Farm Forestry: Land Availability, Take-up Rates and Economics

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SUMMARY

Of the Member States in the European Union Ireland has the lowest proportion of land area covered by forest. Given the large surpluses of agricultural commodities and expected future increases in farm productivity, less land resources will be needed to produce EU food requirements. The Irish government has, therefore, adopted a target to plant 25,000 ha of new forest annually to the year 2000 and thereafter a target of 20,000 ha annually. Substantial incentives to promote afforestation are in place, but with the exception of 1995, the area of land planted has been considerably below target.

The objectives of this study is to examine (i) the availability of land for afforestation, (ii) the factors which impede or promote the uptake of forestry and (iii) the relative economic returns from forestry in a farm context. The availability of land via the market has steadily diminished between 1990 and 1998. The area of agricultural land sold in the period fell from 33,282 ha to 8,656 ha, a fall of 74 per cent. At the same time average price increased from £3,964 per ha to £6,865, an increase of 72 per cent.

Surveys of the opinions of landholders indicate that attitudes toward afforestation are becoming more positive in the 1990s. This is reflected in a substantial increase in the area of farm forestry during the decade. However, a survey of opinions of farmers who had already planted forestry indicated a perception that it is not a suitable replacement for conventional farm enterprises on `good' farmland. Land planted in 78 per cent of sites in this survey was previously utilised as either summer grazing or rough grazing. The principal motivation for planting was the favourable returns to forestry on land that had limited alternative use.

The relative economic returns of forestry in comparison with farm enterprises such as dairying and cattle were assessed post CAP reform (2007), using linear programming techniques. Scenarios involved alternative uses of the farm resources such as extensive/intensive land use, forestry/no forestry and off farm job/no off farm job. The objective was to examine the profitability of forestry on farms in situations in which livestock enterprises qualified for REPS and extensification payments and in which off farm jobs were (a) not available and (b) available at different wage levels. Non economic considerations, such as the perceived unsuitability of forestry as a replacement for agricultural enterprises on `good' land and the irrevocability of the decision to plant forestry could, come into play. In order to reflect these non-economic considerations, together with the higher risk associated with investment by individuals, a high discount rate (10%) was used in calculating returns to forestry.

The analysis shows that in situations in which off farm jobs are either not available or are available at a low wage level, extensification and REPS payments enable efficient livestock enterprises to compete with forestry. In these situations forestry is a profit maximiser only on farms which have surplus land, having first qualified for both extensification and REPS on existing livestock enterprises. However, the availability of off farm earnings at or near the industrial wage rate leads to increases in the forestry area, sometimes to the exclusion of cattle enterprises.

Economic criteria therefore could mean that large areas of land could be transferred to forestry from conventional agriculture in the post 1999 CAP reform situation. Economics may not, however, be the most appropriate arbiter of such a decision.

INTRODUCTION

Given the large surpluses of agricultural commodities and future increases in productivity in agriculture, fewer land resources will be needed to produce EU food requirements. In addition, recent decisions on the reform of the CAP have imposed effective quotas on most conventional agricultural enterprises. These decisions, together with the initiation of the WTO negotiations, have added to the long-term deterioration in the real prices of agricultural output. The importance of premia in maintaining the profitability of conventional agricultural land using enterprises is increasing with each round of CAP reform. This has implications for the future competitiveness of many farm businesses. It also raises the issue of the place of forestry as a farm enterprise. Forestry is unique among enterprises qualifying for premia since it does not have volume or area restrictions imposed on it. In addition farm forestry is not subject to any form of taxation.

In the European Union Ireland has the lowest proportion of land area covered by forest, at 9 per cent, compared with an EU average of 31 per cent. With persistent farm surpluses in the traditional commodities many arguments have been made for forestry as a land use option. The Government's target was to plant 25,000 ha of new forest per annum up to year 2000: thereafter a target of 20,000 ha per annum is envisaged. While there are substantial incentives to promote afforestation, these target levels are not currently being met and are now under review.

This study was carried out to examine specifically:

1. the factors which influence land availability for forestry
2. the factors influencing individual landowners to plant trees, and
3. the relative economic returns to landholders from forestry

In considering these objectives the study traced the evolution of forestry adoption in Ireland. A review of the policy measures and context supporting private and farm forestry is presented. Aggregate data are used to trace the evolution of afforestation since the 1980s. Surveys in selected counties and regions were also carried out to examine the attitudes of landholders to forestry and the motivating factors that promote the up-take of afforestation. A final element of the study examines the economic aspects of forestry within an individual farm context.

Context and Evolution of Farm Forestry

The first incentives for afforestation were introduced in the Western Package Scheme for the Disadvantaged Areas in 1981. Prior to that, afforestation in Ireland was undertaken mainly by the State. In 1987 an improvement in the incentives for forestry was introduced with the payment of allowances to compensate landholders for foregoing livestock headage payments. The Forestry Operational Programme and the Operational Programme for Rural Development introduced in 1990, provided further encouragement for private forestry through increased incentives. These programmes were further enhanced in 1994 and 2000. There are now substantial incentives for changing land use to forestry.

Incentives fall into two main categories: (a) establishment and maintenance grants and (b) forest premia. These are operated by the Forest Service under the control of the Department of the Marine and Natural Resources. At present establishment grants range from £1,600 per ha to £4,000 per ha depending on the mix of species and whether the area planted is designated as `closed' or `unenclosed'. Maintenance grants paid after 5 years range from £550 to £1,300. Forest premia are paid to farmers for 20 years, ranging from £165 per ha annually to £373 per ha depending on species mix, disadvantaged status of the land and whether the land is enclosed or not. Non-farmers receive a lower rate of premium ranging from £135 perha to £145 per ha. An additional incentive is provided by the fact that income from farm forestry is exempt from all forms of tax.

The response to these incentives can be interpreted from Table 1 which shows the annual level of new plantings from 1986 to 1998.

Table 1: Afforestation Levels by Different Categories of Planter, 1986-1998

Year	State	Farmers	Part-time Farmers	Non-farmers	Total private	Total
	ha.	ha[1].	ha[1].	ha[1].	ha.	ha.
1986	4,689	-	-	-	2,280	6,969
1987	5,395	-	-	-	2,953	8,349
1988	7,112	-	-	-	4,596	11,708
1989	6,629	-	-		8,498	15,127
1990	6,670	3,988	-	5,159	9,147	15,817
1991	7,855	7,990	-	3,302	11,292	19,149
1992	7,565	4,195	922	4,017	9,134	16,699
1993	6,827	4,497	2,282	2,391	9,170	15,999
1994	6,622	6,504	2,618	3,714	12,836	19,458
1995	6,367	10,642	4,033	2,668	17,343	23,710
1996	4,426	11,413	3,614	1,529	16,556	20,982
1997	851	7,577	1,635	1,370	10,582	11,433
1998	2,926	7,085	1,837	1,099	10,021	12,927

[1] Detailed data not available for earlier years

Source: Forest Service, Forestry Statistics 1999

There were two main aspects of the response: (i) an increase in the area planted, and (ii) a major switch to private planting. The period since 1986 was characterised by a steady increase in afforestation, from 6,969 ha in that year to a peak level of 23,710 ha in 1995. Since then, however, there is a very significant decline to 12,927 ha in 1998. This increased level of planting is due to new private planting, mainly by full-time farmers. This response can be attributed to the increased incentives available. Why such a major decline in afforestation has occurred since 1996, however, is not clearly understood.

There are substantial regional differences in the level of forest cover in the country. Figure I shows the level of forest cover by DED for 1999. Forestry covers 30 per cent or more of the land in substantial areas of the country. Wicklow, north Clare, Leitrim, Cavan, Donegal, north Mayo and west Waterford have high levels of cover. In general these areas are associated with less fertile soils and hilly terrain. In addition increased levels of afforestation since the late 1980s have been concentrated in these localities.

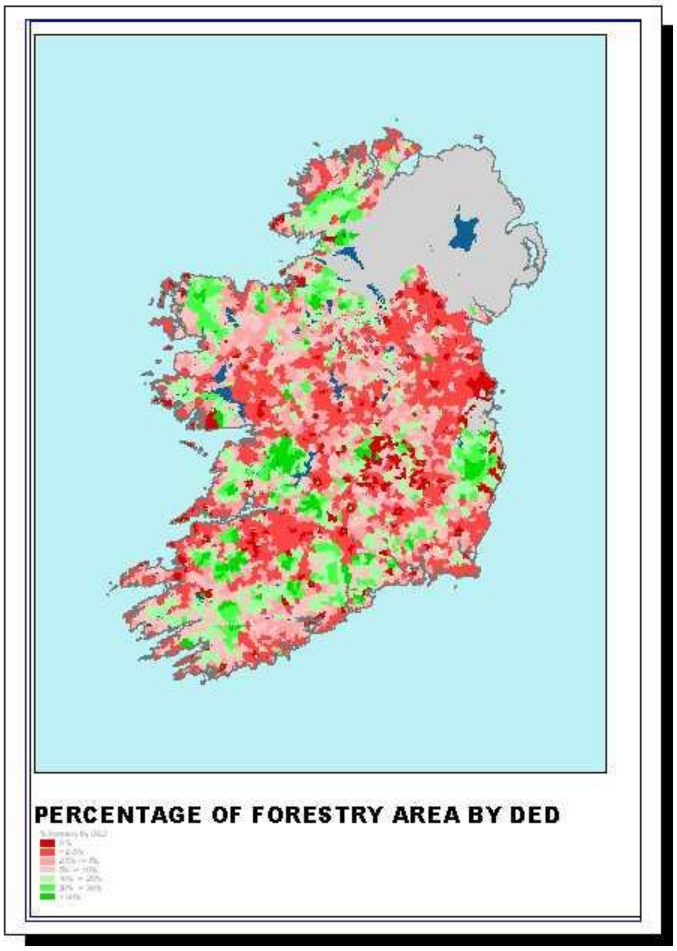

Figure I

Source: Forest Service

FACTORS INFLUENCING LAND AVAILABILITY

Land becomes available for afforestation in two major ways: (i) decisions of present landholders (mainly farmers) to plant some or all of their land, and (ii) decisions at change of ownership either by inheritance/succession or through the market. While the main focus of this study concerns the former, it is relevant to consider the potential of land availability for forestry from land coming on the market. Table 2 outlines the average area and price of land coming on the market between 1990 and 1998.

Table 2: Area of agricultural land sold, and average price paid, 1990-1998

Year	Area Sold	Average price paid/ha
	(ha)	**(£)**
1990	33,282	3,964
1991	31,883	3,736
1992	21,132	3,764
1993	14,210	3,909
1994	18,855	4,215
1995	20,352	4,398
1996	18,089	5,094
1997	11,188	5,373
1998	8,656	6,805

Source: CSO Statistical Release (various issues)

It is clear that between 1990 and 1998 the potential availability of land for afforestation via the market has steadily diminished. In 1998, 8,656 ha changed ownership through sales. This is less than a quarter percent of total agricultural land and represents a decline of almost threequarters in the eight-year interval since 1990. This decline in the volume of sales was accompanied by an increase in the price of land of more than 70 per cent. In these circumstances the possibility and economic rationale of buying land for afforestation has disimproved.

The vast majority of land mobility transactions occur either as a gift during the owner's lifetime or through inheritance after the owner's death. However, there is no information on the change of land use patterns at these critical events. In this study it was not possible to examine the stream of land becoming available at the time change of ownership occurs. However, the factors that influence individual landowners in deciding to plant or not to plant new land were examined by means of a survey of farmer's opinions. Emphasis was placed on establishing, on the one hand, the factors that deter landholders from undertaking afforestation and on the other hand, the factors and circumstances which motivate landholders to plant trees.

FACTORS IMPEDING AFFORESTATION

Numerous studies in Ireland and elsewhere have examined the attitudes of farmers to afforestation. In general the conclusion from Irish studies is that farmers view forestry very differently to other land use enterprises. Kearney *et al.* (1993) found traditional or cultural factors contributed significantly to these attitudes. For instance in Co Wicklow, where there is some tradition of forestry, 87 per cent of farmers had positive attitudes toward afforestation but in the western counties of Mayo and Roscommon less than one-third of farmers had similar views. These unfavourable attitudes were summed up by the authors thus: that forestry was considered inimical to the development of agriculture and could cause depopulation and isolation.

In this study an examination of farmers' attitudes towards afforestation in two selected counties[1] were examined as well as the reasons proffered for negative attitudes. In a survey of 415 farmers in Co Mayo during October/November 1995, farmer attitudes to afforestation in general were established [Figure II]**.**

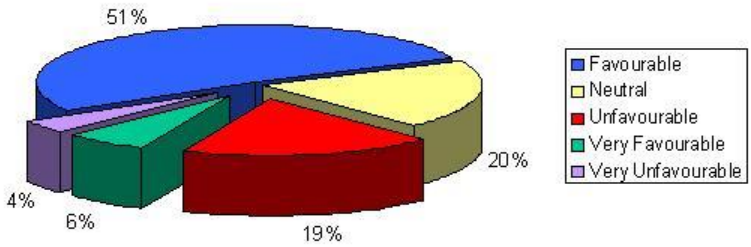

Figure II: Co Mayo Farmers' Attitudes to Forestry

More than half (57%) of farmers indicated a favourable attitude towards `forestry in general' while another 20 per cent had no view either way. Conversely almost a quarter (23%) would not welcome forestry development in their area.

Concerning the option of planting some forest on their own farm, Table 3 summarises the results.

Table 3: Co Mayo farmers' intentions to plant trees on their own land	
	%
Had some forest planted	3
Considered/advanced plans to plant	9
Not likely to plant	45
Definitely not interested	43
All	**100**

It is clear that the vast majority of farmers in the county were not considering afforestation on their own farm despite the incentives available. The main difficulties put forward by those not considering forestry are summarised in Table 4.

Table 4: Co Mayo farmers' perceived main difficulty with farm forestry	
Difficulty	**%**
Location/soil not suitable	10
Farm too small/needs the land	51
Returns not profitable	5
Prefers to farm	19
Other	15
All	**100**

The main difficulty with the idea of farm forestry was that farms were seen as too small to allocate some land to forestry because existing enterprises would have to be scaled back. In addition about one in five indicated they preferred farming to forestry.

In another study in Co Offaly in 1998, 370 farmers indicated broadly similar attitudes. County estimates show that 6 per cent of farms had a forest enterprise with another 4 per cent considering afforestation. Farmers' ratings of forestry as a farm enterprise on their own farm were mixed, with 38 per cent (of those who had not planted nor intended to plant) not in favour and another 22 per cent neutral or indifferent. Thirty per cent indicated a favourable

attitude. The most often cited difficulty was the view that `good land' should not be planted. Favourable attitudes were supported by the belief that forestry was a good use of marginal land or otherwise yielded favourable/or guaranteed returns.

From these studies it may be concluded that there is still a degree of opposition or apathy to forestry among farmers. This arises mainly from pragmatic considerations rather than cultural reasons. To explore this issue further a study of landholders who had already planted some forest was undertaken.

FACTORS WHICH PROMOTE AFFORESTATION

To examine and understand the motivating factors which promote farm forestry, a survey of farmers who had planted new forest between 1992 and 1996 was carried out. A sample of 206 farmers in Counties Leitrim, Roscommon (West Region), Offaly and Tipperary (Midland Region) were interviewed in late 1997. The selection of the sample[2] was made by the Forest Service and the study sites were picked to represent two contrasting farming areas, namely (a) an area in the north-west designated under EU wide criteria as Severely Handicapped and (b) an area in the midland counties in which soils are more fertile and farm structure larger. The specific objectives of the study were: (i) to establish farmers' attitudes and the main motivating factors in adopting a forest enterprise, (ii) to identify the type of afforestation planted and (iii) to establish the farm and household circumstances of farm forest operations.

Motivation and Attitudes to Adoption: The most important reason is summarised, by region, in Table 5**.**

Table 5: Most important reason for planting, by Region

Reason	West	Midlands	Both Areas
Premia incentives	10	21	17
Forestry: better returns	9	7	8
Limited utility of land	51	36	41
Land inconvenient to farm	9	5	6
Long term investment	3	11	8
Labour difficulties	3	6	5
Off-farm job/Tax incentives	3	4	4
Other	12	10	11
All	**100**	**100**	**100**

The reason most often cited for the adoption of a forest enterprise was the limited utility of the land planted, especially in the West region. Coupled with the problem of land being inconvenient to farm, 60 per cent of farmers in the West and 41 per cent in the Midlands indicated limited utility and inconvenience as the main reason for planting. Only a quarter of farmers indicated direct economic factors such as premia or better economic returns from forestry as the main reason. This economic logic was most often associated with the Midlands. Other factors such as long term investments and tax incentives did not feature very often. Questioned on their satisfaction with the decision to plant trees more than 90 per cent indicated a satisfactory experience.

However, as shown in Table 6 the attitude of farmers (who already had some planting) toward using `good farm/grazing' land for forestry were not so favourable.

Table 6: Attitude towards planting good farm/grazing land

Attitude	%		
Would plant	**23**		
Strongly opposed		35	
Most likely would not		42	
All opposed, of which:	**77**		
• Less income from forestry			(18)
• Prefer to farm good land			(28)
• Good land should be farmed			(12)
• Limit schemes/options			(15)
• Other			(4)
All Farms	**100**		

More than threequarters of farmers definitely would not, or most likely would not, plant trees on `good land'. The main factors impeding adoption were beliefs and preferences about planting good land or income considerations or impediments to availing of such schemes as the Rural Environment Protection Schemes (REPS). Furthermore, there were no differences in attitudes between the two regions. On the other hand almost a quarter of farmers would plant good land and this view was held especially by farmers with relatively large areas planted, 12 ha of more. Other studies such as Ni Dhubhain *et al.* (1993) in Ireland and Selby *et al.* (1995) in Finland found similar attitudes among farms concerning afforestation of good land.

Farm Forestry

The average size of plantation was 13.4 ha but this varied from 9.1 ha in the West to 15.5 ha in the Midlands. Conifers accounted for more than half (53%) of sites in the West region while broadleaves or broadleaf mixtures tended to dominate (60%) in the Midlands region. Threequarters of the new afforestation was on less fertile land such as wet mineral soils or peatlands. However, in the Midlands region a third of planted sites were on drained/good land. The previous utilisation of planted land reflects this finding as shown in Fig. III.

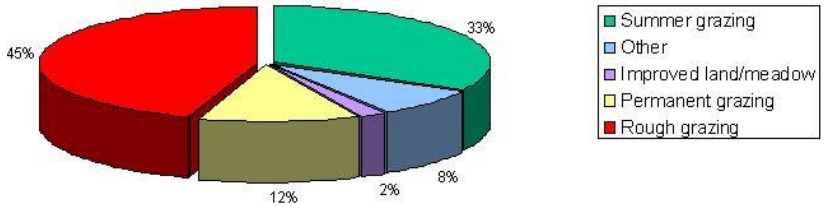

Figure III: Previous Utilisation of Land

More than threequarters (78%) of sites planted were either summer grazing or rough grazing. This did not vary significantly between regions. In this regard it is likely that the forest enterprise had little effect on farm output on these farms. This conclusion is in line with studies in Scotland (Mather, 1995) and Kearney *et al.* (1993) in Ireland. Kearney concluded that up to a million ha in the Irish case, yielding very little at present, could be put under forestry without affecting agricultural output to any degree.

Forest Farms and Households: The main characteristics of farms with a forestry enterprise are summarised in Table 7.

Table 7: Farm Characteristics of Farms with a Forestry Enterprise

Characteristics	
Farm size (ha)	45.5
Farm system (%)	
Dairying	8
Drystock	49
Tillage/other	18
Forestry only	25
All farms	100
Participation in REPS (%)	34

The size of forest farms are generally large at 45.5 ha, compared to the national average for all farms of 29.5 ha in 1998 (CSO, 1999). In this respect there was a significant difference between the regions where the average forest farm in the West was 26.3 ha as compared

with 55.2 ha in the Midlands. By and large, forest farms were devoted to drystock with only a small proportion specialising in dairying. However apart from Co Tipperary the survey regions do not specialise in dairying to a major degree.

A notable feature of the findings is that a quarter of all forest farms was entirely devoted to forestry; this situation did not vary between regions. A finding which was not anticipated is that a third of forest farms were also participating in REPS. Most likely those forest farms already had planted before they were involved in REPS.

Details of the forest farm households are summarised in Table 8**.**

Table 8: Characteristics of Farm Operator and Households on Farms with a Forestry Enterprise

Characteristics	
Operator	
Operator's age (years)	51.8
Operator has off-farm job (%)	35.0
Operator's post-primary education (years)	3.6
Operator's Forest training (formal) (%)	5.0
Operator Forest training (short course) (%)	23.0
Contact with Teagasc adviser (%)	42.0
Household	
No. of persons	3.8
Demographically viable (%)	84.0

In so far as can be judged the demographic profile of forest farm households does not differ substantially from the national situation. Only 5 per cent of operators had any formal training in forestry management (mainly one year on a specialist agricultural college course). Twenty three per cent had participated in the Teagasc 20-hour course.

The general conclusion from the survey is that forestry as a farm enterprise is not an established land use pattern, even for farmers who already had land newly planted. In the main, farmers do not see forestry as appropriate for `good land', preferring plantings on marginal land such as summer grazing or rough grazing. Only 10 per cent indicated a long-term investment motivation for afforestation and almost threequarters had no training in

forestry management. In the absence of inherited tradition and skills in forest management it seems likely that forestry will remain a low preference land use option in the mindset of landholders generally.

ECONOMIC RETURNS OF FARM FORESTRY

While direct economic criteria do not seem to be the primary motivation for afforestation it is axiomatic that perceived economic benefits are necessary requirements in deciding to plant. The range and level of incentives currently available to farmers for various categories of forest are shown in Table 9.

Table 9: Premia Rates for different species

Species	Premia (£)	Planting Grant (£)	Maintenance Grant (year 5) (£)
Conifers			
• non-diverse	265	1,600	550
• 20% diverse	308	1,700	550
• 40% diverse	320	1,900	600
Broadleaves			
• Ash/sycamore, etc	340	3,000	900
• Oak/Beech	373	4,000	1,300

The highest levels of premia and grants are paid for broadleaves at £340 per hectare and £3,900 (including planting and maintenance) respectively for ash and sycamore and £373 and £5,300 respectively for oak and beech. The lowest levels are for non-diverse conifers at £265 and £2,150 per hectare. All payments are free of tax.

As a comparison Table 10 shows the level of income per ha obtained from different systems of farming as shown by the National Farm Survey for 1998.

Table 10: Per cent of farms in different farm systems and Family Farm Income (FFI) derived per ha, 1998		
System	**% of All Farms**	**FFI/ha**
Specialist dairying	19	540
Dairying and other	13	405
Cattle rearing	22	229
Cattle and other	27	263
Mainly Sheep	14	200
Mainly Tillage	5	340
All Systems	**100**	**336**
Source: Teagasc NFS 1999		

Apart from the dairy systems and to a lesser extent the Mainly Tillage system, forestry premia payments exceed prevailing farm income levels. Given that it is a very low cost enterprise forestry could be expected to be a realistic land use option on many drystock farms. This issue is explored more fully in the following section.

The Profitability of Forestry: A Linear Programme Analysis

This analysis examines the profitability of farm forestry compared to existing agricultural enterprises. Since we are investigating future profitability under conditions laid down by the CAP reform agreement, the gross margins used in the analysis for conventional enterprises allow for the cuts in prices and increases in compensatory payments arising from this agreement. These are, therefore, presented for the year 2007 when the CAP reform agreement will be fully operational. They are compared in the following tables with pre reform (1998) gross margins. The specific assumptions used in the calculation of post CAP reform gross margins are derived from the FAPRI Ireland model. (Donnellan *et al.* 1999 and FAPRI Ireland, 2000).

Optimising Models: The objective of the analysis is to find out the place of the forestry enterprise in the optimum plans for individual representative farms under the conditions of the 1999 CAP reform agreement. Linear Programming was the technique used in this exercise.

In the analysis presented below the objective is to maximise gross margin from the available farm resources. Given the different enterprises that are feasible, the model chooses enterprises that are most efficient in utilising the limited resources available. For most

planning or choice problems there are restrictions e.g. land area, labour and capital. Restrictions are also imposed arising out of compliance with extensification or REPS conditions. These set limits to the kinds of plans that can be considered. Linear programming is an efficient way of determining optimum plans, if there are numerous enterprises or processes and numerous restrictions in attaining a specific objective such as maximising farm gross margin.

Selection and Specification of Representative Study Farms

The objective in the selection of farms for study is that they would represent existing types of farms and farming systems. In this study four farms were chosen. Three of these (two dairy farms and a small cattle farm) were taken from a previous study in which cluster analysis was used to group farms into a small number of heterogeneous types (Cawley *et al.* 1995*).* The source of the data for this exercise was the National Farm Survey. The fourth farm (a large cattle farm) was chosen in discussion with cattle specialists and represents the large commercial cattle farm sector.

The following are the details of the representative farms selected for analysis:

1	**Dairy Farms**	
	(a)	Small extensive dairy farm with the following resources:
		Land 26 ha
		Capital (livestock) IR£22,000
		Labour: 1.3 labour units
		Milk Quota: 10,000 gallons
	(b)	Large intensive dairy farm with the following resources:
		Land 52 ha
		Capital (livestock) IR£68,000
		Labour: 1.8 labour units
		Milk Quota: 36,000 gallons

2	**Cattle Farms**	
	(a)	Small extensive cattle farm with the following resources:
		Land 22 ha
		Capital (livestock) IR£12,000
		Labour: 0.9 labour units
	(b)	Large intensive cattle farm with the following resources:
		Land 62 ha
		Capital (livestock) IR£84,000
		Labour: 1.8 labour units

The focus in the analysis was to examine the potential contribution of forestry to gross margin on these farms in 2007 i.e., when the 1999 CAP reform agreement is fully operational. Account was taken in calculating returns to livestock of the importance of extensification payments and qualification for REPS payments in the CAP reform agreement.

The increase in employment within the Irish economy has not only improved the opportunities for employment off farm but the wages earned from such employment have also increased. Off farm job opportunities were, therefore, included in the analysis. d. The results are shown for the scenarios listed below:

Scenarios

Pre CAP Reform (1998)

1.		Excluding Extensification/REPS, Off-farm jobs and Forestry

Post CAP Reform (2007)

1.		Excluding Extensification/REPS, Off-farm jobs and Forestry
2.		Including Extensification/REPS but excluding Off-farm jobs and Forestry
3		Including Extensification/REPS and Off-farm jobs @ £6.50 per hour but excluding Forestry

4		Including Extensification/REPS, Off-farm jobs @ £ 6.50 per hour and Forestry
5		Including Extensification/REPS, Off-farm jobs @ £11.37 per hour and Forestry

The results are presented for the years:

1.		1998 (Pre CAP Reform)
2.		2007 under the conditions arising from the CAP reform agreement (Post CAP Reform)

Livestock gross margins used in the analysis are taken from the Teagasc publication Management Data for Farm Planning, 1998. They do not include headage payments which are paid exclusively in the Disadvantaged Areas. The effect of disadvantaged area payments will be discussed separately. The enterprises included in the analysis were: (a) Calf to beef at 2 years, (b) Single suckling selling weanlings and (c) Single suckling finishing all progeny to beef. All livestock enterprises were included at a high level of efficiency. How the level of efficiency of the livestock enterprises affects optimum plans will receive separate attention. Forestry profitability is represented in the analysis by annuities calculated by conventional discounted cash flow techniques (Phillips 1999). In calculating the annuity for forestry a discount rate of 10 per cent was used. This is higher than the rate, normally in the region of 5 per cent, used by foresters. The reason for choosing a higher rate is to reflect the shorter time horizon that farmers have relative to institutional or state investors. It is also an attempt to take into account the non-economic issues that inhibit farmers from adopting forestry as a farm enterprise and which inform farmers' decisions in relation to forestry. Some of these issues are highlighted in the surveys reported above.

Arising out of discussions with foresters twenty per cent diverse conifers (Sitka Spruce), at yield class 20 and 40 year rotation, was the forestry enterprise used in all scenarios and policy situations. The premia included (£308/ha) were those for 20 per cent diverse conifers shown in Table 9. Grant aid was £1,700 per ha and maintenance grants were included at a level of £550 per ha. Returns and costs of operations were derived from data by O'Brien (O'Brien, 1986) updated by discussions with the staff of Coillte and Nuala Ni Fhlaitheartaigh and Michael Bulfin, Teagasc. Returns to labour from off farm employment in 2007 were calculated using November 1999 levels of the minimum and average industrial wage and assuming an average annual inflation rate of 5 per cent. These are (a) £6.50 per hour representing the minimum wage and (b) £11.37 per hour representing the average industrial wage. These levels are an attempt to mirror opportunities in unskilled and skilled off farm occupations respectively.

Results of Linear Programming Analysis

Table 11: Small Dairy Farm (26 ha)						
	Pre-Reform (1998)	**Post- Reform (2007)**				
Scenarios	**1**	**1**	**2**	**3**	**4**	**5**
Off Farm Job	No	No	No	Yes (£6.50/ hour)	Yes (£6.50 hour)	Yes (£11.37/ hour)
Extensification	No	No	Yes	Yes	Yes	Yes
REPS	No	No	Yes	Yes	Yes	Yes
Forestry	No	No	No	No	Yes	Yes
Farm Plan						
Gross Margin £	13,213	13,246	18,674*	27,415*	27,415*	29,568*
Enterprises	8 Dairy cows	9 Dairy cows	9 Dairy cows	9 Dairy cows	9 Dairy cows	No Dairy cows
	28 LU cattle	28 LU cattle	28 LU cattle	28 LU cattle	28 LU cattle	No cattle
	No Forestry	No Forestry	No Forestry	No Forestry	No Forestry	26 ha Forestry
Weeks worked off Farm	None	None	None	34	34	63
***Includes income earned off farm. 20 per cent of REPS payment has been deducted to cover compliance costs						

Table 11 shows the different scenarios in relation to the small dairy farm for the pre and post CAP reform situations. When similar situations are compared pre and post CAP reform (scenario 1 in each case) little change in gross margin takes place arising out of CAP reform.

Since the stocking rate on the farm allows the farm to qualify for both extensification and REPS payments post CAP reform scenario 2 is more profitable than scenario 1. The availability of off farm employment at £6.50 per hour increases gross margin by approximately 50 per cent (scenario 3), through use of underutilised labour. On this farm forestry is not an option when off farm jobs are not available or when off farm jobs pay £6.50 per hour or less (scenarios 1,2,3 and 4). However when off farm jobs are available at or near the industrial wage (£11.37) all of the farm (26 ha) is taken up with forestry (scenario 5). This increases gross margin by 7.8 per cent. In this scenario livestock enterprises are unable to compete and 63 weeks is worked off farm.

A similar situation pertains in the case of the larger (52 ha) more intensive dairy farm (Table 12).

Table 12: Large Dairy Farm (52 ha)

	Pre-Reform (1998)	**Post Reform (2007)**				
Scenarios	**1**	**1**	**2**	**3**	**4**	**5**
Off Farm Job	No	No	No	Yes (£6.50	Yes (£6.50/hr)	Yes (£11.37/hr)
Extensification	No	No	Yes	Yes	Yes	Yes
REPS	No	No	Yes	Yes	Yes	Yes
Forestry	No	No	No	No	Yes	Yes
Farm Plan						
Gross Margin £	38,883	38,059	41,792*	48,079*	48,079*	56,213*
Enterprises	30 Dairy cows	31 Dairy cows	31 Dairy cows	31 Dairy cows	31 Dairy cows	No Dairy cows
	98 LU cattle	97 LU cattle	42 LU cattle	42 LU cattle	42 LU cattle	No
	No Forestry	No	No	No	No Forestry	52ha
Weeks worked off	None	None	None	24	24	84

* Includes income earned off farm. 20 per cent of REPS payment has been deducted to cover compliance costs

Table 12 shows the different scenarios in relation to the large dairy farm for the pre and post CAP reform situations. When similar situations are compared pre and post CAP reform (scenario 1 in each case) a 2 per cent decline in gross margin takes place arising out of CAP reform. In scenario 2 stocking rate on the farm is lowered from 2.5 livestock units per hectare to 1.4 livestock units per hectare by reducing cattle numbers from 97 livestock units to 42 livestock units. This allows the farm to qualify for both extensification and REPS payments. As a result gross margin increases by approximately 10 per cent (scenario 2). The availability of off farm employment at £6.50 per hour increases gross margin by a further 15 per cent approximately (scenario 3). On this farm forestry is not an option when off farm jobs are not available or when off farm jobs pay £6.50 per hour or less (scenario 1, 2, 3 and 4). However, when off-farm jobs are available at or near the industrial wage (£11.37) all of the farm (52 ha) is taken up with forestry (scenario 5) thereby increasing gross margin by approximately 17 per cent. In this scenario livestock enterprises are unable to compete and 84 weeks per annum is worked off farm.

Table 13 shows figures for the small cattle farm.

Table 13: Small Cattle Farm (22 ha)

	Pre-Reform (1998	**Post- Reform (2007)**				
Scenarios	**1**	**1**	**2**	**3**	**4**	**5**
Off Farm Job	No	No	No	Yes (£6.50/ hr)	Yes (£6.50/ hr)	Yes (£11.37/ hr)
Extensification	No	No	Yes	Yes	Yes	Yes
REPS	No	No	Yes	Yes	Yes	Yes
Forestry	No	No	No	No	Yes	Yes
Farm Plan						
Gross Margin £	4,744	4,424	8,344*	16,502*	18,340*	25,933
Enterprise	Dairy cows None	Dairy cows None	Dairy cows None	Dairy cows None	Dairy cows None	Dairy cows None
	20 LU cattle	20 LU cattle	20 LU cattle	20 LU cattle	20 LU cattle	No Cattle

	No Forestry	No Forestry	No Forestry	No Forestry	7.5 ha Forestry	22 ha Forestry
Weeks worked off-farm	No off-farm job	No off-farm job	No off-farm job	31	30	42
***Includes income earned off farm. 20 per cent of REPS payment has been deducted to cover compliance costs						

Table 13 shows the different scenarios in relation to the small cattle farm for the pre and post CAP reform situations. When similar situations are compared pre and post CAP reform (scenario 1 in each case) a 7 per cent decline in gross margin takes place arising out of CAP reform. Since the stocking rate on the farm allows it to qualify for both extensification and REPS payments, post CAP reform scenario 2 is nearly 90 per cent more profitable than the more intensive scenario 1. Arising from the surplus of labour on this farm, the availability of off farm employment at £6.50 per hour increases gross margin by approximately 98 per cent (scenario 3) and 31 weeks off farm work are taken up. Since stocking rates are very low on this farm, forestry is an option when off farm jobs pay £6.50 per hour thus increasing gross margin by 11 per cent. (scenario 4). However when off farm jobs are available at or near the industrial wage (£11.37) the total farm (22 ha) is devoted to forestry (Scenario 5) thereby increasing gross margin by 27 per cent. In this scenario livestock enterprises are unable to compete while all labour (42 weeks) works off farm.

Table 14 shows a summary of the results for the large cattle farm case.

Table 14: Large Cattle Farm (62 ha)						
	Pre-Reform (1998)	**Post- Reform (2007)**				
Scenario	**1**	**1**	**2**	**3**	**4**	**5**
Off Farm Job	No	No	No	Yes (£6.50/ hour	Yes (£6.50/ hour	Yes (£11.37/ hour)
Extensification	No	No	Yes	Yes	Yes	Yes
REPS	No	No	Yes	Yes	Yes	Yes
Forestry	No	No	No	No	Yes	Yes
Farm Plan						

Gross Margin £	30,970	28,279	36,230*	45,569*	45,569*	59,035*
Farm Enterprise	140 LU cattle	140 LU cattle	88 LU cattle	88 LU Cattle	88 LU cattle	Cattle None
	Forestry None	Forestry None	Forestry None	Forestry None	Forestry None	62 hectares Forestry
Weeks worked off farm	None	None	None	35	35	82

*****Includes income earned off farm. In addition 20 per cent of REPS payment has been deducted to cover compliance costs

Table 14 shows the different scenarios in relation to the large cattle farm for the pre and post CAP reform situations. When similar situations are compared pre and post CAP reform (scenario 1 in each case) a 10 per cent decline in gross margin takes place arising out of CAP reform. If the stocking rate on the farm is reduced by reducing cattle numbers from 140 LUs to 88 LUS to allow the farm to qualify for both extensification and REPS payments gross margin increases by over a quarter (scenario 2). In a situation in which the farm reduces livestock numbers to qualify for extensification and REPS, labour is in surplus. The availability of off farm employment at £6.50 per hour increases gross margin by a further 26 per cent approximately (scenario 3 and 4) and a total of 35 weeks is worked off farm as a result. On this farm forestry is not an option when off-farm jobs are not available or when off farm jobs pay £6.50 per hour or less (Scenarios 1,2,3 and 4). However when off-farm jobs are available at or near the industrial wage (£11.37) the total farm (62 ha) is taken up with forestry (scenario 5) thereby increasing gross margin by approximately 30 per cent. In this scenario livestock enterprises are unable to compete and all farm labour (82 weeks) works off farm.

The analysis, as presented above, includes a comparison of forestry with cattle and dairying. A similar picture emerges when sheep instead of cattle enterprises are used.

Gross margins used in the analysis do not include headage payments that are paid in the Disadvantaged Areas. If these were included gross margins for livestock, that were eligible for these payments, would be increased. Suckler cows, cattle and ewes for example would, therefore, be relatively more competitive .The analysis shown in the above tables was also carried out with disadvantaged area payments being included in the profit from the various livestock enterprises. This analysis showed that while livestock enterprises were marginally more competitive relative to forestry it did not change the choice of enterprise in most scenarios.

All analyses quoted above have been carried out assuming that livestock are operated at a high level of efficiency. Analyses assuming that livestock enterprises are operated at more moderate levels of efficiency lowered the levels of gross margin earned but did not otherwise change the results in most scenarios. Forestry did, however, replace livestock in some scenarios in which off farm employment was available at the minimum wage i.e., £6.50 per hour.

SUMMARY AND CONCLUSIONS

Ireland has the lowest forest cover in the European Union at 8 per cent compared with an average of 31 per cent for the Community as a whole. Apart from some isolated districts there is little tradition of forestry in Ireland and trees or timber have little consequence for the daily lives of rural people or the culture of rural areas. Against this background the government adopted an afforestation target of 25,000 ha annually, or a threefold increase on the 1988 level. Substantial financial incentives were put in place and initially there was a positive response from farmers. By 1995 the government's target was almost achieved. However since then the level of new planting, though higher than pre 1988 levels, has declined to about half the intended target. The reasons for these changing responses are not clear but ultimately reflect the myriads of decisions of individual landowners as to whether or not they plant. The aim of this study was to examine some of these issues.

Land sales can be a potential source of land for afforestation. Since 1990 that source of land availability is becoming much more restricted. In the period between 1990 and 1998 the area of land changing ownership through the market has fallen by three-quarters while the average price has increased by more than 70 per cent.

The indications from survey results are that the attitudes of farmers towards afforestation have become more positive in recent years. It is, however, also evident from the surveys carried out as part of this study that most farmers do not view forestry as a substitute for established farm enterprises. This is especially the case on small farms where land area is more restricted. Moreover it is a widely held view that forestry is not an appropriate land use for "good" farmland.

These views predominate even among those farmers who have already planted forestry. In the majority of situations the previous land use of planted sites was either summer grazing or rough grazing. In addition the soils involved were agriculturally marginal. It is most likely therefore that the impact of forestry on farm output in these circumstances is quite low. This confirms the conclusions (Blom *et al*. 1990) that forestry was only a definite competitor for land classified as rough grazing.

Surveys of the opinions of farmers who have planted new forest, in the period 1992 to 1996, show that the principal motivation was that forestry made good use of land with limited utility or which was inconvenient to farm. Economic reasons such as better returns, premia incentives or long term investments were less widely cited.

The farm circumstance most closely associated with afforestation was large farm size. Large farm size gives more scope to consider alternative land use options. Only a minority of farmers with a forestry enterprise have any formal training in forestry management or maintenance.

The picture emerging from the profitability analysis is that, the increased opportunities off farm for farm family labour and the higher levels of remuneration in off farm occupations could have an effect on the choice of farm enterprise in the post CAP reform situation.

In a situation where off farm jobs are not available, forestry will be a economically viable enterprise only on farms that have surplus land. In the absence of off farm job opportunities, extensification premia and REPS payments will enable efficient conventional cattle enterprises to compete with forestry. Unless off farm job opportunities are available, therefore, the future of many Irish farms post CAP reform would seem to involve farming extensively and in an environmentally friendly manner in order to qualify for both extensification and REPS payments. The forestry option is only relevant when the conditions for qualification for extensification and REPS payments are first complied with.

With the success of the Irish economy, however, off farm job opportunities are becoming increasingly available. If this situation continues a different picture emerges to that discussed in the previous paragraph.

When off farm work is valued at or near minimum wage rates there is no change in farm plans. However, off farm earnings at or near the industrial wage rate changes the farm plan by increasing the forestry area, sometimes to the exclusion of livestock enterprises. This raises issues in relation to the competitiveness of livestock enterprise in an economy in which labour costs are increasing significantly. It also highlights the issue of the finality of the decision to plant forestry. Such a decision is irreversible and determines the use of land for future generations. Economic criteria may not be the most appropriate arbiter of such a decision. This is probably reflected in the attitudes of farmers to planting forestry on good agricultural land.

These conclusions are based on an analysis in which returns to forestry were calculated using 10 per cent discount rate. This is higher than the normal rate used by foresters. The higher rate was designed to reflect the shorter time horizon in which farmers normally make decisions and the antipathy to forestry recorded in the responses to questions in the various surveys carried out as part of this study. If, however, the discount rate used is overestimated then forestry is more competitive than the conclusions above state. In the analysis 20 per cent of REPS payments were deducted to cover compliance costs. Further more detailed analysis may be necessary in relation to REPS on larger intensive dairy farms. For individual highly efficient farms, environmental and extensification payments might not be sufficient to offset the fall in income arising from complying with the qualifying conditions. Further analysis may also be necessary in the case of individual, small, low-income cattle farms. For these any significant extra investment necessary to comply with REPS specifications might involve unacceptable levels of borrowing.

While the addition of disadvantaged area payments improves the competitiveness of livestock vis-a-vis forestry, the results are not changed for most scenarios.

Apart from lowering gross margin, the level of efficiency at which the livestock enterprise is operated did not have a major impact on the choice of enterprises in most scenarios. Forestry, however, becomes more competitive at lower levels of off farm wages in situations in which livestock enterprises are operated at moderate levels of efficiency.

The analysis was carried out taking the point of view of the individual farm owner. Societal issues such as the value of the improvement in the environment arising from carbon sequestration by forests or the cost of the contribution to greenhouse gases of farm livestock have, therefore, not been included in either the costs or the benefits of individual enterprises. Nor has account has been taken of the isolating effects of largescale afforestation in remote areas.

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Footnotes

[1] Advantage of two ongoing surveys of farmers in Cos Mayo and Offaly was taken to examine these issues.

[2] Comparisons of sample parameters with aggregate county values indicate that the sample was representative of all farms which had adopted afforestation between 1992 and 1996.