- *A forestry decision support tool was developed on a Microsoft Excel platform as part of the COFORD-funded FIRMEC project (Forestry in Ireland – Modelling its Economics) in order to model the returns to forest planting and management scenarios.*

- *The FIVE (Forest Investment and Valuation Estimator) tool uses Forestry Commission Yield Models and Coillte 10-year average standing sale prices to estimate the Net Present Value (NPV) as well as the cumulative cashflow for the entire rotation of a given forest plantation. The NPV is the overall net revenue generated by the crop expressed in 'today's money'.*

- *One of the key strengths of the FIVE is its ability to evaluate alternative afforestation scenarios and to present a visual representation of the financial returns from alternative afforestation scenarios. This facilitates farmers in making planting decisions based on the timber returns and not just on the value of the premium payments.*

- *This analysis compares the returns from three afforestation options, taking into account the superseded agricultural enterprises. It also presents a comparison between 'Thin' and 'No-Thin' management options.*

Modelling the economics of forestry in Ireland - The returns to farm afforestation

Mary Ryan*

The FIRMEC project (*Forestry in Ireland – Modelling its Economics*) was initiated to assess the actual and potential contribution of forestry to the national, regional and local economy, in terms of both tradable goods and services and public goods. It also aims to build up the capacity to assess the impact of policy reform and impact of the sector on the wider economy. One of the challenges of this work is to measure the impact of changes in the wider economy and the agricultural sector on farm afforestation rates, and more specifically to examine how the farming sector makes choices regarding decisions to utilise their land and time across a range of alternatives including forestry, dairy, tillage crops, cattle and sheep. The project aims to scope out the data and analytical requirements necessary to model and better understand the responses of farmers and forest owners to policy and economic changes.

A forestry decision support tool was developed on a Microsoft Excel platform as part of the FIRMEC project to model the returns to forest planting and management scenarios. The FIVE (Forest Investment and Valuation Estimator) tool uses Forestry Commission Yield Models and Coillte 10-year average standing sale prices to estimate the Net Present Value (NPV) as well as the

Figure 1: The decision to change land from farming to forestry is a permanent one and farmers need as much information as possible in making this decision.

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cumulative cashflow for the entire rotation of a given forest plantation. The NPV is the overall net revenue generated by the crop expressed in current terms or 'today's money'.

The FIVE tool allows the user to compare the financial returns for different planting and management options and can be used to record farmer preferences when presented with these options. For instance, farmers can be presented with projected income streams based on their individual farm's actual characteristics rather than the theoretical characteristics which would be required in the absence of this tool. Outputs from the FIVE can be used to present farmers with different planting and management options such as; area to be planted; species mix; FEPS; thin versus no-thin; all based on the productivity of their land.

The FIVE was originally developed as a decision support tool that could be used to calculate the financial returns from the farm afforestation decision as well as alternative forest management decisions. A second important benefit from the development of the FIVE has been its application in research. For example, output from the FIVE has been used to conduct a Discounted Cash Flow Analysis of the

decision to plant three different species options. This analysis takes into account the costs and revenues incurred as a result of reducing one of five agricultural enterprises, i.e. grazing land rental value; store to finished beef; lowland sheep; winter wheat and spring barley.

For many farmers, the level of the 20 year tax-free forest premium payment is the main financial motivator in making the decision to plant some of their land. However, it is important that farmers also take into account the long-term returns from timber sales. Using the outputs from the FIVE, farmers can readily see the impact of both premium payments and timber revenues on the long-term value of potential forests as may be seen by comparing the returns from conifer, mixed and broadleaf forests. The assumptions used in the comparison are presented in Table 1 and the financial outputs are presented in Figures 2, 3 and 4. Figures 2, 3 and 4 present the cumulative cashflows for the three afforestation scenarios described in Table 1.

The difference in returns between the three species selections is summarised in Table 2. Despite the higher premiums for broadleaves over the initial 20 year period,

Table 1: Planting and management assumptions.

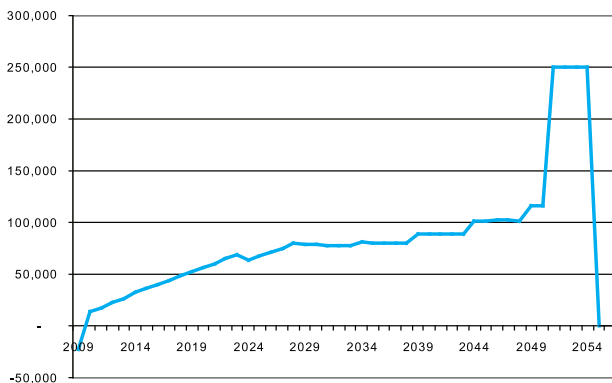|	CONIFER FOREST	BROADLEAF FOREST	MIXED FOREST
Plantation size	10 hectares	10 hectares	10 hectares
Tree mix	Sitka spruce 80% Japanese larch 20%	Ash 100%	Sitka spruce 48% Japanese larch 12% Ash 40%
Productivity (Yield Class)	Sitka spruce – 20 Japanese larch - 10	Ash - 8	Sitka spruce – 20 Japanese larch – 10 Ash - 8
Establishment and maintenance grants	GPC 3	GPC 5	GPC 3 (60%) GPC 5 (40%)
Farmer rate of premium	Yes	Yes	Yes
FEPS (Forest Environment Protection Scheme)	No	No	No
Rotation length	42 years	42 years	42 years
Productive area	90%	90%	90%
Forest management	Thin	Thin	Thin
Thinning type	Marginal Thinning Intensity (MTI)	MTI	MTI
Maintenance and insurance cost	€35	€35	€35
Roading year	Year 15	Year 15	Year 15
Roading grant	Yes	Yes	Yes
Timber prices	Coillte 10 year	UK broadleaf price data (limited data)	Coillte 10 year UK broadleaf price data (limited data)
Discount rate	5%	5%	5%
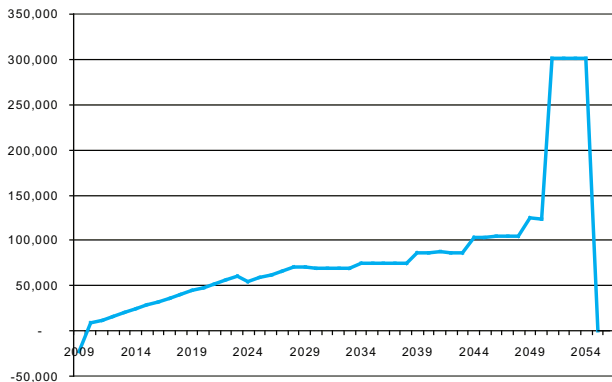
Cumulative Cashflow = €300,750   Net Present Value (NPV) = €75,462

Figure 2: Conifer forest - cumulative cashflow (€) over 42 year rotation.
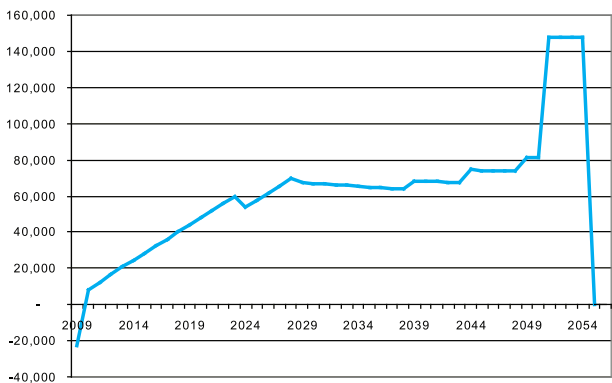
Cumulative Cashflow = €147,990   Net Present Value (NPV) = €53,336

Figure 3: Broadleaf forest – cumulative cashflow (€) over 42 year rotation.

Cumulative Cashflow = €249,376   Net Present Value (NPV) = €74,311

Figure 4: Mixed forest – cumulative cashflow (€) over 42 year rotation.

Table 2: Summary of financial returns.

	Conifer forest	Broadleaf forest	Mixed forest
Cumulative cashflow	€300,750	€147,990	€249,376
NPV	€75,462	€53,336	€74,311

the higher productivity and value achieved for the conifers for both thinnings and clearfell, means that the overall financial return from conifers is the highest.

One of the key strengths of the FIVE is its ability to evaluate alternative afforestation scenarios and to present a visual representation of the financial returns from these afforestation scenarios. This facilitates farmers in making planting decisions based on the timber returns and not just on the value of the premium payments. This is a purely financial model and does not take non-timber values into account but it is hoped to expand the capacity of the model in the future.
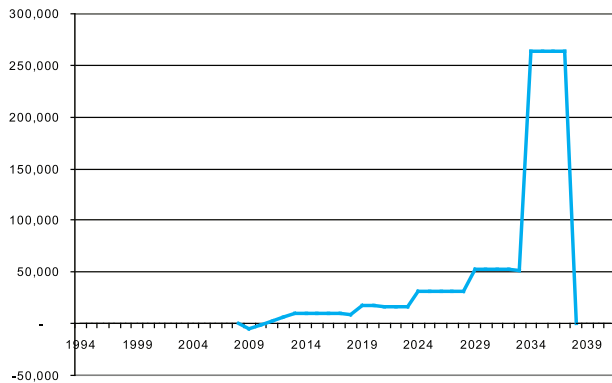
Thin versus No-Thin

The FIVE can also be used to assess the financial returns from Thin versus No-Thin scenarios. For instance, we can look at a Sitka spruce and Japanese larch forest which is currently 15 years old and use the decision support tool to evaluate the returns to thinning given the assumptions in Table 3.

The Cumulative Cashflows and the NPV for the *Thin* and *No-Thin* scenarios are presented in Figures 5 and 6.

Table 3: Thinning assumptions.

	THIN	NO-THIN
Plot area	10 ha	10 ha
Productive area	90%	90%
Current age	15	15
Species and Yield Class	Sitka spruce – 20 Japanese larch - 10	Sitka spruce – 20 Japanese larch - 10
Inspection paths	Year 14	Year 14
Road Grant - Yes	Year 15	Year 37
Thinning type	Marginal thinning intensity	No-thin
Rotation	40 years	40 years

Cumulative Cashflow = €263,190   Net Present Value (NPV) = €85,486

Figure 5: Thin Scenario- cumulative cashflow (€) over 40 year rotation.

Cumulative Cashflow = €241,385   Net Present Value (NPV) = €71,972

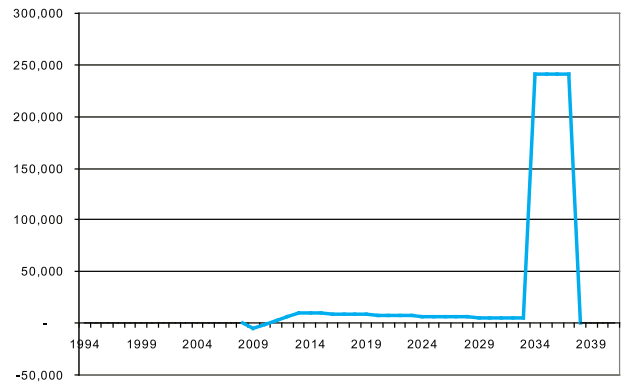Figure 6: No-Thin Scenario- cumulative cashflow (€) over 40 year rotation.

Thin versus No-Thin scenario results

As this hypothetical plantation is already 15 years old, the result does not take into account any costs or revenues up to this point. For this average 10 hectare plantation, there is an increase in NPV of €13,514 in today's money over the course of the rotation as a result of thinning. As profits from the sale of timber are generally not liable for income tax, this increase in revenue is essentially tax free profit for the farm forest owner.

The overall effect is that the thinning operation produces more valuable trees resulting in an increase in the overall revenue generated over the lifetime of the crop. The cashflows presented are cumulative so they are increasing over time as thinnings are carried out, but initially decrease over time for the *No-Thin* scenario until the final clearfell. Obviously in the *Thin* scenario, there is ongoing income generation from the thinnings whereas in the *No-Thin* scenario, the plantation incurs a small loss until clearfell as there is no income to offset the cost of maintenance and insurance. The scenarios illustrate the financial impact of thinning on the potential revenue of a forest using timber production models and historical average timber prices.

Conclusions and future work

While the FIVE strives to produce a result which is as close to reality as possible, the results presented reflect a general picture only and are best used for comparison purposes with other options. The FIRMEC team intends to use this decision support tool in a study analyzing how farmers make decisions about various planting and thinning options. These data will be used to quantify potential farm forest owners' attitudes under alternative market conditions and to generate a dataset of farm characteristics and planting choices. This dataset will then be interrogated using discrete choice econometric tools to develop an econometric equation capturing farmer preferences for planting.

Work on developing the capacity of the FIVE is ongoing and it is also intended to compare the outputs from the FIVE against other financial models such as COFORD's GROWFOR - Dynamic Yield Models.

Acknowledgements

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