the forest edge or running through the forest. 55% of the rivers and streams occurred along the forest edge. This would be expected as rivers or streams have historically been used as physical boundaries between landowners. An appropriate riparian buffer zone is defined as an area left unplanted between the forest and the stream/river and should have a minimum width of 10m as outlined in the Forestry and Water Quality Guidelines (Anon. (d), 2000). From Table 5.1.1. it can be seen that 62% of the FORSEE study sites had the appropriate riparian buffer.																	
Problems and Improvements The forestry and water quality guidelines have been amended three times since they were first published in 1992. In the first edition of the guidelines (1992) the minimum riparian buffer width was 5m, it is only since the last edition of the Guidelines in 2000 that the minimum 10m riparian buffer was recommended, therefore any sites between 1992 and 2000 that adhered to the guidelines when the site was planted have been deemed as having the appropriate riparian buffer.																	
Remarks and Conclusions: This indicator shows that the greater number of forests in the FORSEE study have an appropriate riparian buffers as per Irish Forest Service policy (guidelines and code of best practice).																	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.																	

Indicator 5.3.2: Water Table Depth

Costs:

Total Cost
€2847
Shared Cost
€1886
Marginal Cost
€961
Cost/ha
€0.08

These costs
include:

Fieldwork
Site Description
Data Analysis
Data processing
Travel to the plots
Time travelling to the plots
Time finding & installing the plots
Prepare sampling plan
Organise the data collection points
Computer & software

Results:

Figure 5.3.2 a: Mean water table depth in the FORSEE study sites.

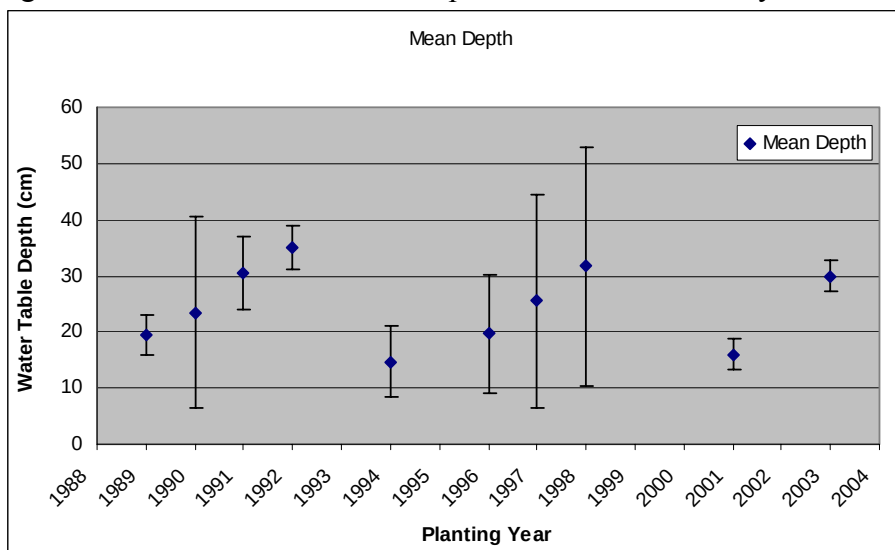
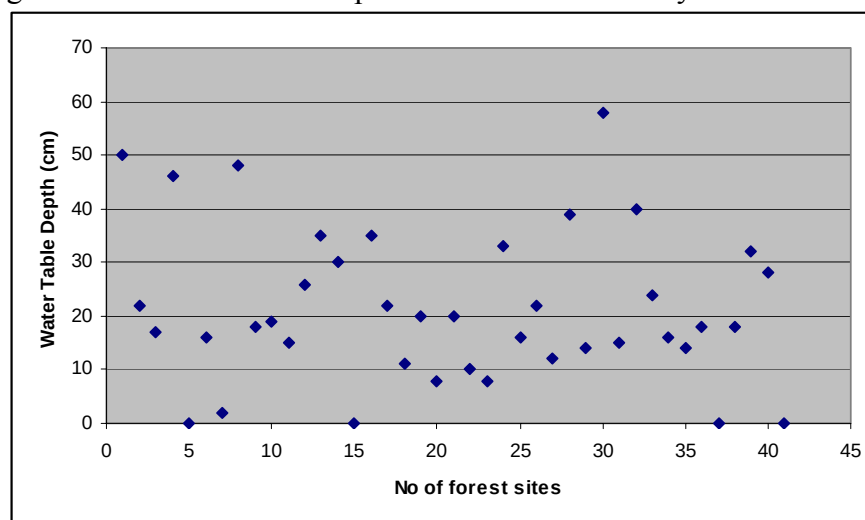


Figure 5.3.2b: Water table depths in the FORSEE study sites.



Remarks:

Figure 5.3.2a shows the mean water table depth for the different planting years in the FORSEE study sites. The water table depths range from 14cm to 35cm. A depth of 14cm would be considered very high for the water table and poor tree growth has been associated with high water tables (Adams et al, 1972). During forest establishment drainage

	channels are installed to a depth of 40cm to aid in lower the water table for successful tree establishment. From Figure 5.3.2b it can be seen that 59% of the study sites had a water table depth of 20cm or less. It was not feasible to undertake the nutritive status component of this indicator.		
Problems and Improvements			
The water table depths were measured 2 weeks after installation and the sampling period was from September to March, when rainfall levels would usually be at their highest. It would be recommended that samples be taking during spring and summer during the growing season.			
Remarks and Conclusions:			
This indicator shows that the water table depth is quite high is some of the study sites and could impact on tree productivity. The soils of the pilot zone are mainly peaty and high water tables would be associated with these soils. If adequate drainage was not carried out at establishment this will be reflected in this indicator. Forest drains should ideally remove surplus water to the depth of the drain, ideally to a depth of 50cm.			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i> .			

Criterion 6: Maintenance of other socio-economic functions and conditions

The concept of sustainable forest management considers not only the ecological and productive functions of the forest but also society values, quality of life and the best interests of both current and future generations. This criteria deal's with the ability of forestry to meet social goals. The strategic plan for forestry in Ireland "Growing for the future" (Anon, 1996) emphasises the importance of socio-economic and cultural functions of forests. This is further substantiated through government legislation such as the Local Government (Planning and development) Acts 1963-1996, the Planning and Development Bill 1999, the Safety, Health and Welfare at Work Act 1989 and the National Monuments Acts 1930-1994 which are to safeguard and protect public interests and societal values.

The value of socio-economic functions can be measured through the economic contribution of forestry to the national economy. The direct economic contribution of forestry to the Irish economy and the social contribution of forestry to the rural economy was recently evaluated (Ní Dhubháin et al., 2006). This study evaluated for the first time the total economic contribution of the forestry sector to the Irish economy. In 2003 direct output in the forestry sector was €255.4 million. Of this €134.5 million represented GVA (gross value added) which was 0.12% of GNP (gross national product). It was also calculated that for every one million euro in expenditure in the forestry sector a further €850,000 in expenditure is generated for the rest of the economy and for every 100 jobs in the forestry sector an extra 90 full-time equivalent jobs are provided in other sectors of the economy. With all these factors taken into account it was estimated that the value of forestry to the Irish economy in 2003 was €472.4 million. Direct employment in forestry was 3,780, with the total employment supported by the forestry sector estimated to be 7,182 (Ní Dhubháin et al., 2006).

Agriculture has traditionally been the mainstay of rural communities in Ireland, but due to various reforms in EU policy forestry has become an attractive alternative land use in recent years. The Economic and Social Research Institute (ESRI) found that forestry has positive impacts on rural communities and has over time found increasing acceptance as a rural based industry (Kearney and O'Connor, 1993). The growth of private/farm forestry

in Ireland is a recent development and forest policy aims to further promote the benefits of afforesting part of the farm. Support services for the private sector in the form of forestry co-operatives, timber growers association, forest farm partnerships and other organisations give the forest owner advice on how to best manage the forest enterprise. The social impacts of forestry in rural communities have been the focus of many studies (Collier et al, 2003; Gallagher, R., 1991; Kearney, B., 2001; Kearney and O'Connor, 1993). These studies focused on the factors influencing farmer participation in forestry, attitudes of farmers to forestry, co-operative farm forestry and farm forestry trends. Attitudes to forestry in the West of Ireland from a survey completed in 1992 found that the majority of farmer's, who had planted land planted marginal/bog type land and their main reason for planting was for shelter and financial reasons (Ní Dhubháin and Gardiner, 1994). In the same survey, 82% of the respondents who had not planted forestry said a lack of suitable land and a limited land resource were the two most popular reasons. However attitudes to forestry in Ireland have changed since 1992, where previously forestry was often seen as the last option for land use. In a survey of Mayo farmers in 1995 more than half of the farmers indicated a favourable attitude towards forestry in general. However the majority of the farmers in Mayo were not considering forestry on their own farms despite the incentives available. In a survey of farmers in Offaly in 1998 the opinions were similar where forestry was considered a good use of marginal land but should not be considered for good land.

Most of the perceived negative impacts of forestry presently are associated with the species planted (Ní Dhubháin et al., 2006). Forest cover in Ireland is dominated by conifers, mainly Sitka spruce (*Picea sitchensis*). The rapid expansion of the forest estate of mainly monocultures of evergreen conifers has a perceived negative impact on the landscape due to the lack of species diversity. However much of the land planted to date has been hill and marginal land where species diversity options are limited. Government policy (through the Forest Service) aims at increasing broadleaf planting to 30% of the annual national afforestation programme (Anon, 1996) and if achieved this will greatly enhance the landscape, however this will only be achieved when the attitude of planting only 'bad land' fades. A case study on the social impact of forestry in three areas in

Ireland where the species composition and forest cover were similar in all areas but the maturity of the forest cover and the historical rate of afforestation varied was conducted by Ní Dhubháin et al., 2006. In the area where forestry was the youngest (Newmarket, Co. Cork) and rates of afforestation had occurred the fastest, forestry was felt to have contributed very little to the area in terms of employment and amenity. In the area where there was a long history of forestry (Shillelagh, Co. Wicklow) the social impacts of forestry were more positive and the amenity and recreational benefits of the forests in the area were acknowledged. In the third case study (Arigna, Co. Roscommon) forestry was perceived positively in the local community mainly due to the availability and use of consultation mechanisms regarding forestry but concerns were expressed regarding the dominance of evergreen conifers in the area.

Recreation and amenity from forestry is very important in local communities. All public forests and forest parks have been open to the public since the 1970's. As set out in 'Growing for the Future' it is national policy to encourage the provision of public access to forests and the development of associated amenities, with due regard to owners rights. In the survey of forest owners of the FORSEE sites only 2 of the forests had public access for recreational use and both forests were used frequently by the public. The total number of visits to Irish forests has been estimated to be in the region of 8.5 million annually (Anon (b), 2000). Coillte Teo (the state owned commercial company that manages the public forest estate) maintains an open forest policy – keeping the forest estate open to all people at all times.

Indicator 6.01: Distribution of the number and area of forest holdings (not forest ownership), classified by type of management and size classes.

Costs:

Total Cost
€5765
Shared Cost
€4190
Marginal Cost
€1575
Total Cost/ha
€0.16

These cost
include:

Survey/ Editing
Site Description
Data Analysis
Data processing
Travel to the forest owners
Time travelling to the forest owners
Organise sampling plan
Computer

Results (FORSEE forest owner survey):

Figure 6.01a: Type of management

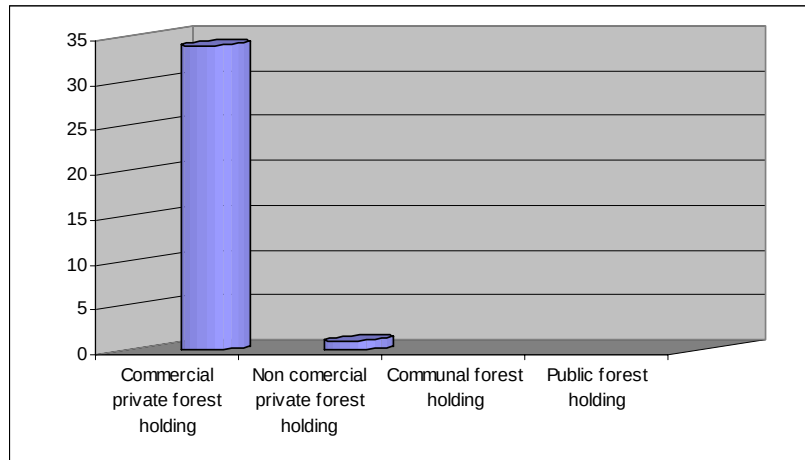


Figure 6.01b: Do you manage your woodland

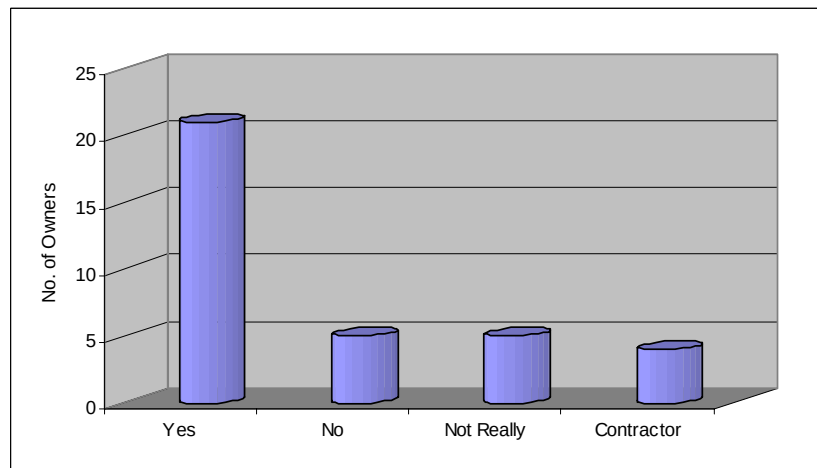


Figure 6.01c: Forest Area

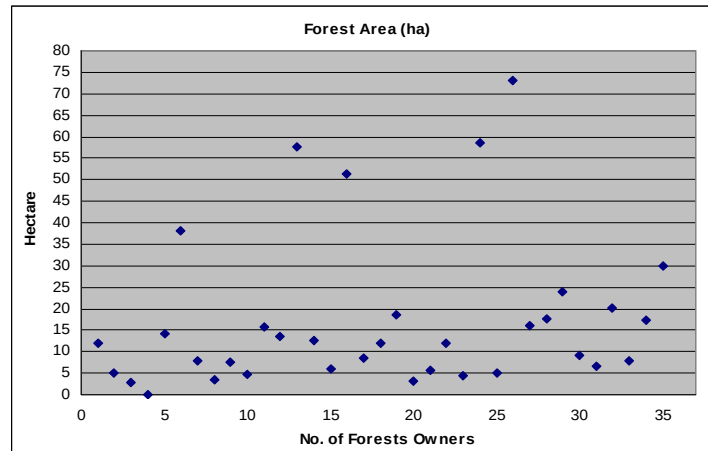


Figure 6.01d: Size Classes

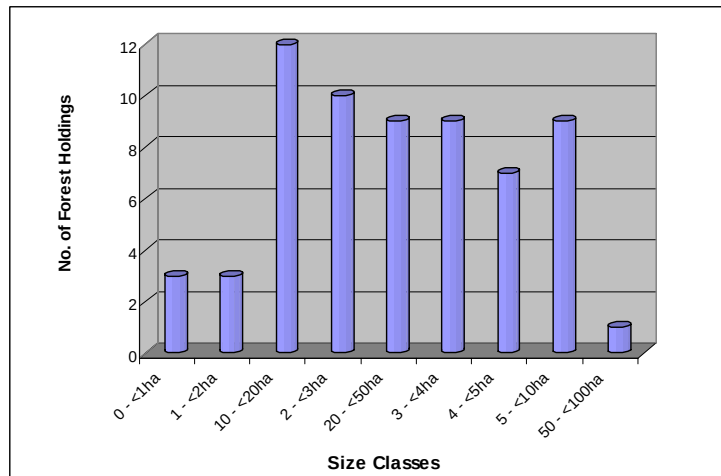
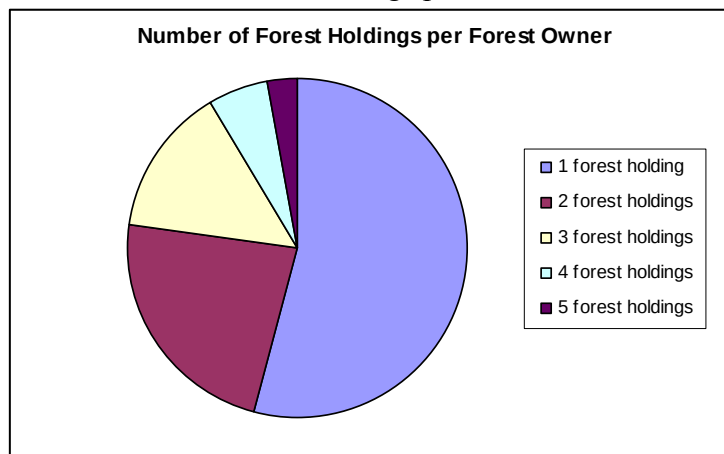


Figure 6.01e: Number of forest holdings per forest owner.



	Remarks: 99% of the forest holdings in the pilot zone were managed as commercial private forest holdings (figure 6.01a). This would be expected in privately owned forests. In figure 6.01b, 60% of the forest owners managed their woodland and 28% of the forest owners did not manage their forest. 12% of the forests were in a management contract with an independent forestry contractor. The total forest area owned per forest owner (figure 6.01c) ranges from 2.86 ha to 73 ha. As can be seen in figure 6.01c, most of the total forest area is less than 20 ha. The largest forest area (73 ha) is made up of three forest holdings and ranges within two different size classes (one in the 10-<20 ha class and two in the 20-<50 ha class). The majority of forest holdings were in the 10-<20 ha size class and the 2-<3 ha size class (figure 6.01d). The size classes don't seem to follow any particular trend as both the 20-<50 ha and the 3<4 ha size class have the same amount of forest holdings. The lowest amount of forest holdings per size class is the 50-<100 ha.
Problems and Improvements	
The forest owners were often confused by the forest holding classifications and were unsure as to which category they should select. Private woodland owners would be reluctant to classify their forest as a non-commercial private forest holding even if they managed it or not and the only forest holding that fell into this class was a woodland where parts of the wood were managed both commercially and non commercially, how to make this distinction was unclear.	
Remarks and Conclusions:	
A comparison of results within another geographic area nationally or an increase in the sample size would be possible future areas to research.	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB <i>Atlantic Area</i>.	

Indicator 6.03: Net revenue of the forest enterprise

Costs:

Total Cost
€5765
Shared Cost
€3928
Marginal Cost
€1837
Total Cost/ha
€0.16

These cost
include:

Survey/Editing
Site Description
Data Analysis
Data processing
Travel to the forest owners
Time travelling to the forest owners
Organise sampling plan
Computer

Results (FORSEE forest owner survey):

Figure 6.3a: Forest Income (for 2005)

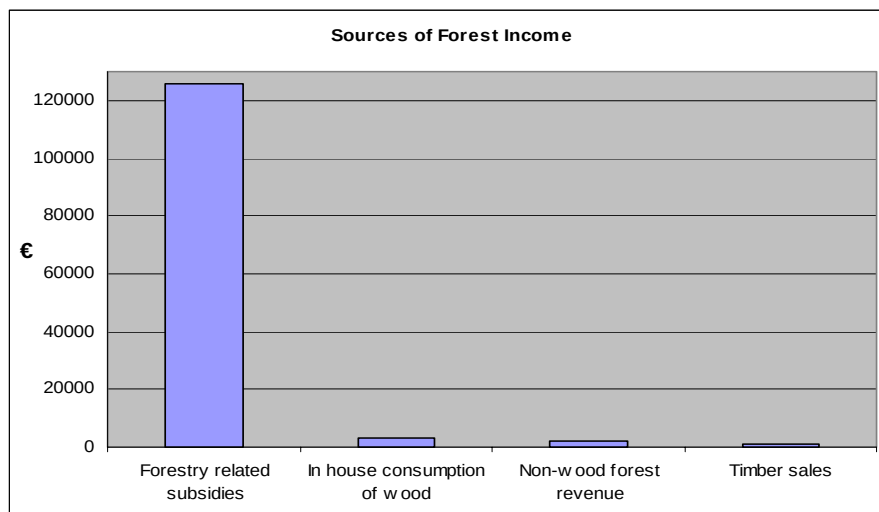


Figure 6.3b: Forest Expenditure (for 2005)

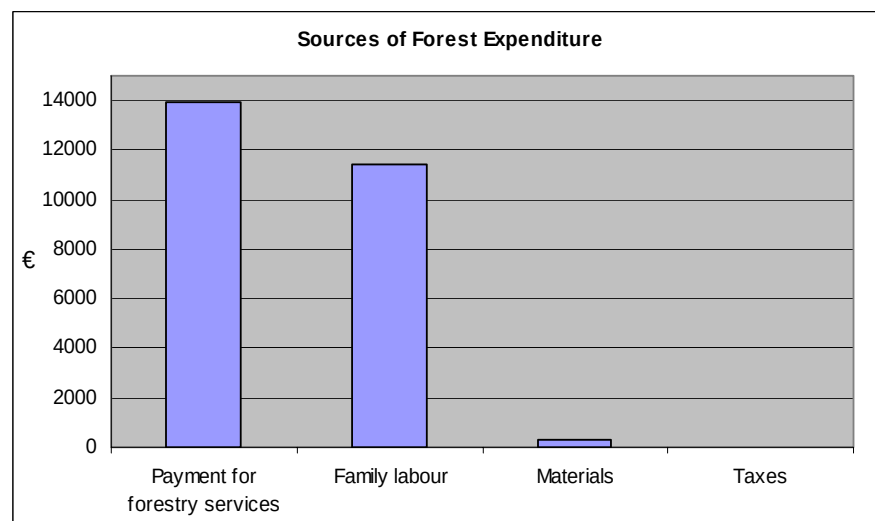
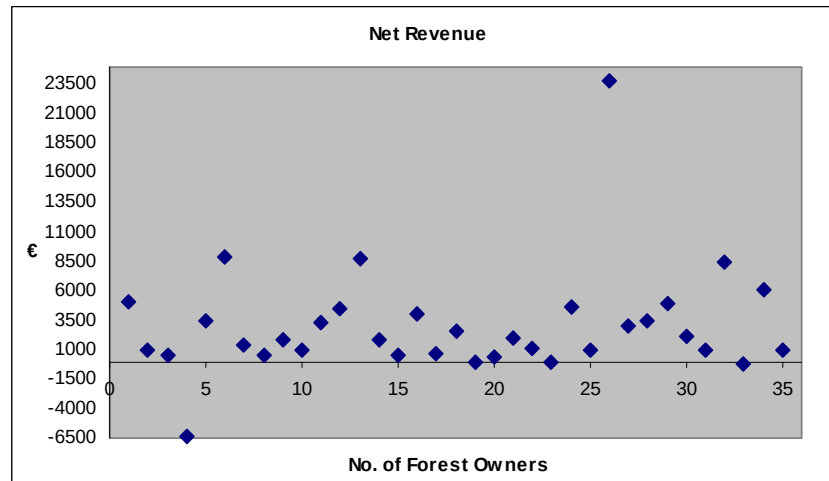


Figure 6.3c: Net Revenue (for 2005)



Remarks:

As all but one of the forests is less than 15 years and therefore no harvesting has yet taken place, the main source of forest income is from forestry related subsidies (figure 6.3a). The total forest income generated from forestry related subsidies for the 35 forest owners during 2005 was €125,811. The minimum forestry related subsidy a forest owner received was €326 and the maximum €23,500. These subsidies are directly related to the size of the forest area. The mean annual subsidy was €3595. The only non-wood income was generated from an annual woodcock shoot, in mature woodland over a 2 day period. A small number (17%) of forest owners cut timber for in house consumption. The only income generated from timber sales was from timber harvested for firewood and sold to neighbours. This amounted to very little income generation. The age of the forests range from 2 to 18 years with the exception of a mature old estate woodland (age unknown) and none of the forests had yet been thinned so the potential income generation from non-wood products and timber sales is presently very low. Forest subsidies and any income from timber sales are exempt from taxes in Ireland.

The main source of forest expenditure was payment for forestry services (figure 6.3b). These forestry services included consultancy, contractor labour and fire insurance. The highest single cost was for forest labour on the old estate woodland where a forest worker was employed part-time (6 months per annum) to carry out maintenance work on the woodland such as cutting the paths for the woodcock shoot. Fire insurance was the most frequent payment in forest expenditure. Family labour is a cost that is often unaccounted for in forest expenditure but as

	seen in figure 6.3b it was the second largest expenditure. Mean expenditure for family labour was €814/forest owner. Expenditure for materials was very low (€340 - 2 forest owners) which could indicate that either the forests are in good condition or that maintenance work is not been carried out. Expenditure for materials was in both cases for fencing materials. It should be noted that a condition of the afforestation subsidy ensures that the condition of a plantation is of a very high standard when handed over by the contactor to the farmer at 4-5 years. This usually results in little subsequent maintenance being required until 1st thinning is completed. The net revenue of the forest enterprise was in general profitable which was due to the both the afforestation grant and forest subsidies. However two forest owners made a loss due to family labour costs. The mean net revenue of the forest enterprise was €3034. The maximum individual net revenue was €23,900 and 98% of this was from forest subsidies.
Problems and Improvements	
The results show the net revenue for the year (2005) may not be reflective of the sustainability of this indicator. A possible improvement could be to assess the net revenue on a 5 year basis or on the term of the forest management plan which would give a more accurate assessment of the income, expenditure and the net revenue of the forest enterprise.	
Remarks and Conclusions:	
The results would indicate that forest owners were receiving substantial forest subsidies for their forests but that the income level (possibly because of the age of the forest) does not reflect the expenditure level.	
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.	

Indicator 6.04: Expenditure for services

Costs:

Total Cost
€5765
Shared Cost
€3534
Marginal Cost
€2231
Total Cost/ha
€0.16

These cost
include:

Survey/Editing
Site Description
Data Analysis
Data processing
Travel to the forest owners
Time travelling to the forest owners
Organise sampling plan
Computer

Results (FORSEE forest owner survey):

Figure 6.4a: Total area for sustainable services.

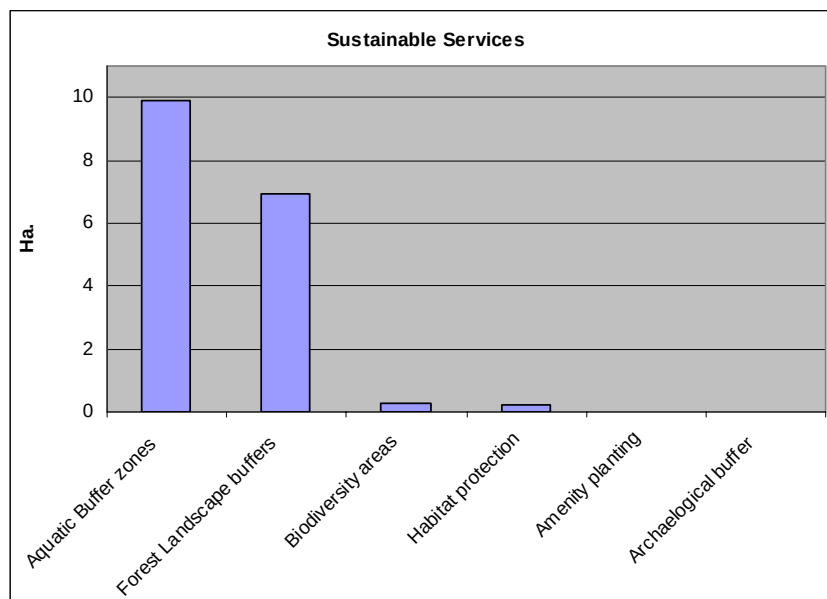
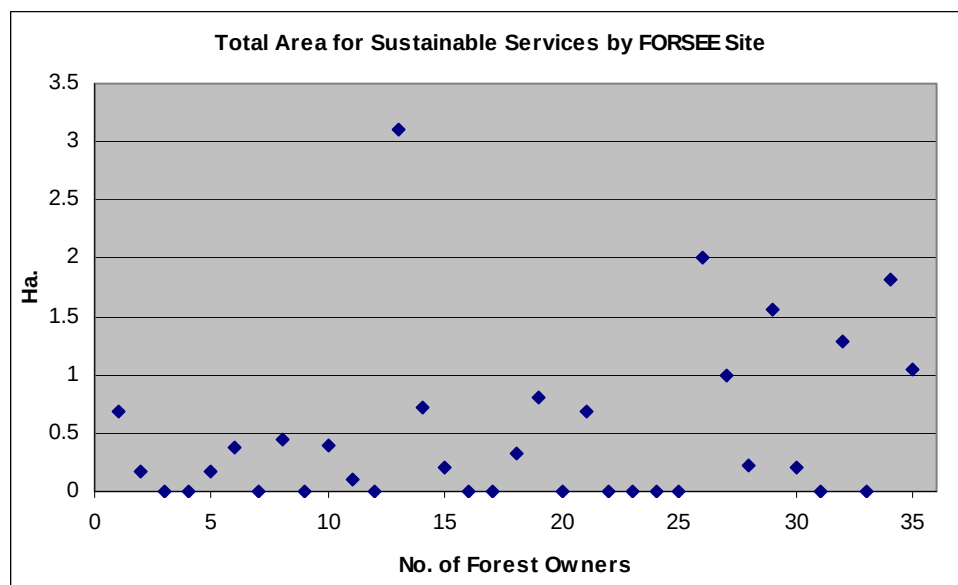


Figure 6.4b: Individual forest areas for sustainable services.



	Remarks: The total area excluded for sustainable services was 17.31 ha or 2.7% of the total forest area. Figure 6.4a shows that aquatic buffer zones accounted for 9.88 ha or 1.5% of the total forest area of the forest owners. This buffer zone is a 10 metre strip left unplanted alongside the stream and is the minimum width allowable in the Forest Service Forestry and Water Quality Guidelines (Anon (d), 2000). Depending on slope and soil type this buffer width can extend to 30 metres. Forest landscape buffers accounted for 6.93 ha or 1.1%. These landscape buffers are a 10 metre strip left unplanted along public roads as per national policy in the Forest Service Forestry and Landscape Guidelines (Anon (e), 2000). The average area left unplanted for sustainable services were 0.49 ha or 3% of the forest area. Currently in Ireland the minimum area to be left unplanted for biodiversity is 15%. There was no amenity planting sites from the forest owners surveyed and no archaeological sites. The largest single area (figure 6.4b) for sustainable services was 3.1 ha which comprised both aquatic and forest landscape buffers.
Problems and Improvements	
This indicator is best assessed from forest records and not from a forest owner survey as the forest owners were mostly not aware of what sustainable services were and they found it difficult to estimate the area.	
Remarks and Conclusions:	
This indicator is best assessed from planting records (ordnance survey maps) and a ground survey if the records are unclear.	
Project co-financed by European Union. A community initiative ERDF- INTERREG the IIIB Atlantic Area.	

Indicator 6.05: Forest sector workforce

Costs:

Total Cost
€5765
Shared Cost
€3534
Marginal Cost
€2231
Total Cost/ha
€0.16

These cost
include:

Survey/Editing
Site Description
Data Analysis
Data processing
Travel to the forest owners
Time travelling to the forest owners
Organise sampling plan
Computer

Results (FORSEE forest owner survey):

Figure 6.5a: Classified by job characteristic:

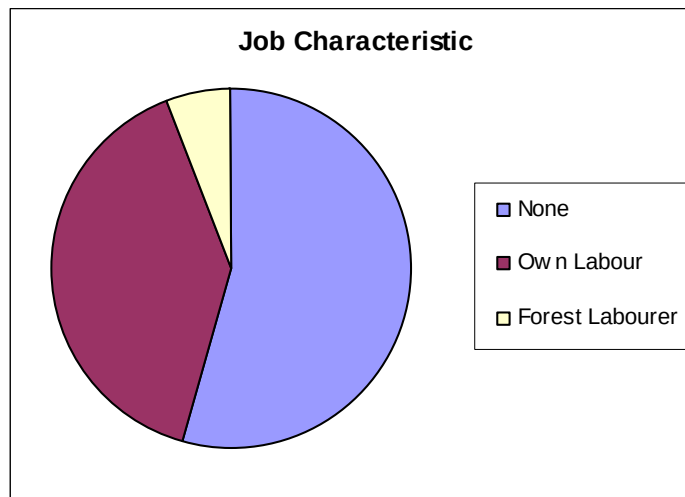


Figure 6.5b: Classified by labour input:

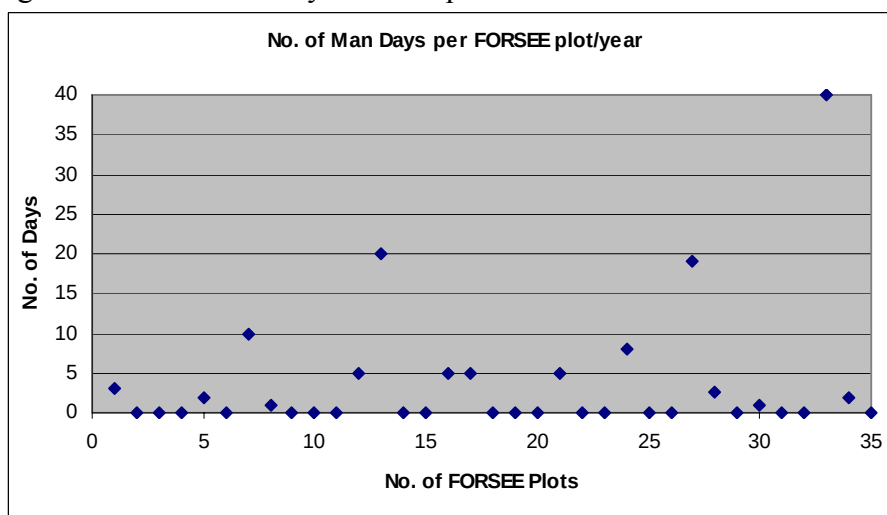


Figure 6.5c: Classified by gender:

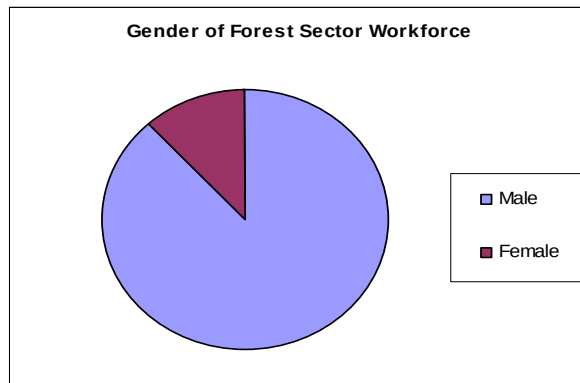


Figure 6.5d: Classified by age:

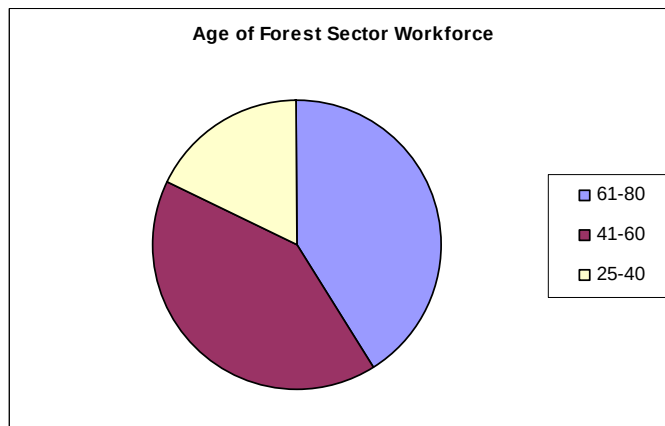


Figure 6.5e: Age of the Forest Sector Workforce

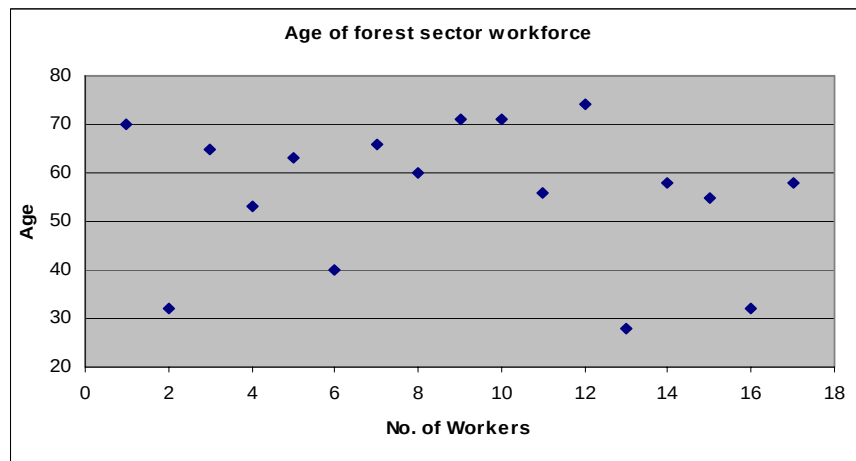
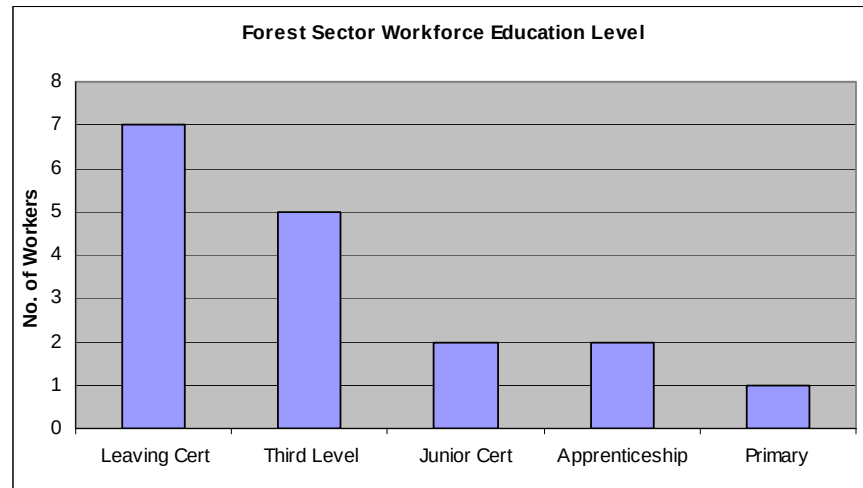


Figure 6.5f: Forest sector workforce classified by education:



Remarks:

Results from the forest owner survey show that >50% of the sites had no labour input (figure 6.5a). The majority of the labour input was by the forest owners own labour and on 3 of the forest sites work was by a forest labourer. Two of these 3 forest sites are in a management contract with a forestry contractor company and therefore the forest labourer was employed as part of the management contract and not by the forest owner. The breakdown of labour input (figure 6.5b) shows that 20 of the 35 forest owners had no labour input in their forests and that 10 forest owners had 5 or less man days in the forest.

The forest sector workforce from the forest owner survey was 88% male and 12% female (figure 6.5c). The female workers were also the forest owners.

Results from the forest owner survey on the age of the forest sector workforce on work completed in the FORSEE forest owners sites show that 76% of the workers (forest owners and forest workers) were greater than 50 years (figure 6.5e). 35% were greater than the retirement age (65) and 24% were over 70 years. The age classes 41-60 and 61-80 both accounted for 41% of the forest workforce respectively (figure 6.5d). These results would indicate that the workforce is quite old but it should be considered that results from the survey showed that in all instances where the forest workforce was greater than 50 years it was because the work was carried out by the forest owner. Accordingly the age of the forest workers reflects broadly the age profile of landowners in the area.

The educational level (figure 6.5f) of the forest workforce showed that 76% had completed secondary level education and of the 76%, 29% had completed third level education.

Problems and Improvements			
The job characteristic, age, gender and education level is reflective only of work carried out on the FORSEE forest owners sites and therefore only reflects the forest sector workforce on a local scale. This would not be an accurate representation of the forest sector workforce in the pilot zone. National data on forest sector workforce statistics does not exist as forestry is grouped with agriculture for CSO (Central Statistics Office) statistics and results separated for forestry are unavailable.			
Remarks and Conclusions:			
While > 50% of the sites had no labour input this does not necessarily mean that these sites showed a poor standard of maintenance. As previously outlined (indicator 6.3), little maintenance is required between the end of the establishment contract (years 4-5) and 1st thinning, which has yet to be carried out on all forests in the survey with the exception of one forest.			
Project co-financed by European Union. A community initiative ERDF-INTERREG the IIIB <i>Atlantic Area</i>.			

3. Conclusion

This study highlighted two main weaknesses in the development of carbon stock and stock change estimates in Ireland, which are related to the lack of soils data and a repeated NFI. Additionally, a lack of tree increment data not only limits carbon stock estimates but also the calculation of net annual increment. In the absence of this data it was not possible to evaluate indicator 3.1 increment and fellings, to estimate the balance between net annual increment and annual fellings of wood on forest available for wood supply. However, significant advancements have been made in developing more robust estimates based on national data since the inception of the FORSEE project and the pilot zone carbon stock estimates developed during this project are testament to that.

Approximately one third of the pilot zone has been established since 1990 which is 3% higher than the national average and is therefore eligible for offsetting against national greenhouse gas emissions under the Kyoto Protocol. The forest area of the pilot zone is 15% of the total land area and is well above the national average of 10%. Plantation forests accounted for 94% of the forest area. A comparison between the NFI forest definition and the FAO forest definition in both the pilot zone and the region revealed less than 0.5% difference in the calculated forest area.

The large range in carbon stocks in the pilot zone was attributed to the high frequency of organic soils, which in some cases accounted for more than 98% of the total C stock reported for a plot. The carbon stock in the woody biomass varied significantly, largely due to the young age structure of the forest in the pilot zone with vegetation representative of previous land use (i.e. blanket peatlands or grasslands) still dominating young stands. A comparison between calculating C stocks using biomass functions or stand volume and biomass expansion factors (BEF) found that applying the later approach lead to a significantly lower woody biomass carbon stock estimate for the region. This is due largely to applying volume equations and BEF to small trees. There was an absence of deadwood in post 1990 stands. This carbon pool increases with stand age and forest management practices such as thinning and therefore is likely to be more prominent in the future.

This study highlighted the weakness of having to apply a volume model for *Picea sitchensis* to all the species in the region. This was due to the lack of national models for any of the other species planted in the pilot zone. In an attempt to estimate the potential impact such an assumption would have, species specific volume equations were taken from literature. This indicated a 6% variation between using the national *Picea sitchensis* equation for all species and using non-national species specific equations. Therefore it can be concluded that the development of nationally specific volume equations for all species would improve confidence in the volume estimates.

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