To thin or not to thin?

NIALL FARRELLY and STEPHEN HYNES investigate the impact of thinning on financial returns in farm forest plantations.

Many plantations planted in the late 1980s and 1990s are now coming to the age of first thinning. It is estimated that some 40,000 hectares of farm forest plantations have now reached or passed first thinning age. The decision whether or not to thin a plantation relies primarily on whether the operation will prove profitable, as it is based on the price attained for produce. The purpose of this research was to examine the effect of thinning on the financial returns of a farm forest plantation. The study used data from Teagasc Monitor forests and used yield model simulations to examine what differences, if any, thinning makes to crop growth and financial returns.

Growth data

Data from two unthinned farm forest plantations located in Co. Laois and Co. Galway were utilised in the study. Both plantations were planted in 1989 and were composed of pure Sitka spruce. Both plantations were on wet mineral gleyed soils showing highly productive yields in excess of 24m^3/hectare/annum. Measurements of diameter distribution (diameter at breast height or DBH), stocking (number of trees per hectare), and top height (height of 100 largest diameter trees per hectare) for the plantations can be seen in **Table 1**.

TABLE 1: Growth data of the plantations used in the study.

Location	Age (years)	Yield class (m^3/hectare /annum)	Mean DBH (cm)	No. of stems/hectare	Mean top height (m)	Basal area/ha (m^2)	Volume/ hectare (m^3)	Rotation length (years)
Laois	17	24+	16.5	2,250	14	48.2	308	40
Galway	17	24+	17.8	2,188	15	54.5	375	36

TABLE 2: The final harvest volume (clearfell volume), thinning volume, total volume output and net present value of each stand for thinned and unthinned simulations in the study.

Site	Rotation length	Clearfell volume (m^3)/hectare	Thinning volume (m^3/hectare)	Total volume output (m^3/hectare)	NPV €/hectare
Laois unthinned	40	1,059	0	1,059	19,573
Laois thinned	40	670	470	1,140	22,254
Galway unthinned	36	1,035	0	1,035	21,889
Galway thinned	36	681	413	1,094	24,634

Stand projection models

Stand (growing trees) projection models called 'Growfor' (**Figure 1**) were available from COFORD (The Council for Forest Research and Development). These models require inputs of age, mean DBH, stocking and top height (**Table 1**) in order to calculate the predicted growth pattern of forest stands at various stages of the life cycle of a forest crop. For various age classes, the development of the forest stand is modelled. Outputs from the modelling process include percent mortality, diameter growth, volume production, and the volume assortments available from the crop. Using growth prediction data, the relative value of the crop at any age can be computed, using the volume assortments and the long-term average standing timber prices (**Figure 2**) to generate revenue comparisons of thinned and unthinned forest stands.

Net present value

To provide revenue comparisons for thinned and unthinned plantations, the economic method of 'net present value' (NPV) was calculated using the standard formulae:

$$\mathrm{NPV} = \sum_{t=0}^{n} \frac{C_t}{(1+r)^t}$$

Where: C = revenue at each point in time,
t = time period in which revenue is generated,
n = the total time of the operation, and
r = the discount rate.

The revenue generated, C, was discounted over t years, where t was the time of the thinning and/or rotation length. The NPV from timber sales at each thinning age and/or at the end of the rotation period were then summed. The discount rate used was 5%. All revenues were reduced by 15% to account for unproductive areas in forests.

Thinning

Rotation lengths of 40 years for the Laois site and 36 years for the Galway site were chosen as the age of final harvest. A thinning simulation was generated

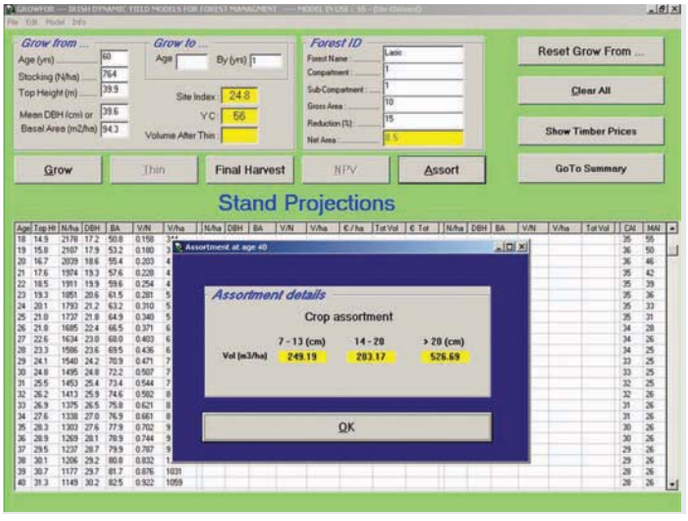

FIGURE 1: The stand projection model 'Growfor' has greatly facilitated the modelling of forest stand development.

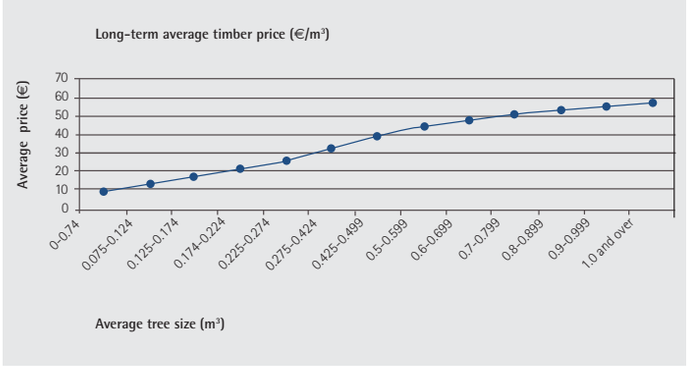

FIGURE 2: Long-term average timber prices for the last 15 years.

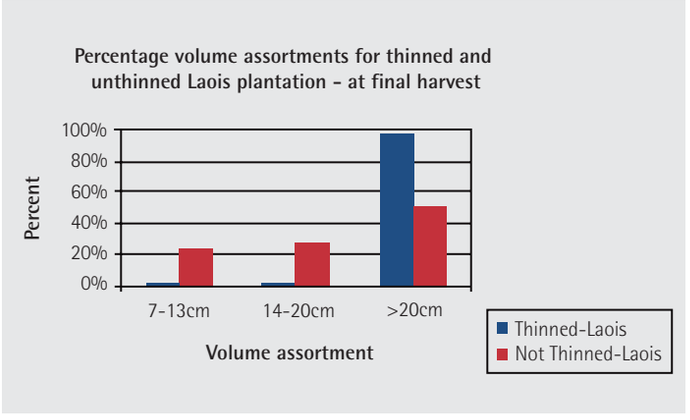

FIGURE 3: A comparison of volume assortments for the thinned versus unthinned Laois plantation at final harvest in the study.

Most thinning in Ireland is carried out by harvesting machines.

using the growth models for both stands commencing at 17 years of age by removing 33% of the volume per hectare for both sites. For the Laois site, four subsequent thinnings were simulated, removing 92m^3 at age 22, 27, 32 and 37 years, with final harvest taking place at 40 years. For the Galway site, a further three subsequent thinnings were applied, removing 98m^3 at age 22, 27 and 32 years, with a final harvest taking place at 36 years. The total volumes removed in thinning simulations were 470m^3 (Laois) and 418m^3 (Galway).
A no thinning simulation was also simulated by growing the stands until 40 years (Laois) and 36 years (Galway) without removing any volume.

Impact of thinning

The model showed that thinning resulted in an increase in total volume production of between 5% and 7% compared to no thinning for the Galway and Laois sites, respectively. Comparisons of thinned and unthinned simulations are available in **Table 2**.
As smaller volume trees are removed during thinning, two effects are noticed. Firstly, the overall mean diameter of the thinned crop is increased and, secondly, the remaining trees are freed from competition and increase in size as a result of increased growing space. The average tree sizes for thinned stands are greater at final harvest compared to unthinned stands, with 98% of all the volume in the thinned stands greater than 20cm, compared to just 50% greater than 20cm in the unthinned stands. Thinning produces a greater amount of larger diameter trees (sawlog grade), which in turn generate more revenue. The unthinned stands produce a smaller proportion of sawlog grade material (50%), with an equal proportion of lower value pulp and pallet wood grade material (50%). The overall effect is that thinning operations produce more valuable trees, resulting in an increase in the NPV of both of the plantations examined. The NPV of the unthinned Laois plantation is €19,573 per hectare, compared with €22,254 for the thinned simulation (an increase of 12%). Similarly, the Galway site increases in value from €21,889 per hectare to €24,634 (an increase of 11%) with thinning.

Implications for plantation management

With an investment over a long period of time, such as forestry, it is important to maximise the revenue potential of the crop. Thinning will increase the value of the crop, as the average tree size is increased and there is a larger proportion of valuable sawlog produced over the rotation than in unthinned plantations. In addition, the value of the crop is released at periodic intervals over the crop rotation in thinning operations, giving periodic income generation, compared with the value of the crop being realised at a later stage in the no thinning scenario. Increases in revenue returns of between 11% and 12% associated with thinning have been demonstrated in this study. This research has demonstrated that, in order to maximise return on investment, farmers should consider thinning plantations to recommended levels rather than allowing plantations to remain unthinned. The exact rate of return is very dependent on timber prices at any moment in time, which can be subject to periodic price fluctuations that can subsequently result in lower returns. However, it must be stressed that other factors, such as the increase in wind risk associated with thinning, will play a key role in the overall profitability of thinning operations, and these are not addressed here. Further research is ongoing to see if thinning lower yielding plantations shows similar results.

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