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Economic activity and employment levels in the Irish forest sector

Forestry Services Ltd
Henry Phillips

COFORD Socio-Economic Contribution of Irish Forests Working Group

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Foreword

The forest industry makes a significant contribution to the Irish economy, from establishing and managing the resource to the harvesting and processing of forest products. These activities provide employment across rural Ireland, as well as income to forest owners. At the same time, forests provide a range of other services including biodiversity, water quality, recreation and climate change mitigation.

In order to better quantify the direct socio-economic contribution of the forest sector, a COFORD working group was established in 2019. Its overall objective was to scope out and evaluate models that would quantify the economic contribution of the forest sector in Ireland, including employment levels. This report is an important outcome of the group's activities.

The work presented is the first formal updating of employment and economic activity in the sector since 2010. Direct employment, across the forestry & logging and manufacture of wood & wood products sectors, has been estimated as some 5,600 full-time equivalents. This is less than the previous estimate of 7,000 persons and is likely attributable to greater mechanisation across all forest operations, allied to improved logistics. The decline in afforestation rates over the past decade will also have had an impact, though somewhat balanced by an expanded level of reforestation planting, as crops come to maturity are felled and regenerated.

There is good reason to believe employment levels in the sector will grow over the coming decade and beyond, particularly in skilled areas such as mechanised forest harvesting. In particular, the most recent COFORD roundwood forecast foresees an increase in production from 4.7 million cubic metres in 2021 to 7.9 million by 2035. Also, all policies and reports (including recent COFORD publications) point to the urgent need to expand afforestation to at least 8,000 ha per annum to tackle climate change. If these come to fruition they will have a significant and lasting impact on employment, not just in planting but in management, harvesting and wood processing down the line.

On behalf of the Council, I would like to thank the report's authors for this timely and important report, and the members of the Socio-Economic Working Group for commissioning and facilitating its production.

Eugene Hendrick
Chairman
COFORD

Chairperson's Introduction

The forest sector can be defined as encompassing the following broad economic activities:

- forestry[1]: (the establishment, management and harvesting of forests);
- wood processing: including sawmilling, particle board manufacture, woodfuel production and
- other services including hunting, foliage collection etc.

There have been a number of assessments of the wider economic impact of the forest sector in Ireland (e.g. Gray, 1963; Clinch, 1999); the most recent being the assessment generated in the FORECON study (Ní Dhubháin et al., 2010). FORECON (as did its predecessor, ECONTRIB, (Ní Dhubháin et al., 2006)) employed input-output analysis and provided estimates of the direct, indirect and induced impacts (both employment and output) of the forest sector in Ireland using employment and output multipliers.

Input-output tables published by the Central Statistics Office (CSO) were used to generate these multipliers[2]. The estimates from 2010 (Table i) indicated there were 3,125 full-time equivalents (FTEs) directly employed in forestry & logging; a further 2,406 FTEs were employed due to indirect and induced impacts. A total of 3,907 FTEs were directly employed in the manufacture of wood products. Indirect and induced employment in this sector represented an additional 2,501 FTEs.

The CSO is currently engaged in statistical work related to forestry (see Appendix 5) and the aim is to produce a set of national accounts covering the forestry sector[3]. However, in the meantime given it has been 12 years since the last estimates of employment and economic impact were generated, it was timely to re-estimate employment and economic activity in the forest sector (as defined).

All economic activities across the European Union are classified by EUROSTAT and national accounts using a system called NACE. Those engaged in forestry and logging activities are classified under NACE 02[4]; wood processing activity is captured under NACE 16[5]. Employment and other economic data for NACE 16 are published in several statistical releases by the CSO; in contrast, employment data for NACE 02 are often grouped with that for agriculture (NACE 1) and fishing (NACE 3). This is the case for the Labour Force Survey conducted quarterly by the CSO; it is only in the Population Census (conducted at 5-year intervals) that employment data for forestry & logging are published. Thus estimates of employment and economic activity associated with this sector are not readily available. The challenge in arriving at reliable estimates is compounded by the fact that so much of the work undertaken in forestry is carried out by contractors. With respect to national statistics, the activity (employment and output) associated with contractors is allocated to the NACE code that the contractor is associated with for revenue purposes. Therefore some fencing contractors may appear in the agricultural statistics (and not forestry); similarly those engaged in timber haulage are classified under the NACE Code associated with Freight Transport by Road (NACE 49) and not forestry, even though the majority of them operate more or less full time in the forestry sector.

Within the scope of the COFORD Socio-Economic Contribution of Irish Forests working group, it was decided to focus on the one element for which official CSO data are weakest, i.e. employment in forestry & logging. To this end the COFORD Council proposed that a study be undertaken to address this gap and subsequently DAFM initiated a Request to Tender for such a study in December 2020. A subset of the COFORD Socio-Economic Contribution of Irish Forests Working Group formed the Steering Group for the study.

This report presents the results of this study. The study took a bottom-up approach, in that a detailed survey of companies involved in the forestry sector was undertaken to generate coefficients that would link employment to activity. In doing so a spreadsheet model was developed that can be used to show how employment and economic activity will fluctuate as afforestation and harvesting rates change. The estimate of direct employment generated in this study is shown in Table i along with an estimate of the associated economic activity. Figures

[1] Defined as forestry and logging by EUROSTAT.
[2] Input-output tables are published at 5-year intervals by the National Accounts section of the CSO, the I-O table for 2015 was published in 2018.
[3] https://ec.europa.eu/eurostat/cache/metadata/en/for_eaf_esms.htm#contact1633418404808
[4] Forestry and logging includes silviculture and other forestry activities; logging; gathering of wild growing non-wood products as well as support services to forestry (EUROSTAT, 2008)
[5] NACE 16 relates to the manufacture of wood and of products of wood and cork, except furniture; as well as the manufacture of articles of straw and plaiting materials (EUROSTAT, 2008)

shown for 2020 are derived from a number of sources (as shown in Table i) using different methodologies to those used in 2010 and this should be taken into account when making comparisons. Other aspects to consider include:

- The multipliers for forestry & logging are those that were used in the 2010 study as more up-to-date multipliers for this sector have not been generated[6].
- The estimated 23, 491 landowners who have established forests on their land since 1980, the majority of whom are farmers (DAFM, 2021), are not accounted for in the employment figures shown in Table i.
- The value of the non-market functions of the forests e.g. carbon sequestration, recreation etc are not accounted for in the figures shown in Table i.

A comparison of the 2010 figures with those from 2020 show that direct employment in both forestry and wood processing have fallen. There are a number of reasons for this:

- Forest age-class structure: employment potential tends to be high at the establishment phase; falls during the post establishment phase and rises again at the harvesting phase. Following harvesting, reforestation is associated with an increase in employment and the cycle continues. Thus changes in afforestation rates will influence employment levels as will changes in the volumes being harvested. Afforestation rates have fallen substantially in the period since 2010.
- Degree of innovation in the sectors, mainly mechanisation of operations and improved logistics in the supply chain.

Table i: Estimates of employment and economic activity

Measure	Sector	2010		2020	
Employment (FTEs)*		Direct	Total (Direct +indirect +induced)	Direct	Total (Direct +indirect +induced)
	Forestry & logging	3,125[a]	5,531[a]	1,978[b]	3,501[e]
	Manufacture of wood & wood products	3,907[a]	6,408[a]	3,611[c]	5,922[e]
Output (€ million)					
	Forestry & logging	379.8[a]	673.0[a]	180.0[d]	320.4[e]
	Manufacture of wood & wood products	1,330.9[a]	2,200.0[a]	1,029.0[d]	1,775.0[f]

[a] Source: FORECON (Ní Dhubháin et al., 2010)
[b] Source: COFORD study (2021-this report)
*[c] Source: CSO (2016). Note this figure does not represent FTEs - instead it represents the numbers employed in the sector.
[d] Source: CSO (2020).
[e] Source: Generated by applying employment multipliers from FORECON (Ní Dhubháin et al., 2010) to direct employment values
[f] Source: Generated by applying output multiplier from CSO (2018) to direct output value.
Note: The COFORD study (this report) estimated the economic activity associated with forestry and logging to be €148 million in 2021 (note this does not include VAT or profit)

[6] Forestry is grouped with agriculture and fishing in the Input-Output tables which makes it difficult to generate multipliers for forestry

Prof. Áine Ní Dhubháin, Chair of COFORD Socio-Economic Contribution of Irish Forests Working Group.

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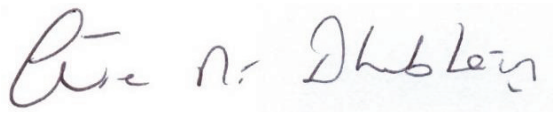

Chairperson COFORD Socio-Economic Working Group

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Executive Summary

There have been many estimates of the direct employment in the forestry sector over the past two to three decades including the strategic plan for the development of forestry (DAFF, 1996), Bacon (2004), ECONTRIB (Ní Dhubháin et al., 2006) and FORECON (Ní Dhubháin et al., 2010). Much of the supporting analysis was dependant on assumptions regarding labour inputs for afforestation, reforestation and harvesting. Thus it is timely to revisit the relationship between labour and cost inputs, the area planted and the volume of timber harvested to reflect current levels of productivity, modern work practices and to determine the direct employment generated by the levels of activity in nurseries, planting, harvesting, forest maintenance and road construction in the forestry sector.

The study had four tasks: (1) Determine the extent (e.g. full-time equivalents) and nature (e.g. direct or contract) of employment generated for a range of forestry activities, (2) Determine the labour and material inputs (costs) associated these activities, (3) Develop coefficients showing the labour and material inputs associated with each forest activity and (4) Using the coefficients and national information available on the extent of forest operations produce estimates of the national employment and economic activity generated by the forestry sector.

The overall approach adopted was to source the required information through a combination of questionnaires/surveys, structured interviews and to validate the data where possible by comparing with known values. Following agreement with the COFORD Socio-Economic Contribution of Irish Forests Working group Committee on the activities to be studied and the data to be collected, a detailed survey questionnaire was trialled and then circulated to a number of forest companies and forestry contactors. These companies account for approximately 60% of harvesting, circa 70% of reforestation and road upgrading, 25% of afforestation and plant production of 17 million. Data were collected for each activity under the headings of labour, machine, materials and administration / technical support. A second less detailed questionnaire focussing on overheads was circulated to a number of other forest companies to validate the data from the main survey and to explore in more detail the overhead element of costs.

Following data analysis, a series of coefficients were generated for each activity encompassing FTE/unit, % contract/direct and costs/unit including materials and machine costs. National level data for the main activities i.e. afforestation, reforestation, harvesting, road construction and upgrading and forest maintenance were provided by DAFM.

An overall forest sector model was developed in MS Excel which allows the user to specify a year from 2016 to 2020 and the FTEs and economic contribution are calculated (the relevant levels of activity are included in a lookup table). Based on 2020 levels of activity (afforestation 2,434 ha, reforestation 13,076 ha, harvesting 3.91 million m^3 based on forecast volume, new road construction 168 km and road upgrade of 209 km), the overall FTE is estimated as being 1,978 (Table 9). By far the most significant activities in terms of employment are harvesting (514 FTE) and reforestation (500 FTE) together accounting for 75.6% of the estimated employment. The total economic contribution is estimated as being €147.10 million. Caution is advised if users wish to enter years outside of the period 2018 – 2022. Harvesting includes road haulage of roundwood even though the majority of hauliers are classified under Freight Transport by Road.

The direct employment is significantly less than previous estimates e.g. Bacon (2004), ECONOTRIB (2006), FORECON (2011), even allowing for differences in the levels of the main activities. Previous estimates used coefficients based on forest practices and technology from circa 2003. The lower estimate of direct FTE in this study can be attributed to a combination of (a) significant increase in the use of contract labour, (b) improvements in harvesting technology with greater output per machine in felling and extraction, (c) improvements in timber haulage and (d) increasing percentage overall volume from clearfells.

If the afforestation programme was to increase to 8,000 ha in line with current Government targets then the FTE employed increases to 2,415 and the economic contribution to €168.36 million (Table 10). Caution is advised on merely increasing the future levels of activity and thereby assuming that the contractor infrastructure will expand to meet any increased levels of planting and harvesting. When asked during data collection, 100% of respondents were of the view that (a) labour will be a limiting factor to the expansion of activities and (b) the sector needs to improve the terms and conditions of labour staff and professional foresters if they are to continue working in the sector.

Background

The COFORD Socio-Economic Contribution of Irish Forests Working Group was established to formulate the socioeconomic contribution of the Irish forestry sector, inter alia, to scope out and evaluate models that could be used to update figures on the contribution of the forestry sector to the national economy, including the bioeconomy. One of the challenges to assessing the contribution of the forestry sector to the national economy is the high proportion of work that is undertaken by contractors and sub-contractors. Across all areas of activity in forestry, from establishment to harvesting to haulage, the work involved is often contracted to companies who in turn sub-contract this work. Arising from the prevalence of work contracting in the forestry sector, official employment statistics for forestry in Ireland may only capture a proportion of the employment and economic activity.

Study Overview

The objective of this study is to estimate the employment and economic activity generated by the forestry sector. This study should provide coefficients that, when coupled with high-level information that is available on forest activities (e.g. level of afforestation), can be used to estimate employment and economic activity on an ongoing basis.

Tasks

1. Determine the extent (e.g. full-time equivalents) and nature (e.g. direct or contract) of employment generated for a range of forestry activities that occur in forest types that are representative of Ireland's forest estate. This work should also determine how those undertaking these various forestry activities are classified in the official statistics using NACE codes which is the common basis for statistical classifications of economic activities within Ireland (e.g. is a fencing contractor captured within agriculture or forestry sector?).
2. Determine the labour and material inputs (costs) associated with a range of forestry activities that occur in forest types that are representative of Ireland's forest estate.
3. Using the information generated in tasks 1 and 2, generate coefficients showing the labour and material inputs associated with each unit of the different forestry activities that occur in forest types that are representative of Ireland's forest estate.
4. Using the coefficients developed at task 3 above and national information available on the extent of forest operations produce national employment and economic activity generated by the forestry sector.
5. Produce a written report documenting the methodology used to complete the above tasks.

Approach and Methodology

The overall approach adopted was to source the required information through a combination of questionnaires/surveys, structured interviews and to validate the data where possible by comparing with known values. To ensure a geographic spread in the collection of data, forest companies with a wide catchment were used.

At the outset, it is important to note that there are a limited number of forest companies operating in the sector and the type of information required to determine the economic impact of forestry can be viewed as being commercially sensitive. Similarly, there are a limited number of harvesting, planting and forest establishment contractors many of whom are small operators employing labour on a piece-rate basis and who may not be familiar with the type of information required. Our list of contractors included 30 operating in the fencing, groundworks, planting and maintenance areas, 34 operating in timber haulage and 22 operating in harvesting (Figure 1).

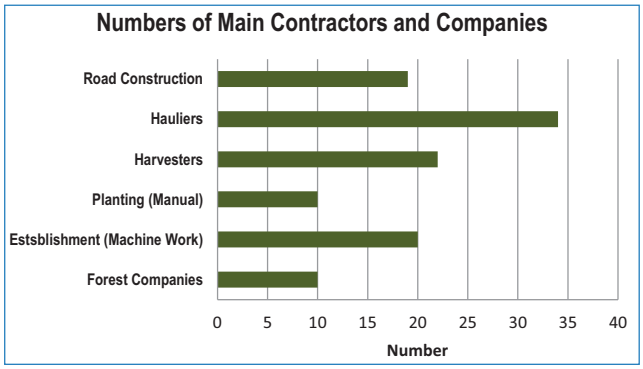

Figure 1 - Forest Sector Companies/Contractors

Task 1: Determine the extent and nature of employment generated for a range of forestry activities that occur in forest types that are representative of Ireland's forest estate.

The starting point to determine the extent and nature of employment for the range of forest types that are representative of Ireland's forests was the series of five tables listed in the Request for Tender (RFT) (Appendix 1) document covering:

1. Afforestation (conifer and broadleaf)
2. Reforestation (conifer and broadleaf)
3. New Road Construction
4. Road Upgrading
5. Harvesting (conifer and broadleaf)

Following discussion with the Steering Group, the level of detail was expanded upon to include percentage labour by direct and contract working. Broadleaves were further broken down into soft (e.g. alder & birch) and hard broadleaf species (e.g. oak and beech). Further activities were initially added for consideration which included:

1. Nurseries
2. Recreation (construction of nature trails, bikeways and marked walkways)
3. Maintenance (drainage and fence repairs, inspection paths, fire lines, road repairs)
4. Agroforestry
5. Reconstitution of Woodland

Survey 1

The template for the collection of data was finalised following initial testing within Forestry Services Ltd (FSL) and an example is shown in Figure 2.

Operation	Sub-operation	% of Sites Sub-op Occurs	Labour Type		Labour Input (Hours/ha)		Labour Cost (€/ha)		Direct Purchases Associated with Operation (€/ha)		
			%-Direct	% Contract	Range (Min - Max)	Mean	Range (Min - Max)	Mean	Description	Range (Min - Max)	Mean
Cultivation and drainage	Mounding										
(per ha)	Ripping										
	Pit Planting										
	Scarification										
	Scrub Clearance										
	Firelines										
Fencing	Cattle										
(per ha)	Cattle/Sheep										
	Cattle/Rabbit										
	Rabbit/Hare										
	Deer										
Planting	Plants										
(per 1,000)	Planting										
	Stakes & Shelters										
Fertilising	NPK										
(per ha)	Rock phosphate										
Maintenance (Year 1 to 4)	Filling In										
(per ha)	Weeding / Cleaning										
	Fencing										
	Drainage										
	Firebreak										
	Trespass Removal										
Admin and Tech Support	Grant Application										
(per ha)	Supervision										
	Third party professionals										
	Overheads										

Figure 2 - Data Collection Template Afforestation / Reforestation

The % Sites heading was used to determine on what percentage of sites, the relevant sub-operation occurred. Thus, for example, scrub clearance only occurs on a relatively small percentage of sites but is still a cost. Similarly, not all sites receive fertiliser application.

Following this initial testing and an analysis of recent afforestation by Grant Premium Category (GPC), it was decided to drop the Agroforestry template due to the low uptake.

The final list of activities comprised:

a) Afforestation (conifers, hard and soft broadleaves).
b) Reforestation (conifers, hard and soft broadleaves).
c) Harvesting[7] Conifers (first, second and third thinning, clearfell, windblow, chipping, residues).
d) Harvesting Broadleaves (tending/respacing, first, second third and subsequent thinning, clearfell, CCF).
e) Road Construction (peat and mineral, special construction works e.g. bridge / main culvert).
f) Road Upgrading (peat and mineral).
g) Nurseries.
h) Forest Recreation (marked walkways, cycleways, nature trails).

Under each activity data were collected under the following headings:

a) Labour - type, hours, cost and range of inputs.
b) Machine - hours, costs.
c) Materials – description, costs.
d) Administration and overhead – licencing, supervision, third party professionals, overheads.

Once the list of operations and sub-operations was finalised we proceeded to determine how these various activities are classified in the official statistics using NACE (Nomenclature of Economic Activities). Apart from transport, fencing and recreation, the list of operations and sub-operations are classified as coming under Code 210 Silviculture and Other Forestry Activities. Fencing falls outside forestry if the contractor is classified under agriculture while recreation (construction activities) does not appear to come under Code 210. The majority of fencing contractors are small operators and are not classified and it is only the larger ones that operate at regional or national level e.g. Farm Relief Services that would fall under agriculture. These larger contactors are rarely engaged by the forest companies. The majority of hauliers identified (28 out of 32) are classified under NACE Code 49.41 Freight Transport by Road even though the majority of them operate more or less full time in the forestry sector. Only a minority of hauliers (2 out of 32) are classified under forestry. The overall amount of road freight activity in 2019 was 12.4 billion tonne-kilometres and haulage of circa 3.5 million tonnes of roundwood would account for a small proportion of this.

A list of forest companies and contractors was drawn up to be sent the series of templates. It became obvious at this stage following phone conversations with the smaller contractors that they would be unable to complete the detail in the template(s) relative to them. Notwithstanding this, they did provide feedback and some data which was used to validate and supplement the returns from the forest companies.

Coillte, Western Forestry Co-op, Euroforest and FSL agreed to complete the series of templates while None So Hardy (nursery) agreed to complete the template on nurseries. This spread of companies covers approximately 60% of harvesting, circa 70% of reforestation and road upgrading, 25% of afforestation and plant production of 17 million which is circa 44% of national requirements assuming current levels of activity. Although only 25% of afforestation is covered, along with reforestation they are the two areas of activity where the input costs are well known.

[7] Harvesting includes haulage to the millgate.

Task 2: Determine the labour and material (costs) associated with a range of forest activities that occur in forest types that are representative of Ireland's forest estate.

Survey 2

The forest companies encountered a number of difficulties in completing the series of templates generated for Survey 1. In particular, they were not familiar with the level of administration and technical support that was associated with any of the main activities. Nonetheless, they provided a best estimate which was not always in the format required. To overcome this, it was decided to devise a second survey questionnaire specifically to address the administrative and technical support inputs associated with establishment, harvesting and road construction. The survey questionnaire (Survey 2) included five sections:

a) Afforestation (Figure 3).
b) Harvesting.
c) Road Construction.
d) Labour.
e) Management Activities.

The Afforestation section deals with all activities necessary to process an afforestation application (Form 1), establish the crop, completion of Form 2 (i.e. first instalment of 75% grant) and the maintenance of the crop until free growing stage and the submission of the Form 3 (i.e. second instalment of remaining 25% grant). The harvesting section covers the time and activities undertaken taken to process a successful felling licence application, the time spent on a typical thinning and clearfell site supervising contractors, dealing with health and safety, client relations and measurement (weight dockets etc.). The Road Construction section covers the time and activities undertaken to successfully process a Form 1 application, supervision, health and safety, client relations during road construction and Form 2 completion and submission.

The Labour section requested views on the availability of labour, the cost of labour and the retention of labour and staff within the sector. This would provide insights into the future availability of labour for any planned increases in the afforestation/reforestation programme and also the availability of labour to service the forecast of increased roundwood volumes from thinnings and clearfells.

The Management Activities section sought to identify the number of person days per year professional foresters spent against a range of activities. This could be used to validate or crosscheck the amount of time respondents indicated they spent on dealing with afforestation, harvesting and roading sites.

The findings from Survey 2 could be used to supplement the administration and technical support values from the more detailed templates. The survey was completed by five forest companies and one consultant/owner association. The format of tick boxes, inputs per work site as opposed to per hectare or per m^3 and a series of choice values proved very successful. The details were analysed and collated to provide time inputs per average afforestation, thinning, clearfell and roading site.

Survey 1 Analysis

The detailed templates were analysed and collated into a master spreadsheet (Appendix 3) and where possible, averages determined for each of the activities and sub-operations. Replies were weighted depending on the size of the respondent's business. There were a number of gaps as some respondents were not familiar with the activity e.g. reforestation of broadleaves or clearfelling of broadleaves.

Forester Time FORM 1 APPLICATION			Number Possible in One Working Day						
Initials visits to potential Form 1 applicants	②		③		⑤		Other please specify		
Follow up visits to potential Form 1 applicants	②		③		⑤		Other please specify		
Complete and submit Form 1	②		③		⑤		Other please specify		
Put up site notice	③		④		⑤		Other please specify		
Office administration (quality control, ownership, TCC etc)	②		③		⑤		Other please specify		
Further information requests									
% of Applications subject to Further information requests	10%		30%		50%		Other please specify		
Number of Further information requests dealt with in one day	②		③		⑤		Other please specify		
Office Admin re follow up with DAFM and referral agencies - per applicatio	③		④		⑤		Other please specify		
% of applications submitted which receive approval	50%		60%		75%		Other please specify		
Percentage success rate (Number of Form 1a submitted to actual planting	33%		50%		60%		Other please specify		

Natura Impact Statement/other 3rd party professionals			Number of days to Prepare NIS/Report						
Ecology / Archaeology expert	③		④		⑤		Other please specify		
% of Applications requiring NIS/Archaeology Report	75%		80%		90%		Other please specify		
Administration of form 1a, b and C procedure - days	0.5		0.6		0.7		Other please specify		

Establishment			Number of Days per Planting Site						
Walk site with contractors - machine, fencing, planting	1		2		3		Other please specify		
Health and Safety	4		5		6		Other please specify		
Supervise machine work	4		5		6		Other please specify		
Supervise fencing work	1		2		3		Other please specify		
Supervise planting work	2		5		6		Other please specify		
Admin work involved Form 1a, 1b, 1c	1		2		3		Other please specify		
Client relations	1		2		3		Other please specify		

Form 2 Completion and Submission			Number of Days per Form 2 Site						
Internal mapping	1		2		3		Other please specify		
Site survey by Engineer	1		2		3		Other please specify		
Office administration (TCC, ownership, provenance etc)	1		2		3		Other please specify		
Further information requests/remedial actions									
% of files subject to Further information requests	10%		30%		50%		Other please specify		
Number of Further information requests dealt with in one day	②		③		⑤		Other please specify		
Client relations	1		3		5		Other please specify		

Crop Maintenance + Form 3 Submission			Number of Days per Form 3 Site						
Site visits and supervise on going maintenance operartoins	1		2		3		Other please specify		
Client relations	1		2		3		Other please specify		
Form 3 site inspection + complete and submit	1		3		4		Other please specify		
Further information requests/remedial actions									
% of files subject to Further information requests	10%		30%		50%		Other please specify		
Number of Further information requests dealt with in one day	②		③		⑤		Other please specify		
% of 2nd installment grant spent on direct costs of maintenance, on averag	60%		70%		80%		Other please specify		

Figure 3 - Survey 2 Questionnaire Admin and Technical Support – Afforestation Form 1 through to Form 3

Some respondents costed the sub-operation in terms of overall machine costs as this is what they were more familiar with rather than the actual time input for the particular sub-operation, others on occasion costed materials as machine running costs. In hindsight, the level of detail being asked was overly ambitious. To overcome the difficulty with machine costs it was decided to adopt an alternative approach. Average labour costs and fuel costs per machine hour were obtained from a series of contractors for haulage, harvesting, cultivation and roading. The cost of fuels and labour were deducted from the overall machine cost to provide a cost estimate for tyres, repairs, tracks, etc. It is worth noting that the majority of harvesting machines are now purchased with maintenance and service contracts and the owners/operators are not completely familiar with the costs of tyres, tracks, repair etc. as was the case in the past.

Notwithstanding the shortcomings, it was possible to construct a series of inputs and costs across the range of activities including afforestation, reforestation (Figure 4), harvesting (thinning, clearfell and windblow), road construction, road upgrading, plant production and maintenance.

Administration and Overheads

The results of Survey 2 on administration and technical inputs (Appendix 2) indicate that the overheads associated with many activities are significantly higher than heretofore[8]. If we examine afforestation, the forester and office inputs total 5.44 days per hectare planted (Table 1)[9]. To convert the "days/site" to hectares, the average size of afforestation from 2011 to 2020 was used (6.6 ha). The average size has decreased from 7.4 ha in 2010 to 6.9 ha in 2020 (DAFM, 2021).

Table 1 - Administration and Technical Support Afforestation

Summary Afforestation	Days/Site	Days per Ha
Days per successful F1	3.7	0.57
NIS	2.6	0.39
Admin Form 1 procedures	0.42	0.06
Establishment	16.7	2.53
Form 2 completion and submission	4.81	0.73
Crop Maintenance and Form 3	7.62	1.15
Total Days	**35.9**	**5.44**

Previous work in 2006 on behalf of the Forest Service on costs and overheads associated with afforestation indicated a value of 3.60 days per hectare which equates to 63% of the current level (Phillips (2006)). While part of this can be explained by the decrease in the average size of afforestation sites, over the intervening fifteen years significant efficiencies have been introduced in terms of information technology, mapping and online submission of forms. Notwithstanding these efficiencies, enhanced DAFM scheme requirements and increased regulatory and health and safety compliance have added to the time inputs to process afforestation applications resulting in the 5.44 days figure in Table 1.

[8] Phillips, H. (2006) Independent assessment current operational costs forestry plantation establishment including review of overheads applicable. Report commissioned by the Forest Service.
[9] This includes time expended on dealing with F1s that did not reach F2 stage.

	Planting	Sub-operation	Labour Type		Hours/ha	Cost/ha				
			Direct	Contract	Mean		Materials	Cost	Machine	Total/ha
Conifer	Cultivation and drainage	Mound, drain, firelines	1	99	10.6	€170	Diesel	€85	206.7	
	Fencing	Erect fence at 150m/ha	0	100	4.5	€55	Wire, stakes, stainers gates	€417		
	Planting	Plant conifer at 2500/ha	13	87	22	€242	Plants	€607		
	Fertilising	Spread NPK / GRP	10	90	2.8	€30	Fertiliser	€40		
	Maintenance	Fill weed repairs	8	92	24.6	€271	Plants; chemicals	€83		
	Subtotal		**8%**	**92%**	**64.5**	**€768**				
	Overheads + Admin				43.52	€1,132		€1,232	€207	
	Total per ha				**108**	**€1,899**		**€1,232**	**€207**	**€3,338**
Blvds Soft	Cultivation and drainage	Mound, drain, firelines	2	98	12.7	€203	Diesel	€112	247.65	
	Fencing	Erect fence at 150m/ha	0	100	6.4	€78	Wire, stakes, stainers gates	€756		
	Planting	Plant broadleaves	12	88	25.9	€285	Plants 1395if Hblvds	€807		
	Fertilising	Spread NPK / GRP	0	100	3.2	€35	Fertilizer	€59		
	Maintenance	Fill weed repairs	12	99	33.8	€372	Plants chemicals	€248		
	subtotal		**9%**	**91%**	**82.0**	**€974**				
	Overheads + Admin				43.52	€1,132		**€1,982**	€248	
	Total per ha				**126**	**€2,106**		**€1,982**	**€248**	**€4,335**
Refor Con	Cultivation and drainage	Mound, drain, firelines	0	100	11.75	€188	Diesel	€90	€229	
	Fencing	Erect fence	0	100	2.25	€28	Wire, stakes, stainers gates	€167		
	Planting	Plant conifer at 2500/ha	11	89	22	€242	Plants	€607		
	Fertilising	Spread NPK / GRP	0	100	2.8	€30	Fertiliser	€40		
	Maintenance	Fill weed repairs	9	91	24.6	€271	Plants; chemicals	€83		
	Subtotal		**7%**	**93%**	**63.4**	**€759**				
	Overheads + Admin				25.8	€679			€229	
	Total per ha				**89**	**€1,437**		**€987**	**€229**	**€2,654**
Refor Blvds Hard	Cultivation and drainage	Mound, drain, firelines	0	100	14	€224	Diesel	€105	€273	
	Fencing	Erect fence at 150m/ha	0	100	5.1	€62	Wire, stakes, stainers gates	€303		
	Planting	Plant broadleaves	0	100	32.9	€362	Plants 807 if soft	€1,396		
	Fertilising	Spread NPK / GRP	0	100	2.6	€29	Fertiliser	€48		
	Maintenance	Fill weed repairs	12	88	33.35	€367	Plants; chemicals	**€248**		
	subtotal		**5%**	**95%**	**87.96**	**€1,044**				
	Overheads + Admin				25.8	€679			€273	
	Total per ha				**114**	**€1,723**		**€2,099**	**€273**	**€4,095**

Figure 4 - Labour Inputs and Costs for Afforestation and Reforestation

The results of Survey 2 were used to provide values for the administration and technical support for all activities apart from road construction which proved problematic.

Task 3: Generate coefficients showing the labour and material inputs associated with each unit of the different forest activities that occur in representative forest types.

Afforestation and Reforestation

The analysed data from Task 2 were converted to FTE[10], materials and machine cost per hectare to provide coefficients that could be used with the main species types (Table 2 and Table 3) (Appendix 4). The costs and activities cover the period from planting until the crop reaches free growing stage.

Table 2 - FTE/ ha - Afforestation

	Labour and Machines					Administation Technical Support			Totals/ha	
Afforestation	FTE/ha	Cost/ha	% Contract	Materials + Fuels	Machine Cost	FTE/ha	Cost/ha	% Direct	FTE/ha	Cost/ha
Conifer	0.0374	€768	92%	€1,232	€207	0.0253	€1,132	93%	0.0627	€3,338
Broadleaf Hard	0.0476	€974	91%	€2,570	€248	0.0253	€1,132	93%	0.0729	€4,923
Broadleaf Soft	0.0476	€974	91%	€1,982	€248	0.0253	€1,132	93%	0.0729	€4,335

The afforestation over the past five and ten year periods was analysed to determine the percentage planting by each of the twelve grant premium categories (GPC) (Table 4). Going on the previous five years would provide a more reliable indicator of the mix of planting types due to the impact of ash dieback and the increased awareness regarding native species. The three types of afforestation in Table 2 account for circa 98% of the planting by using hard broadleaves for GPC 6, 7, 9 and 10, soft broadleaves for GPC 8 and conifer for GPC3 and 4. However, a simpler and preferred approach to use the (a) % conifer, (b) % soft broadleaves and (c) % hard broadleaves supplied by DAFM was adopted.

[10] One FTE = 1,723 hours per year

Table 3 - FTE/ ha Reforestation

	Labour and Machines					Administation Technical Support			Totals/ha	
Reforestation	FTE/ha	Cost/ha	% Contract	Materials + Fuels	Machine Cost	FTE/ha	Cost/ha	% Direct	FTE/ha	Cost/ha
Conifer	0.0368	€759	93%	€987	€229	0.0150	€679	100%	0.0517	€2,654
Broadleaf Hard	0.0511	€1,044	95%	€2,099	€273	0.0150	€679	100%	0.0660	€4,095
Broadleaf Soft	0.0511	€1,044	95%	€1,510	€273	0.0150	€679	100%	0.0660	€3,506

Table 4 - Afforestation by Grant Premium Category (GPC)

		2011-2020		2016-2020	
Description	Category	Ha	%	Ha	%
Unenclosed	GPC1	959	1.8%	270	1.2%
SS/LP	GPC2	63	0.1%	35	0.2%
20% Diverse	GPC3	38,569	71.4%	16,906	76.7%
Diverse conifer	GPC4	4,864	9.0%	1,494	6.8%
Broadleaf	GPC5	2,297	4.2%	124	0.6%
Oak	GPC6	3,576	6.6%	963	4.4%
Beech	GPC7	191	0.4%	56	0.3%
Alder	GPC8	1,791	3.3%	595	2.7%
NWS	GPC9	1,109	2.1%	987	4.5%
NWS	GPC10	597	1.1%	582	2.6%
Agro	GPC11	28	0.1%	28	0.1%
Fiber	GPC12	8	0.0%	5	0.0%
	Total	54,052	100%	22,045	100%

There are no national data on reforestation areas by species. Based on the All Ireland Forecast 2016-2035 the greater proportion of clearfell areas and by implication reforestation is currently being undertaken by Coillte. The expectation is that these commercial crops will be replaced with mainly coniferous species with a percentage of broadleaves, site permitting. However, from 2025 onwards the private sector clearfell area matches that of Coillte and by 2027 it is forecast to be the main provider of reforestation sites. Some of these will be broadleaf but the greater proportion will be conifer. Thus for reforestation, we believe that a combination of 80% conifer, 15% soft broadleaves and 5% hard broadleaves would be representative. Some sites or parts of sites may be managed or set aside for biodiversity. At this stage, it is impossible to estimate what percentage. However, the final spreadsheet model can be updated to allow for this eventuality.

Thinning

The 2016-2035 All Ireland Forecast provided information on harvest areas and volumes by thinning type. The forecast estimate for 2020 is that 28% of the harvest volume will come from thinnings. The latest All Ireland Forecast 2021-2040 does not provide information on harvest area by thinning type. Over the forecast period 2021-2040, the volume from thinnings will reduce and average only 12.9% compared with the previous forecast estimate of 19%. On average it is estimated that circa 85% of first thinned conifer sites will receive a second thinning and circa 50% will receive a third thinning. Based on this, the proportion of volume by thinning type will be first thinning (40%), second thinning (34%) and third and subsequent thinning (26%). The coefficient values for conifer thinnings and clearfells are provided in Table 5.

Table 5 - FTE and Economic Contribution from Harvesting (Conifers)

	Labour and Machines					Administation Technical Support			Totals/100m3	
Conifers	FTE/ 100m3	Cost/ 100m3	% Contract	Materials + Fuels	Machine Cost	FTE/ 100m3	Cost/100m3	% Direct	FTE/ 100m3	Cost/ 100m3
First Thinning	0.0178	€502	97%	€396	€1,595	0.0081	€432	89%	0.0260	€2,924
Second Thinning	0.0176	€494	100%	€389	€1,559	0.0066	€316	81%	0.0241	€2,758
Third + Sub Thinning	0.0145	€408	100%	€345	€1,309	0.0064	€312	80%	0.0210	€2,374
Clearfell	0.0110	€308	99%	€269	€883	0.0075	€359	90%	0.0185	€1,819
Clearfell Windblow	0.0125	€349	100%	€296	€1,034	0.0091	€413	83%	0.0216	€2,093

For broadleaves, the picture is less clear. Based on the findings from a survey[11] to determine management practices for the All Ireland Forecast 2021-2040 a proportion of these crops will be held for long term retention with minimum harvesting interventions and an estimated 30% will be managed under a continuous cover forestry regime with intermittent fellings (thinnings). The All Ireland Forecast does not provide any information on broadleaf thinning volume or thinning areas or clearfell areas for broadleaves. Broadleaves however represent just less than 3% of the forecast volumes between 2021 and 2040. To provide some estimate for broadleaves, the coefficients for second thinning were used as a surrogate / best estimate for all harvest types. The values for broadleaf harvesting are provided in Table 6.

Table 6 - FTE and Economic Contribution Harvesting (Broadleaves)

	Labour and Machines					Administation Technical Support			Totals/100m3	
Broadleaves	FTE/ 100m3	Cost/ 100m3	% Contract	Materials + Fuels	Machine Cost	FTE/ 100m3	Cost/100m3	% Direct	FTE/ 100m3	Cost/ 100m3
Tending	0.0282	€874	100%	€566	€2,461	0.0081	€432	89%	0.0364	€4,333
First Thinning	0.0258	€737	100%	€542	€2,319	0.0081	€432	89%	0.0340	€4,029
Second Thinning	0.0241	€687	100%	€504	€2,106	0.0066	€316	81%	0.0307	€3,613
Third + Sub Thinning	0.0229	€654	100%	€479	€1,964	0.0064	€312	80%	0.0293	€3,409
Clearfell	0.0177	€506	100%	€417	€1,395	0.0075	€359	90%	0.0252	€2,677

Clearfell

The All Ireland Forecast 2021-2040 (COFORD, 2021) provides information on clearfell volumes and estimates that 87.1% of forecast volumes will come from clearfells. This is an increase of 6% on the estimate from the previous All Ireland Forecast. The forecast does not provide any indication on the breakdown of clearfell volumes to account for windblow. The incidence of windblow is related to the occurrence of extreme weather events e.g. Storm Darwin, and as such is difficult to estimate. Based on the experience of FSL and anecdotal information an estimated 5% of overall harvest volumes relate to windblow.

Haulage

Haulage of roundwood is included in all of the estimates of FTE and economic activity for all of conifer and broadleaf harvesting (Tables 5 and 6). As noted earlier (Survey 1), the majority of hauliers are classified under Freight Transport by Road. However, road haulage has been included in previous estimates of economic activity for the sector.

Roading

The results from Survey 1 indicated that road design and layout is undertaken by direct labour while the actual construction is carried out by contactors. The time and cost inputs for new road construction and road upgrade are shown in Table 7.

Table 7 - FTE and Economic Contribution - Roading

	Labour and Machines					Administation Technical Support			Totals/km	
Roading	FTE/ km	Cost/ km	% Contract	Materials + Fuels	Machine Cost	FTE/ km	Cost/km	% Direct	FTE/ km	Cost/ km
New Road Construction	0.2329	€6,826	95%	€36,615	€10,011	0.2089	€9,716	96%	0.4418	€63,168
Road Upgrading	0.0813	€2,240	100%	€20,680	€2,730	0.0870	€5,476	99%	0.1683	€31,126

Over the five year period, 2016-20 new road construction averaged 84 km per year in the private sector compared with 82 km per year for the Coillte estate.

The Forest Road Manual/Guidelines (Ryan et al. 2004) are based on a road design capable of sustaining 500,000 equivalent standard axle (ESA) loads (under ideal conditions). When the number of passes is equal to the number of ESA loads for which the pavement was designed, the pavement (in theory) will have deteriorated to the point where it is no longer useable and will need to be rehabilitated. Anecdotally within the forest sector, this has been taken to be one single conifer rotation or 40 years. Due to the reduction in thinning volumes and the adoption of shorter rotations, the lifespan of a forest road was estimated as being 47 years.

[11] Phillips, H. All-Ireland Forecast 2021-2040: Analysis of Survey Questionnaires 22nd June 2021. Unpublished

Road upgrading is a major operation on an existing road to ensure it is capable of timber haulage. Its purpose is to bring a currently substandard road up to full standard specification. Road work is considered as upgrade when:

a) The formation or carriageway has to be widened;
b) the entire carriageway has to be sheeted; or
c) a new drainage system and/or a significant number of new culverts have to be installed.

To estimate the requirement for upgrading the total roading infrastructure in the overall forest estate was determined and then 1/47th of this was assumed to be upgraded. The new road construction in the private sector since 1996 totals 1,545 km and it is assumed that only minimal road construction occurred prior to 1996. Based on the Coillte roads survey (2014) there were 7,950 km. Since then there has been road construction to facilitate windfarms and also to access commercial forest crops and this was estimated as being of the order of 518 km. Thus the estimated total roading infrastructure in 2020 is 10,013 km.

Maintenance

Forest maintenance now constitutes a minor element in the overall management of forest plantations. Over the years the drive for cost reduction and increased profitability has seen maintenance being undertaken only when deemed unavoidable. The private sector undertakes little or no maintenance. Coillte in contrast still undertakes inspection paths for the majority of conifer plantations. Thus while respondents did provide some information (Table 8), it is difficult to extrapolate this to the overall forest estate.

Table 8 - Basic Information on Maintenance

		Labour and Machines					Administation Technical Support			Totals/km	
% Sites	Maintenance	Hours/ha	Cost/ ha	% Contract	Materials + Fuels	Machine Cost	Hours/ km	Cost/km	% Direct	Hours/ ha	Cost/ ha
47.5% & 5%	Inpsection Paths	2.2	€34	98%	€12	€0				2.2	€46
7.5%	Drainage Repairs	2.0	€32	100%	€19	€39				2.0	€90
10.00%	Fence Repairs	2.5	€28	95%	€45	€0				2.5	€72
32.5%	Road Repairs	1.2	€19	0%	€23	€23				1.2	€66

The following assumptions were used to estimate the FTE and economic contribution for forest maintenance:

a) An estimated 47.5% of the conifer element of the Coillte afforestation and reforestation programme and 5% of the private afforestation programme at age 15 will require inspection paths. This is equivalent to circa 4,544 ha in 2020.
b) An estimated 7.5% of the afforestation and reforestation programme at age 20 will require once-off drainage repairs. This is equivalent to circa 1,966 ha in 2020.
c) 10% of the afforestation and reforestation programme at age 20 will require once-off fence repairs. This is equivalent to 2,621 ha in 2020.
d) 32.5% of the thinned area each year will require road repairs. This is equivalent to circa 6,708 ha in 2020.

Nurseries

None So Hardy nursery provided details on employment for full-time staff and contractors, together with the cost for materials and fuels. This was converted to a FTE and material coefficient per 1 million plants produced. The total plant requirement was estimated based on the following:

Afforestation (including filling in) – Conifer 2,750 plants/ha; Broadleaves 3,300 plants/ha
Reforestation (including filling in) - Conifer 2,750 plants/ha; Broadleaves 3,300 plants/ha

Recreation

Having carefully considered the range of costs for the construction of recreational facilities, it was decided to delete this from the analysis. All of these activities are once-off e.g. the construction of the new bikeway in Collaney, County Sligo and it is impossible to estimate the levels of construction on an annual basis. Furthermore, the scale of contribution to the overall forest sector activity is likely to be small.

Forest Sector Model

Based on the estimates for FTE, materials and machine costs, an overall spreadsheet model was developed which allows the main parameters regarding individual activities to be input together with an extensive series of standard costs/values regarding costs of labour and machines etc. Thus it is possible to vary the species percentage in afforestation or reforestation as well as increase or decrease the size of the planting programme. Similar flexibility is inbuilt to harvesting and roads construction. The model was further enhanced by the addition of a series of time-related lookup tables for afforestation, reforestation, roading, harvesting and forest maintenance operations by John Redmond (DAFM). This allows the user of the model to specify a particular year to estimate the FTE and economic contribution. However, the coefficients determined for each activity are based on 2020 data only and consequently, it is not recommended to use the model beyond plus or minus two years of the base year i.e. 2018- 2022.

Findings

Based on 2020 levels of activity (afforestation 2,434 ha, reforestation 13,076 ha, harvesting 3.91 million m^3 based on forecast volume, new road construction 168 km and road upgrade of 209 km), the overall FTE is estimated as being 1,978 (Table 9). By far the most significant activities in terms of employment are harvesting (514 FTE) and reforestation (500 FTE) together accounting for 75.6 % of the estimated employment.

Table 9 - Employment and Economic Contribution - Current Levels of Activity

	Labour + Machines				Admin + Support		Totals	
	FTE	Cost € million	Materials + Fuels	Machine € million	FTE	Cost € million	FTE	Contribution € million
Afforestation	99	€2.04	€3.97	€0.54	61	€2.75	161	€9.30
Reforestation	500	€10.29	€13.78	€3.05	196	€8.88	695	€36.01
Harvesting	514	€14.40	€12.07	€43.07	290	€14.12	804	€83.65
Roading	56	€1.61	€10.47	€2.25	53	€2.78	109	€17.12
Maintenance	17	€0.42	€0.36	€0.23	0	€0.00	17	€1.02
Nursery	156	NA	NA	NA	36	NA	191	NA
Totals	**1341***	**€28.76**	**€40.66**	**€49.15**	**636**	**€28.53**	**1,978***	**€147.10**

It is recognised that the data do not capture the total employment related to the overall levels of activity in the sector e.g. public servants, forest recreation, forest researchers and some back-office functions from the larger forest companies. While respondents provided estimates of overheads, there are still a small number of office/administration employees not fully captured. Similarly, there are forester activities that have not been captured, for example, the valuation of forests, forest certification and preparation of management plans. The total economic contribution in 2020 is estimated as being €147.10 million.

Comparison with Previous Estimates

The ECONTRIB (Ní Dhubháin et al., 2006) and Bacon (2004) reports estimated the direct employment in forestry as being 3,780 while the FORECON (Ní Dhubháin et al., 2010) report estimated the direct employment in forestry for 2010 as being 3,125. The Labour Force Survey (LFS) estimated that the number of people employed directly in the forestry and logging sector averaged 2,800 between 1998 and 2017. The census of Ireland estimated that there were 1,913 people employed in forestry and logging (NACE 02) in 2011 and 2,268 in 2016 (DAFM, 2021).

Using the model to estimate employment in 2016, even though it is outside the recommenced two year period, gives an estimate of 1,956 FTE. This is lower than the census figure of 2,268 and the difference can be partly explained by increased efficiencies mainly in harvesting and transport over the intervening period. It is also

*Rounded down to the nearest whole number.

significantly lower than the LFS figure of 2,800. However, the LFS counts jobs rather than FTEs and includes part-time employees which could account for part of the difference together with increased efficiencies outlined above.

The ECONTRIB (Ní Dhubháin et al., 2006) and Bacon (2004) estimates of employment used coefficients to convert hectares planted and cubic metres harvested to FTE. These coefficients were based on forest practices and technology available at that time. The coefficients used estimated that every 1,000 ha increase in afforestation would generate 104 FTE indirect employment. The current model estimates that only 55 FTE will be generated for each additional 1,000 ha of afforestation. Similarly, when you take harvesting, the older coefficients assumed that each 1 million m^3 harvested would create an additional 500 FTE indirect employment. The current model estimates the value per million m^3 as being 201. The reasons for these differences can be attributed to a combination of (a) significant increase in the use of contract labour, especially in planting, (b) improvements in harvesting technology with significantly greater output per machine in both felling and extraction, (c) improvements in timber haulage with significant increases in productivity and (d) the methodology used to derive the coefficients. The improvements in harvesting and transport are reflected in the current rates which have shown little movement over the past ten years.

Increased Level of Afforestation

If the afforestation programme was to increase to 8,000 ha in line with current Government targets then the FTE employed increases to 2,415 and the economic contribution to €168.36 million (Table 10). Caution is advised on merely increasing the future levels of activity and thereby assuming that the contractor infrastructure will expand to meet any increased levels of planting and harvesting. The findings from Survey 2 indicate that 100% of respondents were of the view that (a) labour will be a limiting factor to the expansion of activities and (b) the sector needs to improve the terms and conditions of labour staff and professional foresters if they are to continue working in the sector. Respondents indicated that average labour cost would need to increase by 46% if contractors were not to be lost to the construction or other sectors. These are significant findings that the sector and indeed forest policy will need to consider.

Table 10 - Employment and Economic Contribution –Assuming National Targets are Achieved

	Labour + Machines				Admin + Support		Totals	
	FTE	Cost € million	Materials + Fuels	Machine € million	FTE	Cost € million	FTE	Contribution € million
Afforestation	327	€6.70	€13.05	€1.76	202	€9.05	529	€30.57
Reforestation	500	€10.29	€13.78	€3.05	196	€8.88	695	€36.01
Harvesting	514	€14.40	€12.07	€43.07	290	€14.12	804	€83.65
Roading	56	€1.61	€10.47	€2.25	53	€2.78	109	€17.12
Maintenance	17	€0.42	€0.36	€0.23	0	€0.00	17	€1.02
Nursery	212	NA	NA	NA	49	NA	261	NA
Totals	**1625**	**€33.42**	**€49.74**	**€50.37**	**790**	**€34.83**	**2,415**	**€168.36**

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Appendix 1 - Templates from Request for Tender (RFT)

Table 1: Forest Establishment

Operation	Sub-operation	Labour input (FTES/ha)	Labour cost (€/ha)	Direct purchases associated with operation (€/ha)
Ground preparation and drainage	Mounding			
	Ripping			
	Pit planting			
	Scarification			
Fencing	Cattle			
	Cattle/ Sheep			
	Cattle/Rabbit			
	Rabbit/Hare			
	Deer			
Planting	Trees			
	Tree planting			
	Stakes and tubes			
Fertilising	Nitrogen			
	Potassium			
	Phosphate			
Maintenance (Year 1 to 4)	Beating up			
	Weeding			
	Fencing			
	Drainage			
	Firebreak			
Administrative & Technical Support				

Table 2: Harvesting

Operation	Sub-operation	Labour input (FTES/m^3)	Labour cost (€/m^3)	Direct purchases associated with operation (€/m^3)
Tending and Respacing broadleaves	Felling			
	Extraction			
	Haulage			
	Road Upgrade			
	Admin. & Tech. Support			
Thinning	Felling			
	Extraction			
	Haulage			
	Road Upgrade			
	Admin. & Tech. Support			
Clearfell	Felling			
	Extraction			
	Haulage			
	Road Upgrade			
	Admin. & Tech. Support			

Table 3: Road Construction

Operation	Labour input (FTES/m)	Labour cost (€/m)	Direct purchases associated with operation (€/m)
Tree Clearance			
Excavation			
Pavement formation (various depth)			
Special construction works (e.g. Bridge, deep peats, etc.)			
Admin. & Tech. Support			

Table 4: Road Upgrading

Operation	Labour input (FTES/m)	Labour cost (€/m)	Direct purchases associated with operation (€/m)
Tree Clearance / Hedge trimming			
Pavement upgrade			
Special construction works (e.g. Bridge, deep peats, etc.)			
Admin. & Tech. Support			

Appendix 2 - Survey 2 Results and Analysis

Summary Afforestation	Days/Site	Days per Ha
Days per successful F1	**3.7**	**0.57**
NIS	**2.6**	**0.39**
Admin Form 1 procedures	**0.42**	**0.06**
Establishment	**16.7**	**2.53**
Form 2 completion and submission	**4.81**	**0.73**
Crop Maintenance and Form 3	**7.62**	**1.15**
Total Days	**35.9**	**5.44**

Summary Road Construction	Days/Site	Days per 1000m
Days per successful application	**4.55**	**13.90**
Days per NIS report	**3.9**	**11.91**
Road construction	**7.86**	**24.01**
Form 2	**5.29**	**16.16**
Total	**21.60**	**65.99**

Summary Thinning	Days/Site	Days per ha
Licence application	**1.79**	**0.18**
Prepare NIS	**2.02**	**0.2**
Days per Thinning site	**13.48**	**1.3**
Total	**17.28**	**1.73**

Summary Clearfell	Days	Days per ha
Licence application	**1.79**	**0.40**
Prepare NIS	**2.02**	**0.45**
Days oer Clearfell site	**13.42**	**2.98**
Total	**17.22**	**3.83**

Labour

		YES	NO
Q.1	Do you believe the forest sector can compete with the construction industry for manual labour	0%	100%
Q.2	Do you believe that the forest sector needs to improve the terms and conditions for manual labour including contractors	100%	0%
Q.3	If Yes to Q.2 then please indicate % increase in rates you consider necessary	46%	
Q.4	If Yes then lease indicate any change in terms of employment you cnsider necessary	Training centre - forestry skills	
		YES	NO
Q.5	Do you believe availability of labourwill be a limiting factor on the growth of the forest sector	100%	0%
Q.6	Do you believe terms and conditions that prevail in the construction sector should be replicated in the forest sector	80%	20%
Q.7	Do you believe qualified foresters are remunerated equivalently to their counterparts in the construction industry – open question please expand on your opinion	N0 (100%): Mistrust from FS; Too much red tape; More oportinities in cnstruction (no career path); Sector not fit for purpose; No compensation for long hours worked (40%); Perceived as cost layer by sawmills	

Q.8	What is your average annual fuel bill for Forestors/staff regularly on the road	€0 to €3,000	0%	€3,001 to €6,000	80%	€6,001 to €8,000	20%

Management Activities

How many man-days per year would your business spend on:	Totals	Days/Year	% Time
1 Preparation of Forest Management Plans	140	3.0	1%
2 Advice to Existing/Potential Clients	2540	54.7	25%
3 Regarding Q2, how many of these days would not lead to additional business income?	2155		
4 Preparing forests for sale	860	18.5	8%
5 Sourcing Land or Forests for buyers	2300	49.5	22%
6 Regular Inspections / Site Visits	3375	72.6	33%
7 Asset /Forest Valuations	725	15.6	7%
8 Forest Certification	285	6.1	3%
Total	10,225	220	100%
FTE	46.48		

General Business Activity Questions:

1 For what reasons have you delayed activities in the past two years	Licensing (80%); Application procedures (20%)
2 In your opinion what are the major constraints to achieving Afforestation targets, assuming licences are not an issue	Levels of grants/premia (60%); Application procedures (40%); Additional expense on applicant (40%); Negative PR re licensing (20%); Loss of skillled staff / contractors to other sectors (20%)

Appendix 3 - Results and Analysis Detailed Survey 1 Questionnaire

Planting

	Planting	Sub-operation	Labour Type		Hours/ha	Cost/ha				
			Direct	Contract	Mean		Materials	Cost	Machine	Total/ha
Conifer	Cultivation and drainage	Mound, drain, firelines	1	99	10.6	€170	Diesel	€85	206.7	
	Fencing	Erect fence at 150m/ha	0	100	4.5	€55	Wire, stakes, stainers gates	€417		
	Planting	Plant conifer at 2500/ha	13	87	22	€242	Plants	€607		
	Fertilising	Spread NPK / GRP	10	90	2.8	€30	Fertiliser	€40		
	Maintenance	Fill weed repairs	8	92	24.6	€271	Plants; chemicals	€83		
	Subtotal		**8%**	**92%**	**64.5**	**€768**				
	Overheads + Admin				43.52	€1,207		€1,232	€207	
	Total per ha				**108**	**€1,975**		**€1,232**	**€207**	**€3,413**
Blvds Soft	Cultivation and drainage	Mound, drain, firelines	2	98	12.7	€203	Diesel	€112	247.65	
	Fencing	Erect fence at 150m/ha	0	100	6.4	€78	Wire, stakes, stainers gates	€756		
	Planting	Plant broadleaves	12	88	25.9	€285	Plants 1395if Hblvds	€807		
	Fertilising	Spread NPK / GRP	0	100	3.2	€35	Fertilizer	€59		
	Maintenance	Fill weed repairs	12	99	33.8	€372	Plants chemicals	€248		
	subtotal		**9%**	**91%**	**82.0**	**€974**				
	Overheads + Admin				43.52	€1,207		**€1,982**	€248	
	Total per ha				**126**	**€2,181**		**€1,982**	**€248**	**€4,411**
Refor Con	Cultivation and drainage	Mound, drain, firelines	0	100	11.75	€188	Diesel	€90	€229	
	Fencing	Erect fence	0	100	2.25	€28	Wire, stakes, stainers gates	€167		
	Planting	Plant conifer at 2500/ha	11	89	22	€242	Plants	€607		
	Fertilising	Spread NPK / GRP	0	100	2.8	€30	Fertiliser	€40		
	Maintenance	Fill weed repairs	9	91	24.6	€271	Plants; chemicals	€83		
	Subtotal		**7%**	**93%**	**63.4**	**€759**				
	Overheads + Admin				25.8	€724			€229	
	Total per ha				**89**	**€1,483**		**€987**	**€229**	**€2,699**
Refor Blvd Hard	Cultivation and drainage	Mound, drain, firelines	0	100	14	€224	Diesel	€105	€273	
	Fencing	Erect fence at 150m/ha	0	100	5.1	€62	Wire, stakes, stainers gates	€303		
	Planting	Plant broadleaves	0	100	32.9	€362	Plants 807 if soft	€1,396		
	Fertilising	Spread NPK / GRP	0	100	2.6	€29	Fertiliser	€48		
	Maintenance	Fill weed repairs	12	88	33.35	€367	Plants; chemicals	**€248**		
	subtotal		**5%**	**95%**	**87.96**	**€1,044**				
	Overheads + Admin				25.8	€724			€273	
	Total per ha				**114**	**€1,768**		**€2,099**	**€273**	**€4,140**

Conifer Harvesting

Operation	Sub-operation	% of Sites	Labour Type		Labour Input					
			Direct	Contract	Hrs/100m3	Cost/100m3	Fuel/100m3	Machine/100m3	Cost/m3	Cost/t
First Thinning	Felling	100	5	95	11.5	€190	€143	€817	€12	€13.00
	Extraction	100	5	95	8.25	€136	€69	€372	€6	€6.53
46	Chipping on site	0		100	0	€0				
	Chip Haulage	0	0	100	0	€0				
	Haulage	100	0	100	11	€176	€183	€405	€8	€8.64
	Subtotal		**3%**	**97%**	**30.75**	**€502**	**€396**	**€1,594.5**	**€24.9**	**€28.2**
Admin &Tech Support	Preharvest Activities	100	35	65	1.875	46				
	Felling Licence	100	100	0	2.1	76				
	Mark Measure	65	55	45	1.26	16.25				
	Third party professionals	50	50	50	4.65	91.25				
	Supervision and sales invoici	100	100	0	4.375	126				
	Overheads	100	100	0	2.5	76				
			89%	**11%**	**14.0**	**431.5**				
Second Thinning	Felling	100	0.5	99.5	11	€182	136.6	782	€11	€12.43
	Extraction	100	0	100	8.25	€136	69.3	372	€6	€6.53
46	Chipping on site	0	0	100	18	€0				
	Chip Haulage	0	0	100	18	€0				
	Haulage	100	0	100	11	€176	€183	€405	€8	€8.64
			0%	**100%**	**30.3**	**€494**	**€389**	**€1,559.0**	**€24.4**	**€27.6**
Admin &Tech Support	Preharvest Activities	100	35	65	1.875	46				
	Felling Licence	40	100	0	2.75	30.4				
	Mark Measure	100	5	95	1.2	25				
	Third party professionals	30	50	50	0.9	12.3				
	Supervision and sales invoici	100	100	0	4.375	126				
	Overheads	100	100		2.5	76				
			81%	**19%**	**11.3**	**315.7**				
Third + SubsThin	Felling	100	0.5	99.5	8.5	€140	105.6	604	€9	€9.61
66.125	Extraction	100	0	100	6.65	€110	55.8	300	€5	€5.26
	Chipping	0	0	100	18	€0				
	Chip Haulage	0	0	100	18	€0				
	Haulage	90	0	100	11	€158	€183	€405	€7	€8.44
			0%	**100%**	**25.1**	**€408**	**€345**	**€1,309.1**	**€20.6**	**€23.3**
Admin &Tech Support	Preharvest Activities	100	35	65	1.875	46				
	Felling Licence	30	100	0	2.75	26.25				
	Mark Measure	100	5	95	1.2	25				
	Third party professionals	30	50	50	0.9	12.3				
	Supervision and sales invoici	100	100	0	4.375	126				
	Overheads	100	100	0	2.5	76				
			80%	**20%**	11.0	**311.55**				
CCF Thin	Felling	100	1	99	10	€165	124.2	711	€10	€11.30
	Extraction	100	1	99	10	€165	84.0	451	€7	€7.91
	Chipping	0				€0				
	Haulage	100	1	99	8	€128	€133	€295	€6	€6.28
			1%	**99%**	**28.0**		**€342**	**€1,456**	**€23**	**€25.5**
Admin &Tech Support	Preharvest Activities	100	70	30	0.75	35				
	Felling Licence	50	100	0	9	120				
	Mark Measure	100	10	90	2.6	50				
	Third party professionals	50	50	50	0.8	16				
	Supervision and sales invoici	100	100	0	0.75	52				
	Overheads	100	100	0	1	52				
			70%	**30%**	**10.0**	**325**				
Clearfell	Felling	100	1	99	4.5	€74	55.9	320	€4.5	€5.09
450	Extraction	100	1	99	3.5	€58	29.4	158	€2.5	€2.77
	Brash Harvesting	0	0	100	14	€0				
	Brash Chipping	0	0	100	5	€0				
	Brash Haulage	0	0	100	14	€0				
	Haulage	100	1	99	11	€176	€183	€405	€8	€8.64
			1%	**99%**	**19.0**	**€308**	**€269**	**€883**	**€15**	**€11.4**
Admin &Tech Support	Preharvest Activities	100	35	65	1.875	46				
	Felling Licence	85	100		2.75	64.6				
	Mark Measure	97.5	100	0	1.25	21.9375				
	Third party professionals	60	50	50	0.9	24.6				
	Supervision and sales invoici	100	100	0	4.375	126				
	Overheads	100	100	0	2.5	76				
			90%	**10%**	**12.8**	**359.1375**				
Clearfell Windblow	Felling	100	0.5	99.5	6	€99	74.5	426	€6.0	€6.78
250	Extraction	100	0.5	99.5	4.5	€74	37.8	203	€3.2	€3.56
	Brash Harvesting	0	0	100	14	€0				
	Brash Chipping	0	0	100	5	€0				
	Brash Haulage	0	0	100	14	€0				
	Haulage	100	0	100	11	€176	€183	€405	€8	€8.64
			0%	**100%**	**21.5**	**€349**	**€296**	**€1,034**	**€17**	**€19**
Admin &Tech Support	Preharvest Activities	100	35	65	2.375	55				
	Felling Licence	95	100	0	2.75	72.2				
	Mark Measure	97.5	51	49	1.95	19.5				
	Third party professionals	75	50	50	1	34.5				
	Supervision and sales invoici	100	100	0	5.175	146				
	Overheads	100	100	0	2.9	86				
			83%	**17%**	**15.7**	**413.2**				

Broadleaf Harvesting

Operation	Sub-operation	% of Sites	Labour Type		Hours/100m3	Cost/100m3			
			Direct	Contract		Mean	Fuel/100m3	Machine/100m3	Cost/m3
Tending and Respacin	Felling	100	0.5	99.5	18	€297	€224	€1,279	€18
	Extraction	100	0.5	99.5	16	€264	€134	€722	€11
	Chipping on site	0	0	100	6.5	€0			
	Haulage of Chips	0	0	100	18	€0			
	Haulage	100	0	100	12.5	€209	€209	€460	
	Shaping	22.5	0	100	9.5	€105			
					48.6	**€874**	**€566**	**€2,461**	**€29**
Administrative and Technical Support (As conifer)									
First Thinning	Felling	100	0.5	99.5	16	€264	€199	€1,137	€16
28.6	Extraction	100	0.5	99.5	16	€264	€134	€722	€11
	Chipping on site	0	0	100	6.5	€0			
	Haulage of Chips	0	0	100	18	€0			
	Haulage	100	0	100	12.5	€209	€209	€460	
	Road Repairs	0	0	100	1.125	€0			
					44.5	**€737**	**€542**	**€2,319**	**€27**
Administrative and Technical Support (As conifer)									
Second Thinning	Felling	100	0.5	99.5	13	€215	€161	€924	€13
	Extraction	100	0.5	99.5	16	€264	€134	€722	€11
28.6	Chipping on site	0	0	100	6.5	€0			
	Haulage of Chips	0	0	100	18	€0			
	Haulage	100	0	100	12.5	€209	€209	€460	
	Road Repairs	0	0	100	1.125	€0			
					41.5	**€687**	**€504**	**€2,106**	**€24**
Administrative and Technical Support (As conifer)									
Third + Sub Thinning	Felling	100	0.5	99.5	11	€182	€137	€782	€11
35	Extraction	100	0.5	99.5	16	€264	€134	€722	€11
	Chipping on site	0	0	100	6.5	€0			
	Haulage of Chips	0	0	100	18	€0			
	Haulage	100	0	100	12.5	€209	€209	€460	
	Road Repairs	0	0	100	1.125	€0			
					39.5	**€654**	**€479**	**€1,964**	**€22**
Administrative and Technical Support (As conifer)									
Clearfell	Felling	100	0.5	99.5	6	€99	€75	€426	€6
240	Extraction	100	0.5	99.5	8	€132	€67	€361	€6
	Bundling	0	0	100	14	€0			
	Brash Haulage	0	0	100	5	€0			
	Haulage	100	0	100	16.5	€275	€275	€608	
	Road Repairs	0	0	100	1.125	€0			
					30.5	**€506**	**€417**	**€1,395**	**€12**
Administrative and Technical Support (As conifer)									

Appendix 4 - Analysis FTE and Economic Contribution Coefficients

	Labour and Machines					Administation Technical Support			Totals/ha	
Afforestation	**FTE/ha**	**Cost/ha**	**% Contract**	**Materials + Fuels**	**Machine Cost**	**Hours/ha**	**Cost/ha**	**% Direct**	**FTE/ha**	**Cost/ha**
Conifer	0.0374	€768	92%	€1,232	€207	0.0253	€1,132	93%	0.0627	€3,338
Broadleaf Hard	0.0476	€974	91%	€2,570	€248	0.0253	€1,132	93%	0.0729	€4,923
Broadleaf Soft	0.0476	€974	91%	€1,982	€248	0.0253	€1,132	93%	0.0729	€4,335

	Labour and Machines					Administation Technical Support			Totals/ha	
Reforestation	**FTE/ha**	**Cost/ha**	**% Contract**	**Materials + Fuels**	**Machine Cost**	**Hours/ha**	**Cost/ha**	**% Direct**	**Hours/ha**	**Cost/ha**
Conifer	0.0368	€759	93%	€987	€229	0.0150	€679	100%	0.0517	€2,654
Broadleaf Hard	0.0511	€1,044	95%	€2,099	€273	0.0150	€679	100%	0.0660	€4,095
Broadleaf Soft	0.0511	€1,044	95%	€1,510	€273	0.0150	€679	100%	0.0660	€3,506

	Labour and Machines					Administation Technical Support			Totals/100m3	
Conifers	**FTE/ 100m3**	**Cost/ 100m3**	**% Contract**	**Materials + Fuels**	**Machine Cost**	**FTE/ 100m3**	**Cost/100m3**	**% Direct**	**FTE/ 100m3**	**Cost/ 100m3**
First Thinning	0.0178	€502	97%	€396	€1,595	0.0081	€432	89%	0.0260	€2,924
Second Thinning	0.0176	€494	100%	€389	€1,559	0.0066	€316	81%	0.0241	€2,758
Third + Sub Thinning	0.0145	€408	100%	€345	€1,309	0.0064	€312	80%	0.0210	€2,374
Clearfell	0.0110	€308	99%	€269	€883	0.0075	€359	90%	0.0185	€1,819
Clearfell Windblow	0.0125	€349	100%	€296	€1,034	0.0091	€413	83%	0.0216	€2,093

	Labour and Machines					Administation Technical Support			Totals/100m3	
Broadleaves	**FTE/ 100m3**	**Cost/ 100m3**	**% Contract**	**Materials + Fuels**	**Machine Cost**	**FTE/ 100m3**	**Cost/100m3**	**% Direct**	**FTE/ 100m3**	**Cost/ 100m3**
Tending	0.0282	€874	100%	€566	€2,461	0.0081	€432	89%	0.0364	€4,333
First Thinning	0.0258	€737	100%	€542	€2,319	0.0081	€432	89%	0.0340	€4,029
Second Thinning	0.0241	€687	100%	€504	€2,106	0.0066	€316	81%	0.0307	€3,613
Third + Sub Thinning	0.0229	€654	100%	€479	€1,964	0.0064	€312	80%	0.0293	€3,409
Clearfell	0.0177	€506	100%	€417	€1,395	0.0075	€359	90%	0.0252	€2,677

	Labour and Machines					Administation Technical Support			Totals/km	
Roading	**FTE/ km**	**Cost/ km**	**% Contract**	**Materials + Fuels**	**Machine Cost**	**FTE/ km**	**Cost/km**	**% Direct**	**FTE/ km**	**Cost/ km**
New Road Construction	0.2329	€6,826	95%	€36,615	€10,011	0.2089	€9,716	96%	0.4418	€63,168
Road Upgrading	0.0813	€2,240	100%	€20,680	€2,730	0.0870	€5,476	99%	0.1683	€31,126

Appendix 5 - CSO Environment Forestry Statistical Work

1. The CSO undertook two new surveys in 2021 - Roundwood Removals Survey and Wood Inputs Survey. These were initially undertaken in Spring 2021 collecting data for 2019 and repeated in the Autumn collecting 2020 data. Both surveys asked enterprises to provide data voluntarily for 2015 to 2018.

The results of the Roundwood Removals survey were consistent with the previous aggregate estimates made by the Department but there were differences at product level. The Wood Inputs Survey collected data on the purchases by sawmills and energy companies of roundwood from Irish forests. The purchases of roundwood can be compared with the Roundwood Removals survey and with export and import figures to examine supply and use of roundwood.

The survey results will be used for the Eurostat Joint Forest Sector questionnaire, for the Eurostat Forest Accounts questionnaire, and for Woodflow.

2. The Department of Agriculture completed and submitted the Joint Forest Sector Questionnaire for Ireland up to 2018. During 2019, the Department agreed that CSO Environment Division would become responsible for compiling and submitting the data with a transition period during 2020 and 2021 during which the CSO would establish data sources.

The JFSQ collects information on:

- the volume of roundwood removals;
- the volume and value of exports and imports of roundwood, wood products, and paper products; and
- the volume and value of the production of wood and paper products.

a. The Roundwood Removals Survey will provide the removals data for the JFSQ.

b. CSO Trade figures were used by the Department for previous JFSQ reporting and will continue to be used by CSO Environment but the methodology will be changed substantially. A Trade return contains the transaction month, the product code (Common Nomenclature or CN), the type of trade (imports or exports), the partner country, the net mass of the goods being imported or exported (kilogrammes), the supplementary unit if relevant (number of cars, litres of petrol, etc.), and the monetary value. The eight-digit CN code can be aggregated to a five-digit SITC code which is the classification used by non-EU countries.

There are over five million JFSQ-related records for the 1994-2021 period in the CSO Trade file. Some CN codes require supplementary unit figures to be provided by the trader in cubic metres. This means a conversion factor can be calculated from the net mass and supplementary unit figures provided by the exporter or importer. CSO Environment Division is using much of the supplementary unit figures provided by traders but we are making adjustments if it looks incorrect. The adjustments being made by CSO Environment will not result in revisions to the figures published by Trade Division.

The Department previously used annual net mass data at the five-digit SITC code level in conjunction with national and UNECE conversion factors to estimate cubic metres. The main differences between the previous Department approach and the new approach are:

- CSO is working at trader import or export monthly transaction code rather than at an annual aggregated level;
- CSO is using the more detailed CN product code which will allow for more accurate reporting of SITC codes that should be split at the CN code level to different JFSQ categories;
- CSO is using trader reported supplementary unit figures.

New figures will be available in early 2022. There will be some differences between the previously reported figures for Ireland and the new estimates. The new series will be discussed with the Department before they are finalised and submitted to Eurostat.

c. The third part of the JFSQ questionnaire relates to production of wood and paper products. CSO Environment is examining the annual CSO PRODCOM survey which contains very detailed information on the products manufactured by Irish enterprises including sawmills. PRODCOM contains both quantity and value data and the quantities are in a variety of reporting units e.g. square metres, cubic metres, kilogrammes, etc. Using PRODCOM provides a means of identifying enterprises that are active in the wood and paper manufacturing sectors and this list can be used to examine other survey and administrative data sources for data such as employment.

The PRODCOM survey was not previously used by the Department but the granularity of the data has the potential to allow a much higher proportion of the JFSQ questionnaire to be completed and using it reduces the data collection burden on enterprises.

3. It should be possible to publish the results from the Roundwood Removals survey and the Wood Inputs survey provided enterprises submit completed questionnaires. Trade data are available monthly. PRODCOM is published around seven months after the data year so it should be possible to compile figures for the JFSQ around October/November.

4. Eurostat conduct a voluntary annual Forest Accounts questionnaire. Parts of this questionnaire will be included as an additional module in the Environment Accounts Regulation with first reporting due in September 2025. It is likely to take around three years to set up a robust data collection for Forest Accounts. Our initial priority will be on the aspects that will be required by the Regulation module. The voluntary questionnaire requests data on:

- Area and value of forest land;
- Volume and value of trees on forest land;
- Volume and value of net increment;
- Volume and value of roundwood removals;
- Intermediate consumption;
- Gross value-added, consumption of fixed capital, taxes and subsidies on production, compensation of employees, gross fixed capital formation, and changes in inventories.

5. The following links provide more information.

- JFSQ questionnaire https://unece.org/forests/jfsq
- Forest Accounts https://ec.europa.eu/eurostat/web/forestry/methodology

6. CSO National Accounts for the forestry and logging sector (A02) are compiled using the Income approach combined with information from Coillte's annual reports. Forest Accounts will enable estimates to be compiled using the Output approach.

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