



02 Economic aspects of woodland creation for timber production

Evaluating the financial costs of forestry

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Guidance

This document is part of a series of *guidance notes* aiming to provide practical information for farmers and other landowners interested in investing in forestry. It is designed to help develop a better understanding of costs involved in establishing and maintaining a plantation woodland, and the potential impacts of variation in these costs on financial revenues.

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Estimating costs

The decision to invest in an afforestation project with the aim of producing timber on a commercial basis involves many considerations, not least the potential costs associated with such an investment. The first step in financial evaluation of afforestation projects (see *Financial Evaluation of Afforestation Projects - Basic Steps*) is to estimate the costs of establishing and maintaining a plantation woodland. The profitability of an afforestation project hinges on careful consideration and control of costs. In particular two aspects need emphasising:

1. Afforestation costs occur at the beginning of a forest rotation, i.e. the period between planting a woodland and felling it for timber (i.e. 15, 30, 60 years).
2. There is a long delay before commercial revenues from harvested timber are received to recoup these costs. The Time Value of Money (see *Financial Evaluation of Afforestation Projects - Basic Steps*) means these future revenues may not be sufficient to recoup afforestation costs and return a profit.

Estimating costs can be a difficult and uncertain task, with actual costs varying widely by woodland type, site conditions and operations that may be undertaken. This guidance note introduces the differences between financial and economic costs, and ways of classifying costs. It provides a breakdown of some of the typical costs involved in establishing and maintaining a plantation woodland, and the potential impacts of variation in these costs on financial revenues.



Evaluating the financial costs of forestry

Financial versus economic costs

Business decisions are built on cost, value and price.

Costs are expenditures that must be made in order to produce and market a good (e.g. timber).

Value is the degree to which purchasers think having those goods (e.g. timber) makes them better off than not having them.

Price is what purchasers pay for the goods (e.g. timber).

In the context of an afforestation project with the aim of producing timber, the cost to produce the timber is the most fundamental element. The costs of producing timber are *financial costs*, i.e. a monetary outlay on production.

These costs are considered *explicit costs* (or *accounting costs*) and would typically be included in financial accounts. Financial or explicit costs are relevant for evaluating alternative courses of action when maximising profits (e.g. by producing timber) is the primary objective.

There are also *implicit costs* (or *economic costs*) that decision makers may account for if the primary objective of an afforestation project is enhancing the welfare of society as a whole and the benefits they may derive from a woodland. These *economic costs* are typically considered in addition to *financial costs* in other economic analyses, such as *cost-benefit analysis* (see box below).

Accounting for implicit costs

Implicit costs (or *economic costs*) are not typically included in financial accounts as they do not necessarily involve monetary exchange. They still represent a cost to the decision maker and are hence sometimes included in economic appraisals of forestry projects. *Economic costs* cover opportunity costs, disbenefits and the shadow cost of lost social benefits.

- *Opportunity costs* are the revenue forgone when a production factor (e.g. land) is moved from one course of action to another. For a land use change from agriculture to forestry the opportunity cost would be the net profit foregone from agricultural use.
- *Disbenefits* are external negative effects that impose costs on society that they would have preferred not to experience (e.g. reduction in water quality). These are typically estimated by surveying society for the lowest monetary amount people are willing to accept to bear these negative effects.
- *Shadow cost* is the net loss of benefits to society incurred by moving from one course of action to another (e.g. changes to landscape or cultural values).

For more information on economic appraisals and economic costs see *Guide to Economic Appraisal of Forestry Investments and Programmes in Europe*.

Evaluating the financial costs of forestry

Classifying costs

Classifying costs helps to identify and formalise afforestation costs in a systematic way to ensure all relevant costs are accounted for in the estimation. There are three main classifications for financial costs of afforestation projects. Which classification type is the most suitable depends on the investor's situation.

- **Traditional factors of production.** This may be suitable when an investor does not already own the land on which trees are to be planted. This is a complex classification as some operations may fit into multiple categories.
- **Physical location of costs.** This is applicable in most circumstances, where land is already owned (e.g. by a farmer or investor) and contractors or external management firms will be employed to undertake most operations.
- **Variability of costs.** This may be most suitable when operations are likely to be carried out in-hand (e.g. by retained labour on a private estate).

Table 1 provides a breakdown of these classifications.

Table 1: Financial costs of forestry classifications

Classification	Description
Factors of production	<p>Factors of production are the inputs needed for the creation of a good (e.g., timber). The factors of production categories distinguish between land, labour, capital and enterprise.</p> <ul style="list-style-type: none"> • Land in the context of forestry includes the place where trees will be planted. • Labour is the effort and time that humans contribute to the production of timber. • Capital is the machinery, tools and raw materials that are used to produce the timber. • Enterprise is the combination of the other three factors to bring timber to market and earn a profit.
Location of costs	<p>The classification of costs based on location distinguishes between direct costs, oncosts and overheads.</p> <ul style="list-style-type: none"> • Directs costs are incurred at the point of physical production (e.g., planting trees or fencing). • Oncosts are associated with employing labour (e.g., supervision of forestry operations). • Overheads are costs that are not easily assignable to any particular operation and could include management fees or insurance.
Variability of costs	<p>The classification of costs based on variability distinguishes between costs that are: variable with production, variable with scale of enterprise and fixed for the enterprise.</p> <ul style="list-style-type: none"> • For costs that are variable with production, total costs will increase with output (e.g., harvesting costs). • For costs that vary with scale of the enterprise, cost per unit of output declines with increasing area afforested or productivity (e.g., establishment and maintenance costs are spread over a larger area or quantity of output). • Fixed costs (e.g., administrative costs) do not necessarily increase or decrease with the scale of the enterprise.

Evaluating the financial costs of forestry

The following section introduces some of the costs of establishing a plantation woodland based on typical contractors' charges and introduces how these costs fit into the classifications in Table 1.

Costing an afforestation project

When carrying out an afforestation project the majority of the cost will be associated with contractor charges. Typical contractor charges for forestry operations can be difficult to come by. Unlike budgeting information for agricultural enterprises these charges are not readily available for use in financial planning. Some reasonable estimates of contractors' charges for typical forestry operations are outlined in Table 2. These consist primarily of labour/

capital, direct or variable costs (either with scale or productivity) depending on the chosen classification (see above).

Alternatively, costs for forestry operations can be derived by calculating labour productivity and wages along with machinery outputs and running costs. For more information see *The Theory and Application of Forestry Economics*.



Table 2: Typical forestry costs

Classification			Category	Typical cost (£)	Timing	Notes/description
Enterprise	Overhead	Fixed	Woodland management plan and grant application	3,000 to 6,000	Prior to planting	A management plan includes site maps, species selections, plan of operations and work schedules. This will typically be written with the assistance of a forestry professional. Management plans are a prerequisite of receiving planting grants and an approved management plan precludes the need to apply for felling licences.
			Land purchase	8,500 (poor) to 19,500 (prime) per hectare	Prior to planting	The fundamental factors that drive land values are location, soil quality, level of supply, tax advantages of owning land and competition from alternative land uses. Poor quality grazing land typically will have the lowest value with prime grassland and arable land commanding a premium.
Land						
Labour and capital	Direct	Variable with scale	Ground preparation (drainage)	90 - 110 per hectare	Year 1	Ground preparation includes clearing the land for tree planting. The costs of this will vary based on the condition of the site. Grassland will often be the least expensive to prepare, while sites with dense vegetation cover (such as bracken) can be more costly. In upland sites, drainage may be required, this is done using either a subsoiler or burying pipes. 'Mounding' (or in some cases ploughing) is used to create an elevated and free draining area of bare soil for tree seedlings to be planted into.
			Ground preparation (mounding)	300 - 400 per hectare	Year 1	
			Fencing	4 - 11 per metre	Year 1	When establishing a woodland for commercial timber production it is crucial to protect the crop from herbivore damage. Lowest cost options will typically prevent livestock access, with higher cost options preventing deer and small herbivore (e.g., rabbit) access.
			Spot spraying	80 - 100 per 1000 trees	Year 1	Spot spraying clears a weed free area for tree planting to reduce competition with tree seedlings. The cost of this will typically include chemicals and the spraying operation.
			Trees for planting	200 - 400 per 1000 trees	Year 1	Prices are dependent on species and size; broadleaves typically cost more than conifers.
			Hand planting	350 - 600 per 1000 trees	Year 1	Planting will take place between November and April, and one person will typically plant around 500 - 700 trees per day.
			Replacing dead trees	200 - 350 per hectare	Year 2 - 3	Replacing dead trees is termed 'beating up' and is typically required once in the second year and again in the third. Costs of replacement trees will depend on the number required.
			Weeding with herbicide	75 - 130 per hectare	Year 1 - 4	Up to two weeding operations per annum might be required in each of the first four years. Costs will typically include materials.
			Roading	13,000 to 30,000 per km	Mid rotation	For commercial timber production, access roads will need to be constructed to allow access for timber lorries. The costs of this will vary depending on access to road stone and the number of culverts required.
			Enterprise	Overhead	Fixed	Mensuration and marking (thinning)
Mensuration (clear fell)	300 - 400 per hectare	Prior to harvesting				
Harvesting and extraction to roadside	10 - 15 per m ³	End of rotation				Timber is normally sold standing in the woodland to a buyer who will bear the costs of harvesting, however in some cases landowners may choose to sell timber after it is harvested and stacked at the roadside.
	Oncost		Supervising harvesting	2-5% of timber revenues	End of rotation	Landowners may employ a forest agent to supervise the harvesting of timber either sold standing (to check sale contract terms are adhered to) or extracted to roadside. The cost of this will vary by management company.
Enterprise	Overhead	Fixed	Management costs and insurance fees	60 - 90 per hectare	Annual	Once the woodland has been established, there will be a requirement for some annual maintenance and management work. For commercial timber production, this will include, fence repairs, pest control, fire prevention, management fees and insurance premiums.



What impact the variation in cost estimations can have on the financial returns of an afforestation project is shown in the example of a typical project below (box 2).

Box 2: Impacts of variation in cost estimations on financial returns

Site: 100 ha upland site

Planting scheme: mixed conifer, planted at a 2m spacing (2,500 trees per hectare)

Yield class: 14, i.e. an average of 14 m³ of timber of the chosen tree species can be expected to grow per hectare per year

Potential yield: around 600 m³ per hectare on a 50 year rotation

Financial returns:

- Revenue (undiscounted): £16,000 per hectare at a standing timber price of £27 per m³.
- Net revenue: Based on a low lifetime costs estimate (undiscounted) of £8,045 per hectare the net revenue would be £7,995 per hectare. Based on a high lifetime costs estimate (undiscounted) of £14,940 per hectare the net revenue would be £1,060 per hectare.

As the example demonstrates it is important to consider increasing costs in the future as these have a significant impact on the potential financial returns of an afforestation project. It is good practice to adopt conservative estimates of costs. This can be done by taking the mid-point or higher value for those quoted as a range in Table 2.

While adopting higher estimates of costs may limit the projected profitability, it is advisable to do so in order to

- avoid 'optimism bias' (underestimation of key costs),
- build contingency for overspend and time delays into the evaluation, and
- set a realistic performance benchmark and expectation for the financial returns of the project.



Evaluating the financial costs of forestry

Practical Guidance & Advice

The concepts of financial and economic costs introduced here together with the information on typical financial costs associated with establishing and maintaining a plantation woodland can be applied when costing a wide range of afforestation projects.

We hope that this guidance note will help you undertake some preliminary due diligence when considering to adopt a forestry enterprise or invest in an afforestation project. Before making the final decision we recommend seeking further advice and guidance from a *forest manager or agent*.

You can find more detailed information on financial evaluations of forestry investments *here*:

- 01 Financial Evaluation of Afforestation Projects - Basic Steps
- 02 Evaluating the Financial Costs of Forestry
- 03 Revenue from Forestry Enterprises
- 04 Accounting for Time
- 05 Alternative Tools for Financial Evaluation of Forestry
- 06 Incorporating Uncertainty and Risk

Technical Information

Guide to Economic Appraisal of Forestry Investments and Programmes in Europe. Snowdon, P. and Harou, P. European Forest Institute 2013. Available at https://efi.int/sites/default/files/files/publication-bank/2018/tr_94.pdf

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About the author

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