

# The Economics of Irish Forestry

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In reviewing the development of State Forestry in Ireland with particular regard to its economic implications, I propose to deal successively with three main periods of development—1908-1922 and 1922-1958—which between them constitute the first half-century of State forest development and, finally, the period from 1958 onwards

## *Early Forest Development, 1908-1922*

In an appendix to this paper (Appendix I) I have reviewed briefly the position of forestry in this country at the beginning of this century and the successive stages of development up to 1922. Here I propose to deal only with the extent to which the various bodies which influenced that period of development had regard to the prospects of good financial return from State forest investment as distinct from other economic and social objectives

The first programme of positive development was put forward by the Departmental Committee on Irish Forestry which sat under the auspices of the Department of Agriculture and Technical Instruction for Ireland in 1908. The Committee favoured quite an ambitious programme of State forest development. In doing so it urged that, apart from any consideration of financial return, regard must be had to “the wider and less direct results of forestry, to its great influence upon the whole prosperity of rural districts and industries and to its social, economic, climatic and other national bearings”. The Committee expressed the opinion that “Ireland will not be managing her business as a prudent nation if she does not take every measure open to her at the present time to establish at least such a forest area” as to provide a moderate insurance for the agricultural and industrial needs of the country with, perhaps, some residue for export.

The Committee, following on the footsteps of an earlier British Committee,<sup>1</sup> adjudged on the evidence available to it that Forestry could “be

<sup>1</sup> Departmental Committee on British Forestry 1902

made a profitable industry in every sense to all who engaged in it" Both Committees recognised that evidence based on experience in Britain and Ireland was scanty and inconclusive. The evidence in general consisted either of estate records, suspect as to their completion or the segregation of forest from other estate accounts, and data related to the timber yields and profits secured in the sale of particular wood lots which might or might not have been representative in character. Both Committees turned accordingly to Continental European countries and quoted data as to income and expenditure of European forest authorities to demonstrate net profitability. In this exercise the impact of interest liability in the initial developmental years of a new forest venture was not brought to the fore and neither Committee commented on this aspect of the matter.

The Irish Committee did, however, furnish with its report a detailed forecast of anticipated expenditure and income over a period of 90 years in the implementation of its proposed afforestation programme. From this forecast the Committee estimated that, if the land was purchased during the first decade under the Land Act 1903 at an annuity of  $3\frac{1}{4}\%$  and planted over a period of 40 years, then, provided compound interest during the first 80 years did not exceed  $2\frac{3}{4}\%$ , the return thereafter would be at the rate of approximately  $4\frac{1}{2}\%$ .

The next body to take an active interest in Irish State forest development was the Development Commissioners set up under the Development and Road Improvements Fund Act, 1909. The Commissioners in their first Annual Report (period ended 31st March, 1911) showed no enthusiasm for financing large-scale afforestation in Britain but took a more favourable view on an application from the Irish Department of Agriculture and Technical Instruction. It put forward recommendations, which were accepted, for advances from the Development Fund on terms providing for no capital repayment or interest charge in the first 30 years, the question of requiring interest and provision for repayment to be further considered at the end of that period. It appears reasonable to conclude that the Commissioners felt that a new forest undertaking could not bear the dead-weight of compound interest accumulation during the early non-productive years.

A much fuller examination of the financial implications of afforestation was made in 1917 by the Forestry sub-Committee of the British Reconstruction Committee which included in its membership various notable authorities, amongst them Professor Sir William Schlich. Using what is known to foresters as the Faustmann formula, a rather fearsome-looking formula which is in fact the simplest method of assessing the inter-relationship of land values, expenditure on planting and maintenance, crop values and compound interest in a forest rotation, the Committee made calculations on the basis of fixed figures of expenditure and estimated timber yields for various conifer species at the prices prevailing immediately prior to 1914. From these calculations the Committee demonstrated that at the rate of interest prevailing in 1917—approximately  $5\%$ —a forest authority buying land at £3 to £6 per acre, or even at £1 per acre, could not balance its books. The Committee extended its calculations to show

that a moderate increase in timber prices which it regarded as a probability would improve the balance sheet considerably but its main conclusion was that the tendency of interest rates to range over a long period from as little as  $2\frac{1}{2}\%$  to as much as  $5\%$  presented insuperable obstacles to any requirement that a forest authority should condition its policy in acquiring land for afforestation or the overall tempo of the afforestation project to calculations of profitability based on interest rates prevailing from time to time. The Committee, therefore, recommended that State forestry development should not be made subject to any specific financial objective but that there should instead be a criterion of minimum productive capacity in terms of anticipated timber yield. The minimum standard suggested, expressed in terms of productive capacity of land devoted to coniferous timber, was capacity to produce 40 cubic feet of timber per acre per annum—not by any means a high criterion or one likely to guarantee a good financial return at the lower end of the range of acceptable land qualities. This approach was subsequently adopted in practice in Britain.

#### *Second Development Period 1922-1958*

Turning now to the period from 1922 to 1958 I think it is safe to say that the conclusions reached by the 1917 Committee influenced the subsequent shape of forest management and development policy in this country. On that basis it is not surprising that declarations of forest policy over the entire period from 1922 to 1958 were not made subject to any specific qualifications as to acceptable levels of financial return. The basic objective of forest policy over that entire period was “the ultimate creation of a home supply of raw timber sufficient to meet home requirements so far as it is possible to grow at home the types of wood required” I quote from the Annual Report of the Minister for Agriculture for 1931-32. Subsequent Reports successively by the Minister for Agriculture and the Minister for Lands (responsible for Forestry since 1933) up to 1957 set out the same prime objective. The phraseology used is indicative of the extent to which policy tended over the entire period to subordinate considerations of financial return to the “wider and less direct results” of forestry stressed originally by the 1908 Committee. Within the basic objective stated, the policy declarations of successive governments during the period were in general concerned with the promulgation of planting targets leading ultimately to the settlement of the present programme of an annual planting of 25,000 acres. Policy declarations were accompanied by references to the advantages to the national economy of the elimination of an adverse trade balance in timber and timber products, the advantages of self-sufficiency in timber and the incidental social gains by way of provision of employment, etc. Throughout, prime emphasis was placed on commercial or economic objectives, rather than the social advantages of afforestation, though with constant recognition of the merits on social grounds of afforestation of comparatively unattractive sites in impoverished areas where there was a reason-

able prospect of growing timber but a questionable economic outlook for the crop

Within the framework of general forestry policy actual forest practice subsequent to 1922 developed on similar lines. This is most easily discernible in the determination of the suitability of individual areas for forestry development. Policy bias in favour of the less prosperous regions of the country where good land is scarce and the bulk of the land is of low fertility has already been mentioned. At the other end of the scale the 1917 Committee had recommended, for obvious reasons, that afforestation should be confined to land "uncultivated and incapable of economic reclamation for permanent arable cultivation". The exclusion of good agricultural land from forestry development was of particular importance in Ireland with its agricultural economy. The Annual Report of the Minister for Agriculture for 1925-26 set out the policy being followed on this front

"The Department do not desire to acquire for afforestation land fit for agricultural purposes which might be capable of being used to form new holdings or enlarge existing ones. With a view, therefore, to preventing such land being acquired for afforestation they have fixed a maximum price at such a figure as to render its sale to the Department for this purpose an uneconomic transaction"

This policy has since been maintained. Within the prevailing maximum price at any time it has always been the practice to judge the suitability of land for forestry purposes on the basis of whether there is a reasonable prospect of growing a timber crop on the land, valuation within the maximum price being related to its probable productive capacity. Some overall economic factors have entered into the question. For example, blocks of land in themselves too small or too far removed from existing properties for economic supervision have been excluded and similarly blocks which would have involved abnormally high expenditure on fencing because of a high boundary-acreage ratio. Neither have blocks of predominantly very low fertility been received with favour except for purposes of experimental work. It has never, however, been the practice to exclude from forestry development lands on which the prospects of an economic return, on the first rotation, were remote because of high initial expenditure in the clearance of heavy scrub preparatory to planting. Such land is usually of a comparatively high productive quality and its acceptance has been justified by the long-term gain to the national economy of securing in perpetuity fuller utilisation of our natural resources even though the forest crop could not sustain the financial burden of the initial reclamation cost. Similar though more borderline issues arise in relation to some other site types such as the limestone crag areas of Clare and Galway where there is comparatively high initial cost on the clearance of hazel scrub and timber yields though reasonably certain are not likely to be high. The cases I have quoted illustrate the exclusion from forest policy and practice of any absolute limitation based on consideration of financial

return The quality of the land devoted to forestry is the most critical<sup>1</sup> controllable factor in determining the ultimate profitability of the undertaking but policy has, with unquestionably good reason, tended to exclude highly-productive land on which a forester could show excellent profits and to favour the inclusion of sites of marginal productivity

Within the general policy framework the forest authorities over the decades have never been in a position to be fastidious in the acceptance of land suitability because of the constant difficulty of maintaining and enlarging the intake of land to meet progressively increased planting targets. Increasing knowledge and experience in such matters as the choice of species for particular site types have secured progressive increases in the potential financial yield of many forest site-types. The introduction of new techniques of ground preparation since the end of the second world war, with the innovation of fertiliser application, had a similar and significant effect. Expanding work programmes and the exhaustion of intake of remnants of former demesne woodlands which were generally sited on good forest land have, however, tended towards a gradual lowering in the average quality of the land being planted. The new techniques of ground preparation in recent years have also tended to depress average land quality in that they opened up the prospect of establishing timber crops on low-fertility peat areas which had to be excluded from earlier forest development as quite unplantable.

Silvicultural management techniques in bygone decades were also largely guided by the urge to correct in the shortest possible time the critical dearth of native sawlog supplies at the commencement of the present century, a situation which had grown worse by the 1920s as a result of further exploitation of existing woodlands during and immediately after the first world war. A policy of maximum production rather than of optimum financial return was a natural consequence. This was of little immediate financial significance in the past as the area of woodland at stages where ultimate policy objectives influenced management techniques was not significant in extent but it did tend to retard discernment of the importance of initiation of research work directed towards the definition of management techniques geared to an objective of maximum economic return.

To close this rather brief review of development pre-1958 reference to the histogram given as an appendix (Appendix II) to this paper will show the continued accelerating climb in the rate of planting in Irish State forests during this first 50-year period. Excluding Northern Ireland a total of 3,222 acres had been planted by 1922 and the current planting rate then approximated 1,000 acres per annum. By 1957-58 the planting rate had been stepped up to 18,000 acres and the post-war target of 25,000 acres was scheduled to be reached in 1959-60—an aim subsequently fulfilled.

### *1958 Review of Economics of Irish Forestry*

From 1919 onwards all expenditure on State forestry had been met from voted monies. The loan charges set up in respect of advances made

prior to that year from the Development Fund were in effect wiped out by transference of the interest of the Development Commissioners to the Forestry Commission set up in 1919. Since the introduction of a separate Capital Budget in 1950-51 it has been the practice to treat expenditure incurred on purchase of land, establishment of new plantations and construction of roads and buildings as capital items for Budget purposes but this has not, of course, involved the introduction of an interest charge in relation to those aspects of forestry expenditure.

The total net State expenditure on Forestry from 1907-08 up to and including 1957-58 amounted to £14 million, mainly on State Forestry. Of this total, £10 million related to the period from 1950-51 onwards. A notional investment value as at 31st March, 1958 may be got by adding to the £14 million interest at the Exchequer lending rates<sup>2</sup> operative over the years. This gives a figure of £21.3 million.

In the mid-1950s two circumstances had combined to provoke a critical reappraisal within the Forestry Service of the financial and economic implications of the programme on hand and of the possible scope for improvements in efficiency and ultimate financial return. One was the approach of some of the earlier plantations to maturity and the growing area of plantations in middle-age producing thinnings for which new outlets could be found in paper pulp or board production. The second, and more important impetus, came from the approach of the annual planting rate towards the target set by the government. The rate of afforestation was, in consequence, rising above the level needed to meet domestic timber requirements and excess production would obviously have to be sold on competitive export markets. The enlarged programmes of work had also brought about a formidable rise in the annual expenditure on land acquisition and planting with a steadily and rapidly-increasing area of existing plantations involving maintenance charges. The rate of growth of expenditure had been further inflated by a continuing spiral in wage rates. From a rather rough and ready analysis of the trend of expenditure on forestry operations in 1956 compared with estimated future receipts at 1956 timber prices it appeared unlikely that investment in afforestation could pay more than 2½% compound interest.

An active campaign was initiated in 1956 directed towards a reduction in operating costs with a much greater focus of attention on silvicultural management objectives in their impact on ultimate financial yield. This increase in emphasis on economic issues became formally part of Government forest policy under the Government's 1958 Five-Year Programme for Economic Expansion which provided for continuance of the 25,000 acre planting target but emphasised<sup>3</sup> the need for ensuring that the country's developing forest industry was based on sound economic lines and the importance, in particular, of securing maximum productivity in

<sup>2</sup> Exchequer lending rates ranged over the period from a minimum of 2½% to a maximum of 6¼%. In the period of more critical importance, i.e. from 1950-51 onwards, range limits had been 3¼% and 5¾%.

<sup>3</sup> White Paper, November 1958—Paragraphs 81 and 85-86.

the forest, on the one hand, and on the other, satisfactory industrial outlets capable of paying remunerative prices

Preliminary to the settlement of the Five-Year Programme the Department of Lands had undertaken a much more intensive analysis of the financial implications of Irish state forestry than the rough calculations made in 1956 and the results of this analysis contributed to the shaping of Chapter 14—Forestry and Forest Products—of “Economic Development”, the detailed study which was issued simultaneously with the Government’s White Paper

For the purposes of the 1958 analysis it was assumed that all crops would be grown on a 50-year rotation and that money values would remain unaltered In the case of timber prices some adjustments in the 1958 levels were assumed the prices for sawlog timber being brought more into line with the prices of imported timber and prices for pulpwood being taken at the prevailing level in Great Britain

The object of the exercise was to estimate the average financial yield which might be secured from the wide range of planting sites being acquired using different species in the proportions of current practice and, subject to some specific modifications to which I will refer later, with the working methods and operational specifications in vogue Actual operational expenditure over the entire range of forest work for the previous few years was studied and analysed on the best information available by year of incidence in the rotation cycle This gave input cost data as closely related as possible to the actual pattern of current experience and a timing schedule for expenditure a great deal more accurate than is commonly used in, say, Faustmann formula applications

Forest labour accounts for the great bulk of forestry expenditure The intensive drive to reduce costs initiated in 1956 had been primarily aimed at a reduction in labour costs and in 1958 a major further stride forward in this field was in hands with the introduction of work study techniques as the basis for an incentive system of payment for forest labour Allowance was made in the 1958 financial calculations for the anticipated economies from this scheme

The most significant other modification of current expenditure was in the field of road construction costs New techniques of forest road construction in course of introduction were expected to yield substantial economies and allowance was made therefor In this particular field, incidentally, some difficulty was experienced in establishing an average pattern of probable road density requirements and a timing schedule distinguishing between roads required at an early age for management purposes and those needed only for extraction of produce, deferment in construction has obvious advantage in reduction of interest charges The difficulty here arose from the absence of a pattern of normal experience Road construction activities were rapidly expanding and the picture was obscured by the existence of arrears

Overheads were similarly analysed

On the income side it was much more difficult to secure reliable data as to timber yields both from thinnings and final crops in view of the young

age of the bulk of the Department's plantations and the absence of any yield data related to a systematic classification of stands of various species by quality related to the productive capacity of the planting sites concerned<sup>4</sup> Assumptions had to be made, for the more significant species, as to the distribution of plantations by quality classes Volume production in thinnings and final crop was then derived by reference to British Yield Tables for the different quality classes of each species, the results being merged in appropriate proportions to give a picture of average anticipated yield In the case of one significant species, Contorta Pine, no yield tables were available and refiguration was unavoidable

On both the expenditure and income sides the temptation towards cautious moderation of individual elements in the calculations was resisted on the basis that error margins could not be assessed and the result of the exercise would be most useful if it were presented unmodified but as something to be treated with caution

The final result—quoted in Chapter 14 of “Economic Development”—was to show an apparent possibility of bearing a compound interest rate of  $5\frac{1}{4}\%$  on all outgoings<sup>5</sup> Such an attractive financial return on the State's forest investment coupled with the provision of raw material for substantial and remunerative manufacturing development would be a very satisfactory outcome Chapter 14 of “Economic Development” emphasised the inevitably wide scope for error in the calculations made but postulated that

“it would scarcely be over optimistic to expect a return of that order (i.e. circa  $5\frac{1}{4}\%$ ) on that portion of the expenditure classified as capital for budgetary purposes This would involve in effect treating “non-capital” expenditure in the Forestry Vote as a social service until such time as the level of Forestry revenue would make demands on the Exchequer for this purpose no longer necessary This course is justifiable not only because of the social advantages of afforestation but also because, unlike other forms of social outlay, it would automatically come to an end in about 15 years and would meanwhile help to produce real national wealth”

#### *Development since 1958*

In the meantime, that is up to 31st March, 1963, total investment in State Forestry has risen to £25 million, an increase of £11 million, and

<sup>4</sup> Quality classification in this context concerns the performance of an individual species on any particular site and is based on height growth and related volume production

<sup>5</sup> The exercise was pursued a step further by plotting the “per acre” figures of expenditure and income year by year against the actual annual planting figures for the previous fifty years and an assumed future fixed planting rate of 25,000 acres per annum, using the notional investment figure of £21.3 million already mentioned as a starting point, with some other necessary transitional modifications In this exercise tests were made with various rates of interest from 1958 onwards It emerged that at an interest rate of  $5\frac{1}{2}\%$  the undertaking would be solvent though capital input would be necessary up to the year 2009-10 The slight difference— $\frac{1}{4}\%$ —in the results from the two calculations reflects the effects of lower interest rates, higher money values and (more pronounced) lower wage levels in the pre-1958 period



the notional investment value calculated as described earlier has risen to £41 million, an increase of £20 million in the five-year period. The current rate of growth in notional investment value is approximately £5 million per annum. It has not been considered practicable to attempt a further assessment on the lines of the 1958 exercise until many issues still the subject of query have been clarified. For the moment, therefore, it is only possible to draw on experience since 1958 to comment on some points which will have altered the picture in the meantime without being able to pinpoint their net effects.

On the expenditure side the introduction of work study techniques in manual field operations has achieved direct economies of at least the order anticipated in 1958. Indirectly it has provided the machinery for much more effective control of field costs, not merely in relation to output levels, but also in the promotion of standard work specifications, and much greater facility in evaluation of the economic implications of alternative job specifications. Its contribution towards the ultimate economics of Irish forestry should, therefore, be rather greater than was anticipated in 1958. Standardisation of work specifications has not yet been completed for all operations, until this work has been brought to finality and work in hands on method and tool improvements reaches a more advanced stage, a re-evaluation of current operational costs on the lines of the 1958 study would be unrewarding.

In the road construction sector, in particular, the position is still not clear but indications are that constructional economies, though considerable, will be lower than anticipated in 1958 and that the incidence of early-stage management road requirements may be somewhat higher than expected. Adverse effect on interest-bearing capacity on these scores should not, however, be significant.

It is perhaps worth mentioning that the use of work study is now being extended into mechanised field work, some aspects of which are already being brought under study control. The scope for economy on this side will, however, not be at all as significant as in the larger sector of manual work.

There has, however, been a very sharp rise in operating costs since 1958 in consequence of a series of wage increases representing in the aggregate a rise of approximately 30% over the 1958 level.<sup>6</sup> This wage rise, if anticipated in the 1958 calculations without the assumption of a corresponding long-term adjustment in prices, would have critically altered the outcome of the calculations without, however, invalidating the less exacting financial objective which "Economic Development" suggested as reasonable. The extent to which prognosis of the profitability of afforestation can be so influenced in five years of relative economic stability by a single factor in no way related to silvicultural techniques or capable of internal

<sup>6</sup> It is of interest that the White Paper issued in February 1963 on Incomes and Output—"Closing the Gap"—drew attention to an increase in weekly earnings in manufacturing industry of almost 30% between 1958 and 1962. The rise in Forestry wage rates was not as heavily concentrated in the last two years of the period but its total impact was similar.

control is an indication of the impracticability of subjecting such a long-term form of investment to control directly and immediately responsive to variations from time to time in its apparent profitability relative to that of other forms of investment. This is an interesting illustration of the wisdom underlying the views expressed by the Committee which studied the financial aspects of afforestation in 1917, and is a strong argument in favour of the moderate expectation favoured by "Economic Development"

On the income side there is still no possibility of drawing conclusions in relation to future timber production from Irish forests from past experience in view of the relatively small acreage of plantations which has so far come into production but a good deal of progress has been made since 1958 in the field of forward prognosis of production trends from data provided by research work. As a first step yield tables for Contorta Pine, the species which had been the subject of particular difficulty in 1958, have now been produced, these are, incidentally, the first Irish Yield Tables so far available. Work is in hands on the correlation of Irish sample plot data with British data to facilitate more accurate interpretation of the British Yield Tables available for various other important species, pending the production of independent Irish tables, but this work is still at an early stage. More significant, work has just been completed on a long-term assessment of thinning production for the period up to 1980 based on a full census carried out in 1958-59 of plantations over ten years of age in 1958 coupled with a sampling survey of younger plantations. Reference to Appendix III will exemplify the many difficulties of accurate prognosis by such methods and, while the new long-term assessment of thinning production should be much more accurate than the 1958 tentative figures, it is not possible at this stage to define its potential error margin. The new assessment is, in general, less optimistic than the 1958 figures and revision of the 1958 financial forecast in the light of these new figures would, therefore, give a less favourable picture of potential financial return.

In regard to timber prices there has since 1958 been some reduction in the disparity between native sawlog prices and imported timber prices. Pulpwood prices have not altered. Long-term price-trend prospects have not, however, clarified to such an extent as to permit of revision of the 1958 price assumptions.

In any attempt at the moment to re-assess the profitability of Irish forestry on the lines of the 1958 forecast the critical factor would be the extent to which it would be valid to expect upward long-term movement in timber prices to take care of the steep rise in basic Irish forest wage rates since 1958. Conjecture on that score raises many difficult issues in regard to future trends of timber supply and demand, production costs in the main timber exporting countries, the depletion of natural reserves of timber, etc., which must remain outside the scope of this paper—even if the implications of a probable continued downward trend in money values are ignored.

It is of interest, however, to note that F A O has recently prepared a

new Study on European Timber Trends and Prospects 1950-75 (not yet published) in which it is estimated that timber consumption in Europe will, in the period between 1960 and 1975, grow much more rapidly than production under present forest policies with the prospect of a sharp increase in the unfavourable European balance in timber trade which emerged between 1950 and 1960 unless a more favourable price structure limits the widening gap between production and consumption. The Study notes the rising level of forest wages in Europe generally. It is reasonable to assume that European timber producers will seek to recover increases in production costs by forcing prices upwards especially if there is any significant response to an F A O suggestion that the growing timber shortage envisaged for the last quarter of the century could be met in part by the extension of forests on to lands becoming surplus to agricultural requirements—a development which would be conducive to a much keener perception of capital forest values. Irish forest policy is, in fact, already in line with the suggestions of F A O and it is, perhaps, not unreasonable to budget on a much more substantial future rise in timber prices, *vis-a-vis* wholesale price levels generally, than has occurred in the past decade.<sup>7</sup>

However much the future trend of timber prices and their implications in relation to the profitability of Irish Forestry may be open to conjecture there is no doubt that much can be done to secure the optimum yield of which external circumstances may permit by a continuing concentration of effort and attention on all those facets of day-to-day management which are capable of influencing profitability.

#### *Forward Planning*

It may perhaps be profitable, therefore, to devote the remainder of this paper to a summary of those factors not primarily determined by forces external to the forest undertaking such as money values, international trends in timber supply and demand, etc., which are most likely to influence future profitability of the forest programme, with a brief indication of steps, in hand or feasible, calculated to assist in securing the most favourable results. The significant factors—granted the pre-requisite of technical “know-how” in which over fifty years of cumulative experience of afforestation has given this country a favourable position—are

- (a) land quality and price,
- (b) establishment (i.e. planting and related) techniques and costs,
- (c) road requirements and costs, and
- (d) silvicultural management in the sense of the co-ordination of thinning, pruning and felling practices in accordance with management plans specifically directed towards the most remunerative pattern of production.

<sup>7</sup> European timber supply cannot, of course, be viewed in isolation. There are outside Europe considerable areas of unexploited virgin forest capable of being brought into production but accessibility will have a major bearing on the economics of their utilisation and in the pattern of world timber trade allowance must also be made for a continuing rise in the timber consumption of undeveloped countries.

I have deliberately omitted from this set of headings market development and overhead costs since both partly involve considerations extending beyond the direct control of the forest undertaking

For anyone not familiar with the normal pattern of forest operations it is difficult to assess the relative significance of these various elements and I propose, therefore, to give in two appendices (Appendices IV and V) a general picture of the incidence of expenditure and income on forest rotations and a note of formulae used in calculations which for reasons of space cannot be quoted but upon which my comments in this section of the paper will be based

Expenditure on afforestation does not vary at all as widely as the inherent productivity of different sites suitable for afforestation in the sense of being technically capable of producing a timber crop Land quality is, therefore, of paramount importance in securing a favourable financial return Figures quoted in Appendix IV illustrate the significance of this question of land quality in the context of a national land use policy which tends to confine afforestation to comparatively unfertile and unpromising sites It may well be that in the long term the inclusion of rather more good quality land in the forest estate will be justified by comparative studies of forest and agricultural returns and there is in any event some prospect that the initial forest crops on less promising sites will in themselves help to create a more favourable forest condition tending towards more profitable subsequent rotations Present land use policy in relation to forestry must, however, in itself be accepted as a factor militating against the financial viability of the undertaking It is, of course, true that the depression of the average quality of the land being planted by the extensive afforestation of less fertile lands in western areas has the compensating advantage of greater social value

Land price is relatively unimportant within the limits of prevailing market prices for the types of land being purchased for forestry purposes Variations in the capital value of such land for forestry development are much greater than the rather narrow range determined by market values in an agricultural land market

Establishment techniques are of much importance in their capacity to ameliorate comparatively unfavourable site conditions and secure the best possible return Much attention is in fact being devoted to research work covering drainage, manurial treatments, planting techniques, plant spacings and, of course, choice of species, species provenance and species mixtures All that can be done in this field is either being done or in prospect

In the matter of establishment costs and costs generally, the advantages of a well-controlled incentive system and a sound system of control and cost evaluation of work specifications have already been stressed and should contribute materially towards an ultimate profitable outturn In this regard the Irish Forest Service is, perhaps, more favourably placed at the moment than any other similar State service in other countries

The progress being made towards efficient road construction at minimum cost will assist, but is of much less critical significance

In the field of silvicultural management in the sense defined, progress is unavoidably slow and difficult—a situation not at all peculiar to this country. One of the biggest difficulties in this sector is the determination of crop management objectives, since the relative profitability of different ultimate objectives will be influenced by long-term trends in demand for, and price of, particular log classifications in relation to both end-use and processing techniques and costs. Even within the saw-log market itself, for example, there is a lack of clearcut information—either here or abroad—in relation to the relative economics of processing sawlogs of different sizes. Test calculations show that in general the effect on financial yield of retention of a crop beyond, say, the point of maximum Mean Annual Increment (see Appendix IV) in the interests of securing logs of larger diameter is likely to depend to a very large extent on the degree to which the sawmiller will find it profitable to pay more per cubic foot of timber for the larger diameter log.

At present it is not possible, therefore, to do more than settle tentative management objectives for individual crops. This work is, in fact, already in hands in the case of crops now in middle-age, but objectives and management directed thereto must remain quite elastic. The impossibility at this stage of settling reasonably firm crop management objectives is incidentally a major obstacle to estimation of the point at which income from the State forests will rise above the level of current expenditure since definite prognosis of crop rotations, a vital factor, is impossible in the absence of reasonably fixed management objectives.

I have already emphasised that ideal crop management calls not alone for well defined management objectives in relation to the ultimate final crop but also the co-ordination with these objectives of thinning regimes, etc., calculated to give the optimum overall return from crops so managed. The forest research programme in hands includes work which will assist in such co-ordination. It is perhaps also worthy of note that steps have recently been taken to standardise quality pruning of sawlog crops to ensure an adequate yield of “clean” timber for which the miller can, with confidence, be prepared to pay a higher price. Of great importance in this context also is the work which has been initiated this year in collaboration with the Institute for Industrial Research and Standards to provide in a long-term research programme data in relation to the mechanical and chemical properties of home-grown timber.

Because of limitations of space I have had to touch but cursorily on some of the work in hands directed towards making forestry and the processing industries which it can support an important and very useful part of this country's future economic life. If, unfortunately, the ultimate level of direct financial return will still have to remain unproven for a long time to come, there is, nonetheless, today room for a confident assertion that what can be done to use this country's natural climatic and other advantages for forestry purposes to the greatest community profit attainable is in fact being done. Much remains to be done in the future but there is good progress in the past and good promise for the future.

The 1908 Committee was in the happy position that its chairman was able to initiate its proceedings with a declaration that the committee could approach its task confident in the knowledge that afforestation had already been proved to be a sound financial investment and that all the necessary silvicultural knowledge to guarantee success was available. There has been a vast increase since in silvicultural knowledge and there is certainly more justification today than there was in 1908 for regarding a national forest investment as a worthwhile contribution to the country's future. A balance sheet fifty years hence based solely on direct investment return may, or may not, in itself show that the investment was worthwhile. No balance sheet can, however, attempt a quantitative assessment of the incidental advantages in the provision of rural employment, increase in national productivity, improvement in balance of payments and promotion of tourist amenity—factors which in themselves might well prove more important than the direct investment return.

May I conclude by putting on record my sincere thanks to the Society for giving me the opportunity to present this paper and my indebtedness to the Minister for Lands for permission to make free use in its preparation of official departmental records. I would also like to put on record my thanks to various members of the technical staff of the Department for their helpfulness in commenting on the paper in draft form. Any opinions expressed are ones, however, for which I must take personal responsibility and I should, of course, say that these opinions should not be taken as necessarily reflecting in any way the official viewpoint of the Department of Lands with which I have the honour to be associated.

#### APPENDIX I

##### STATE FORESTRY DEVELOPMENT IN IRELAND 1899-1922

The history of modern Irish forestry begins with the establishment in 1899 of the Department of Agriculture and Technical Instruction (Ireland). Previous centuries had witnessed a gradual deterioration in the extent and character of Irish woodlands under the influence of historic circumstances. Little natural woodland remained and the demesne woodlands—the commercial value of which had in general been subordinated to amenity and sporting objectives—were disappearing rapidly as a result of the Land Purchase Acts—being exploited either by the vendors before transfer or by the new tenant-purchasers. There were no State forests in the country. The Commissioners of Public Works had power to make loans for land improvements including the planting of trees, but were not themselves forest proprietors. The Congested Districts Board had power to aid and develop forestry but apart from assisting small occupiers in the promotion of shelter belts, the Board had made only one incursion into the realm of forestry—the Knockboy experiment in County Galway which was a dismal failure. The Commissioners of Woods and Forests had been made responsible by the Crown Land Act, 1829 for the management of all Crown forests in England, Wales and Ireland but there were in fact no

Crown forests in Ireland in 1829 and the Commissioners never purchased any land for forestry purposes in the country. A Departmental Committee of Enquiry into the work of the Department of Agriculture and Technical Instruction of Ireland in 1907 summed up the history of the Commissioners' forestry activities in Ireland in two sentences: "It might be thought from their title that the Commissioners of Woods and Forests had something to do with forestry in Ireland. No doubt they had powers in that direction, but in Ireland, at least, they were never exercised"

Despite their preoccupation with agriculture and a multitude of ancillary functions, the newly-formed Department of Agriculture and Technical Instruction made a start in the forestry field fairly soon and in 1904 the Avondale Estate was acquired for use as a forester training school. Some further land in the vicinity was also purchased. This appears to have exhausted the Department's capacity to initiate new forest ventures from the Departmental Endowment Fund established by the 1899 Act. The 1907 Committee mentioned above urged the establishment of adequate machinery and provision of funds for a more active programme but did not feel competent to make detailed recommendations.

As a result, a special Departmental Committee on Irish Forestry was set up in 1908 which put forward recommendations for an ambitious programme aimed at the rehabilitation of an *estimated* 300,000 acres of existing (privately-owned) woodland and the establishment of 700,000 acres of public forest.

In October 1908 the Vice-President of the Department, in answer to one of a series of Parliamentary Questions as to the Government's attitude, said it was true that the Report "had the approval of the whole of the public". Official response to the Report was fairly prompt and was expressed in the provision of an annual vote of £6,000 in each year from 1909-10 onwards to enable more land to be purchased and planted.

Meanwhile in Britain the idea of direct State effort in the field of afforestation was gaining some ground. A Commission on Coast Erosion and Afforestation in 1909 put forward the first proposals in that country for State afforestation extending beyond the establishment of demonstration forests. The Commissioners' recommendations provoked much adverse criticism but their Report led directly to the power given to the Development Commissioners set up under the Development and Road Improvements Fund Act, 1909, to aid forestry, *inter alia*, by purchasing and planting land. The Development Commissioners, though reluctant to promote large-scale afforestation in Britain, decided to sponsor State forestry in Ireland, having regard to the very low percentage of woodland in Ireland and the poor prospects of private forest development due to the Irish land-tenure position. The Commissioners recommended to the Treasury advances up to £25,000 to finance the purchase and planting of land by the State in Ireland and indicated that they would be prepared to recommend advances to cover certain ancillary matters. These proposals were accepted by the Treasury and the Report of the Department of Agriculture and Technical Instruction for 1912-13 records the first land purchases financed by the Development Fund.

When the First World War interrupted progress, there were thus three separate systems of financing Irish State forestry—all operated through the Department of Agriculture and Technical Instruction

- (a) operations financed from the Endowment Fund confined to the original purchasers in the Avondale area,
- (b) operations financed from the annual Vote of £6,000 which were gradually extended to a number of areas, and
- (c) operations financed from the Development Fund which embraced three State forests (Ballyhoura, Co Cork, Glendalough, Co Wicklow, and Baunreagh (now Mountrath Forest, Co Leix,) and would apparently have been somewhat further extended had the war not intervened (Development Commissioners' Report, 1913-14)

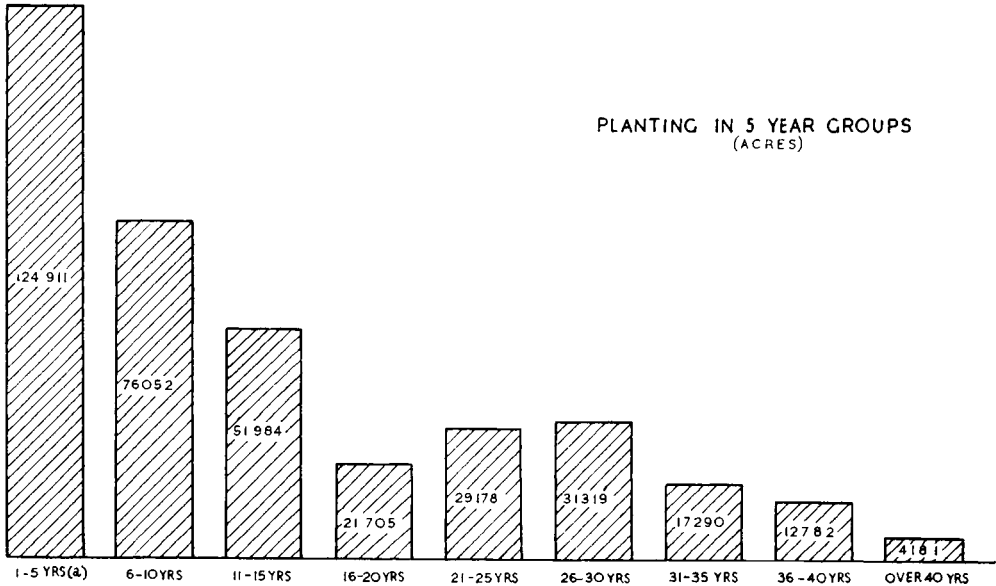
The Final Report (May 1917) of the Forestry Sub-Committee of the Reconstruction Committee reviewed the whole position of forestry in both Great Britain and Ireland. It is of interest that while the Report commented on the major strides made over the previous two decades in the management of the Crown woods in Great Britain and the high standard of management of the new State forests in Ireland, it deplored the unsatisfactory condition of British and Irish woods in general at the outset of the First World War as evidenced by a timber yield of about one-third the acceptable standard under correct silvicultural management. The Committee regarded a substantial addition to the forest holding of both countries as an urgent necessity on various economic and social grounds with a considerable emphasis on security of supplies in time of war and recommended that a new Forestry Commission (for Great Britain and Ireland) should be established to carry out an ambitious programme, relying in large measure on State afforestation. The Committee did not break down their suggested programme into national entities. This Report led directly to the establishment in 1919 of the British Forestry Commission which thus became responsible for a brief period for the development of forestry in Ireland.

The total area afforested in Ireland under direct State action during the period up to 1922 was under 4,000 acres—of which 3,222 acres lay in the Twenty-six Counties.



## APPENDIX II

AGE CLASSIFICATION OF STATE FORESTS  
(EXCLUDING ACQUIRED WOODLANDS STILL INTACT)  
AT 31<sup>st</sup> MARCH 1963



(a) PROVISIONAL IN RELATION TO 1962/63

## APPENDIX III

FORECAST OF THINNING PRODUCTION (1964-80) BASED ON CENSUS OF  
WOODLANDS IN 1958

The Department of Lands carried out in 1958 a full census of all plantations then over ten years of age. For the purposes of the census, the plantations concerned were surveyed and subdivided into individual homogeneous stands. For each stand a record was made of area, age, species (principal and subsidiary), types of stand, stocking level, normality of stocking and various aspects of current situation and condition. Stock volume estimates were visual but were subsequently checked by a Volume Sampling Survey on a random sample basis. The census was designed, *inter alia*, as the basis for a long-term forecast of thinning production.

The census was confined to stands over ten years of age because stands under that age normally carry no measurable timber (i.e. trees at least 2½ inches quarter-girth breast height). A very large area of plantations was thus excluded from the census which should come into production before 1980. It was, therefore, imperative to attempt some assessment of potentialities of these younger plantations, the more especially as there had been substantial changes subsequent to 1948 in the character of the land being

planted and in planting and ground preparation techniques. The method used—the only practicable one in what is believed to have been a pioneering effort at qualitative evaluation of young plantations—was to study on the basis of random samples the early height-growth history of *older* plantations capable of quality class evaluation by standard techniques and apply the resultant data in a study of samples of plantations laid down between 1948 and 1953, it being assumed that post-1953 plantations would follow a similar pattern.

Even in the case of the older stands, prognosis of thinning production involved many hazardous stages in the processing of data derived from plantations where intimate mixtures of different species were common—complicated sometimes by age-mixtures within individual stands. Stocking variations presented further difficulty and in the application of Yield Table data, rather arbitrary allowance had to be made for the divergence of run-of-the-mill plantations from the ideal fully-stocked plots from which Yield Table data derive.

The first tabulated results—in the form of forecasts of thinning production from stands up to 40 years of age and from stands between 40 and 50 years of age became available in September 1963. Further tabulations by reference to regions, species and size of produce are contemplated. Steps directed towards the determination of error-tendencies are under consideration. Error-margins are unfortunately incapable of determination on existing data.

#### APPENDIX IV

##### NOTES ON SOME SIGNIFICANT ELEMENTS IN FOREST ECONOMICS— WITH SPECIAL REFERENCE TO IRISH CONDITIONS

Forest Crop Rotations vary as between different countries in accordance with climatic conditions. Within a country rotations vary with the site, species, treatment and the ultimate objectives of management. Under Irish conditions, rotations for conifers might be expected to range, say, from under forty years to as much as eighty years. Thus references to a rotation of, say, fifty years as a norm under Irish conditions are, in effect, merely indicative of a possible average for the country and do not envisage the production of crops on a standard rotation which would ignore all the elements at work in each plantation.

In any plantation the plants require a few years to establish themselves before a normal pattern of growth emerges. Thereafter a pattern related to site, species and treatment may be expected. The normal pattern of growth, in terms of timber volume production, is one of expanding annual production or "Current Annual Increment" up to what might be called middle age and subsequent gradual decline which gives a pattern of ascending "Mean Annual Increment" (i.e. total volume divided by age or average annual production) up to a point somewhat beyond the year of maximum "Current Annual Increment", decline then setting in.

The graph on the opposite page illustrates these trends in the case of

Quality Class I crops of two species of significantly different growth rate, Sitka Spruce and Scots Pine, the trends being based on the relevant British Yield Tables. Lower Quality Classes show similar patterns with, of course, slower growth reflected in lower and later production peaks.

The volume production figures embrace both the produce of thinnings and the final crop. Even with fast-growing Sitka Spruce crops thinning does not commence until the second decade, on a very slow-growing Scots Pine crop first thinning may be delayed until the fourth, or even the fifth, decade. Thinnings naturally increase both in girth-size and volume per tree as the plantation progresses and the value of the produce in terms of sale price per cubic foot is, therefore, steadily climbing (the bigger diameter log having the higher market value per cubic foot, and the larger tree being more economical to handle). In general this rise in value per cubic foot in relation to tree-girth is a continuing process so long as the plantation maintains active growth.<sup>8</sup> On a moderately heavy thinning regime, the volume removed also climbs steadily with successive thinnings in the earlier thinning phases and this inflates the rate of growth in the financial return from thinnings.

The final crop, with the maximum per cubic foot value, would, if clear felling took place at the point of maximum Mean Annual Increment, account for between 55% and 65% of total production. The income pattern is, therefore, invariably one of low early returns from thinnings with the bulk of the income deferred until final cropping. To illustrate this, the income from one of the two cases used above, Quality Class I Sitka Spruce, on the basis of approximate current timber prices has been used to construct the following Table.

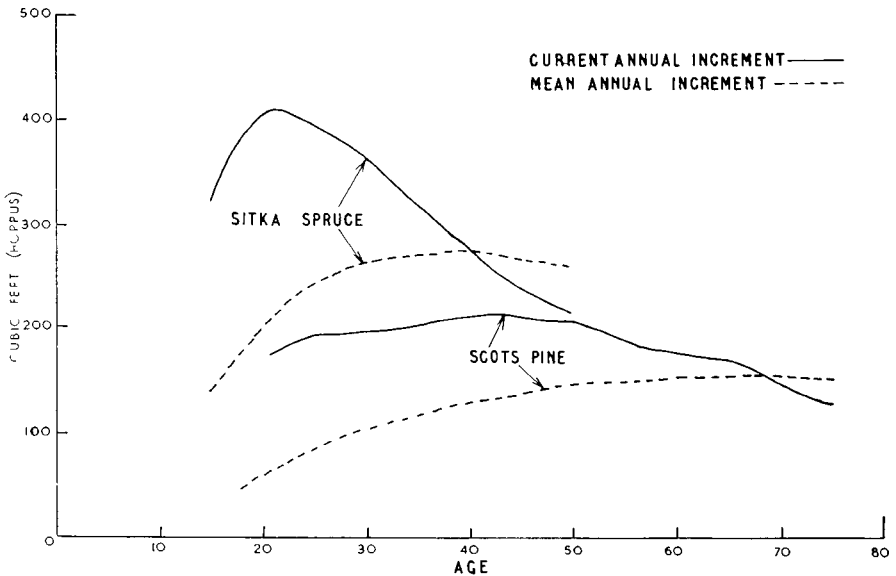
SITKA SPRUCE—QUALITY CLASS I—FELLED AT 40 YEARS OF AGE

Age (Years)	Thinnings (cu ft Hoppus per acre)	Standing Value £
12	150	4
15	290	11
18	470	20
21	540	27
24	570	36
27	560	42
31	720	72
35	640	72
40 (final crop)	6,910	950
		£1,234

If these figures are compared with those in the following Table for Sitka Spruce Quality III the less remunerative return from a poorer site-type becomes immediately apparent. Input costs—apart from land price or rental—will have been more or less equal in the two cases. Figures for

<sup>8</sup> There is question of a fall-off in price beyond optimum sawlog size but this has no practical application in Irish afforestation conditions.

COMPARATIVE TRENDS\* OF CURRENT AND MEAN ANNUAL INCREMENTS  
SITKA SPRUCE (QUALITY CLASS I) AND SCOTS PINE (QUALITY CLASS I)



\* BASED ON BRITISH FORESTRY COMMISSION YIELD TABLES (1953)

Sitka Spruce, Quality IV or V would, of course, show an even more startling contrast

SITKA SPRUCE—QUALITY CLASS III—FELLED AT 50 YEARS OF AGE

Age (years)	Thinnings (cu ft hoppus per acre)	Standing Value £
17	210	5
20	230	9
23	330	12
27	550	25
31	560	35
35	570	43
40	640	56
45	560	63
50 (final crop)	6,210	776
		£1,024

Using the figures set out in the two foregoing tables, along with reasonably accurate estimates of expenditure, in calculations made with the basic formula set out in Appendix V, it emerges that, at a fixed interest rate of 5% the Capital Value of the Quality Class I ground exceeds that of the

Quality Class III site by approximately £120 per acre. At a fixed interest rate of 3% the difference would be of the order of £250 per acre. The income figures used are, of course, based on an ideal fully-stocked plantation in each case. Divergences from that ideal or variations in timber-prices would, so long as their effect was consistent throughout both rotations, have an almost exactly proportionate effect on the difference in Capital Values. A 20% shortfall, for example, in thinning and final crop yields in both cases would reduce the difference in Capital Values to about £95 at 5% and £200 at 3%. Variation in the expenditure figures used would have no significant effect on the difference between the Capital Values of the two sites. Such variation would, of course, have a substantial effect on the level of Capital Value of each of the two sites. Given a high expenditure ratio and a high interest rate, the individual Capital Value of the lower quality site would itself possibly be a negative quantity.

The interplay of expenditure and interest has particular significance in that expenditure on a forest crop is very highly concentrated in the early years of the rotation. The basic figures used in the financial calculations made by the Department of Lands in 1958 showed an expenditure distribution over different heads as follows:

Operations	Percentage of Total Expenditure
I Fencing, drainage, ground preparation, plant supply and planting	25
II Replacement of failures, manuring and cleaning of young plantations	18
III Road construction	20
IV Weeding and Pruning	10
V General Maintenance	27

Expenditure under Head I occurs in or before the actual year of planting and under Head II in the early years after planting, while expenditure under Head III is divided between initial work in the provision of management roads and the later extension of the road network for timber extraction purposes which is normally necessary before thinning commences. Head IV is timed shortly before first thinning while the expenditure under Head V is spread fairly evenly over the entire rotation. Some 40% or more of the expenditure, therefore, occurs before or within 2-3 years of actual planting and over 75% must be met before first thinning stage.

This combination of heavy initial expenditure, deferred main income and long investment period, makes forestry particularly sensitive to high compound interest charges. As a corollary, comparatively minor changes in the basic elements of a sum in forest economics can have significant effects on the level of financial yield from the investment. It is worthy of note also that while early thinnings are not in themselves remunerative, their selling-price gains in significance from the fact that the proceeds of these early thinnings help to arrest the dead-weight accumulation of interest liability.

## APPENDIX V

## FORMULAE USED IN CALCULATIONS OF FOREST ECONOMICS

In studying the implications of variations in site quality, or contrasting results with different species, management specifications, expenditure levels or timber prices, use is normally made of the Faustmann formula the simpler forms of which, while lending themselves to fairly facile calculations, tend towards error from deliberate assumption, for the very sake of simplicity, that establishment costs are concentrated in the first year and that all other charges are at a fixed annual level. The formula presumes a series of identical rotations on a fixed recurring pattern of costs, timber yields, etc.

The following is an elaboration of the formula based on the assembly of all costs, irrespective of classification, by their year of incidence—the formula being related still to a series of identical rotations

$$V_x = \frac{F_x + (1 \cdot OP^{x-t_1} T_1 + 1 \cdot OP^{x-t_2} T_2 + \dots) - (1 \cdot OP^x C_1 + 1 \cdot OP^{x-1} C_2 + \dots)}{1 \cdot OP^x - 1}$$

where  $x$  = Number of years in rotation

$V_x$  = Capital Value of land for afforestation where rotation selected is  $x$  years

$F_x$  = Value of final crop on a rotation of  $x$  years

$T_1$  etc = Thinnings occurring in years  $t_1$ , etc

$C_1$  etc = Costs incurred in years 1, etc

$P$  = Interest rate

If, as is more logical in relation to land being converted to forest use for the first time, it is assumed that, in the case of a continuing series of identical rotations using the same species, the returns will be the same but the pattern of costs will differ as between the first and subsequent rotations, e.g. in relation to roads which have to be constructed in the first rotation, the formula, using the symbols  $CA_1$ ,  $CA_2$ , etc. to denote costs in the first rotation and  $CB_1$ ,  $CB_2$ , etc. to denote costs in subsequent rotations, become

$$V_x = \frac{F_x + (1 \cdot OP^{x-t_1} T_1 + 1 \cdot OP^{x-t_2} T_2 + \dots) - (1 \cdot OP^x CB_1 + 1 \cdot OP^{x-1} CB_2 + \dots)}{1 \cdot OP^x - 1} \\ + (CB_1 + \frac{CB_2}{1 \cdot OP} + \frac{CB_3}{1 \cdot OP^2} + \dots) \\ - (CA_1 + \frac{CA_2}{1 \cdot OP} + \frac{CA_3}{1 \cdot OP^2} + \dots)$$

It is scarcely necessary to stress that the formula cannot be framed to resolve directly an equation in which all the elements other than interest rate are known. In such a case the determination of financial yield is possible only by a series of trial calculations using different interest rates.

In comparing the financial results of varied expenditure and income elements, it is more convenient to fix an arbitrary interest rate and treat the Capital Value of the land as the variable indicator of comparative profitability

A further elaboration of the formula may be used to study the relative merits of long and short rotations for any species on a given site without change in management techniques Taking  $x$  years as the short rotation and  $y$  years as the long and distinguishing annual cost-figures and thinnings relevant only to the longer rotation by symbols

$$\begin{aligned} &CA_{x+1}, CA_{x+2} \text{ etc} \\ &CB_{x+1}, CB_{x+2} \text{ etc and} \\ &TA, TB, \text{ etc} \end{aligned}$$

the somewhat fearsome formula set out beneath can be derived

$$\begin{aligned} V_x - V_y = & \frac{1}{1 - OP^x - 1} F_x - \frac{1}{1 - OP^y - 1} F_y \\ & + \frac{1 - OP^y - 1 - OP^x}{(1 - OP^x - 1)(1 - OP^y - 1)} \left( \frac{T_1}{(1 - OP^{t_1})} + \frac{T_2}{1 - OP^{t_2}} + \right) \\ & - \frac{1 - OP^y}{1 - OP^y - 1} \left( \frac{TA}{1 - OP^{t_a}} + \frac{TB}{1 - OP^{t_b}} + \right) \\ & - \frac{1 - OP^y - 1 - OP^x}{(1 - OP^x - 1)(1 - OP^y - 1)} \left( CB_1 + \frac{CB_2}{1 - OP} + \right) \\ & + \frac{1 - OP(1 - OP^{y-x} - 1)}{(1 - OP^y - 1)(1 - OP - 1)} - CB_{x+1} \end{aligned}$$

The very complexities of these various formulae indicate the difficulty of absolute assertions as to the relative significance of different elements of expenditure and income in determining the profitability or otherwise of afforestation

## DISCUSSION

*Mr H M Fitzpatrick* When your honorary secretary asked me to speak to these papers I was reminded of a paper which was read to this Society many years ago I have a copy of it here—it is “The Forestry Question Considered Historically” by C Litton Faulkner, read in 1903 Mr Faulkner was, I believe, employed in the Irish Land Commission and it is a happy chance that tonight, sixty years later, Mr Gray, also an official in the Department of lands, should bring us up to date in the history of forestry as well as giving a critical analysis of its economics

Mr Gray told us that the Chairman of the 1908 Departmental Committee in his opening address said that they could approach their task “confident in the knowledge that afforestation had already been proved to be a sound financial investment” It seems to me that the Chairman was being unduly optimistic considering how little was really known to them at that time On the other hand, I feel that Mr Gray is pessimistic about the amount of information which we have at the present time He said in reference to profitability “On the income side it was much more difficult to secure reliable data as to timber yields both from thinnings and final crop in view of the young age of the bulk of the Department’s plantations and the absence of any yield data relevant to a systematic classification of stands of various species by quality related to the productive capacity of the planting sites concerned Assumptions had to be made, for the more significant species, as to the distribution of plantations by quality classes Volume production in thinnings and final crop was then derived by reference to British Yield Tables ”

Further on in the paper he said

“On the income side there is still no possibility of drawing conclusions in relation to future timber production from Irish forests from past experience in view of the relatively small acreage of plantations which has so far come into production but a good deal of progress has been made since 1958 in the field of forward prognosis of production trends from data provided by research work”

These statements set me thinking on ways by which data of timber production which has been gained by fifty years of Irish forestry could be presented in a form which would carry conviction in making a case for afforestation General figures for the whole country are not available but, instead of using the general figures of the British Forestry Commission might we not use the method of sampling adopted by the committee on “Forestry, Agriculture and Marginal Land”<sup>9</sup> This committee, which was presided over by Sir Solly Zuckerman and is usually referred to by his name, examined “the ways of increasing the use of indigenous sources of timber products and how any increases would affect the agricultural use of marginal land” They set up a working party to enquire into the economic aspects of the question and “the working party decided that the best means of arriving at an assessment was by examining the

<sup>9</sup> “Forestry, Agriculture and Marginal Land”, a report by the National Resources Committee (H M S O , London 1957)



costs and yields of actual examples of forestry and agriculture enterprises which were being carried on side by side"

The working party chose four areas in England and Wales as representative of poor light land and marginal and better hill land, and they give an outline of the method of calculation used "It transpired", according to the Report, "that if farm buildings had to be provided there was little to choose in the New Forest between forestry and agriculture. Improvement of land already in agriculture and requiring no buildings held more promise for continued agricultural use than if transferred to forestry (5.9% interest for forestry, for agriculture the interest was 19% if no buildings needed and 5.4% if farm buildings were required). In the Sherwood Forest the comparison showed that the return from agriculture, 6.5%, was about as good as from forestry, 6.7%. On the marginal upland areas that were surveyed, forestry tended to have a slight advantage with a return of 6% to 8% on the invested capital, whereas on land under agriculture the total return on capital was from 6% to 7%."

I would like to see limited surveys such as these carried out in Ireland in order to get some concrete data on which to base the case for afforestation. For a start I would suggest a survey be made of the Aughavannagh Valley in the area between the village of Aughrim and Lugnaquilla. Here State forestry has been in progress for nearly half a century and many of the plantations are in production. The Department has accounts of timber volumes sold and revenue obtained as well as figures of expenditure to date on afforestation and maintenance. Returns from agriculture on adjoining lands could be compiled. If the survey were extended to cover the social impact of forestry such as the provision of a regular income to direct forest workers as well as lorry drivers and so on, and the general benefit derived locally from this income, a most useful picture would emerge and more convincing arguments could be advanced in favour of tree growing than is possible at present. It would not be an onerous task for a Government department.

Mr Gray has told us that "the rate of afforestation was (in the mid-1950s) rising above the level needed to meet domestic timber requirements". This is, of course, looking forward to the distant time when our forest area will be in the state of a "Normal Forest" with each year an equal area reaching maturity and being felled and regenerated. This is an ideal towards which all orthodox foresters strive, but it is a far-off goal and our more immediate problem is to meet our desperate need for timber as soon as possible. This would enable us to reduce our heavy import bill for wood and wood products which has been running at about £14,000,000 annually in recent years. When we have a large acreage of plantations, even though immature, we can draw on them to provide pulp-wood for industrial use and by heavy thinnings speed up the growth of the remaining trees so that they may reach saw-log size sooner.

Dr Jack mentions the Sandwell Report on the economic enquiry into small pulp mills. As you know, a special report was prepared on the case of the Republic of Ireland. When it was published early in 1960 a forestry group got together in Dublin to discuss its conclusions. This was shortly

after a symposium had been held by the Society of Foresters of Great Britain and we had the advantage of reading the report of their meeting<sup>10</sup> The Sandwell team examined the needs and output of four types of pulp-mill

- 1 Neutral Sulphite Semi-chemical
- 2 Unbleached Sulphate
- 3 Bleached Sulphate
- 4 Groundwood

Four mills of the size examined would supply about two-thirds of our present needs in pulp and would consume 16,000,000 cubic feet of timber annually or the produce of 300,000 acres of "normal forest", assuming an annual increment of 84 cubic feet of which one-third is saw timber and two-thirds industrial timber suitable for pulping. A radius of fifty miles for supply is quoted and in this small country four mills would cover our territory. The important consideration of effluent disposal is brought up by Dr Jack. These mills produce large quantities of substances which are poisonous to fish if undiluted. A bleached sulphate mill of the size given in the Sandwell Report needs 145,000,000 gallons of water per day to make the effluent safe. The Board of Works gave me some data for 1959, an unusually dry year as you all will remember, of the minimum daily flow of several of our rivers during that season.

<i>River</i>	<i>Point of Measurement</i>	<i>Millions of gals daily</i>
Shannon	Banagher	900
Moy	Coolgroun	130
Feale	Listowel	100
Suir	Clonmel	150
Nore	Brown Barn	60
Barrow	Royal Oak	75

You see that for a bleached sulphate mill the Shannon is the only river about which you could be really happy as regards effluent disposal.

These mills would all require a large supply of electricity. The 28,000,000 units needed by the heaviest user, the groundwood mill, may not look significant when compared with the E S B annual generation of over 2,000,000,000 units but any such new demand might call for extra generating plant and would certainly require special provision in wiring and arrangements for off-peak loading. So it would appear that the development of our forest industries will need as much forward planning as that given to the growing of the trees as told in the two excellent papers we have just heard.

One final word—our forest economists look forward to a rise in the price of timber as a means of balancing their budgets. Timber, I believe, has increased six to seven times over the pre-war price compared to

<sup>10</sup> "The Development of Pulp and Particle-board Industries", Supplement to *Forestry*, Oxford University Press, 1960

three to four times for metal, concrete and other competing materials. There is always a danger that a further increase may lead to the greater use of substitutes or the invention of new materials to replace timber and, although it is largely a question of supply and demand and as such outside our control, I don't think we should be too happy about the possibility.

*Mr C K McGrath* In speaking of the economics of forestry it is not sufficient to discuss the production side only, since this represents only one-half of the account. I note that in the section of his paper headed "Forward Planning" Mr Gray found himself precluded from discussing the factors that influence the other side of that account, such as the economics of produce disposal, the circumstances that have pegged down the prices paid for native thinnings to their 1958 level despite substantial rises in production costs, and the need for expert information as to what products made from native thinnings can give the best returns to both producer and processor. This last point is relevant to the major problem of reconciling the aim of State forestry to secure economic prices for its produce with the need for competitive exports of the end products. These and other problems relating to the income side of the forestry account appear to be of vital importance in the planning of the road ahead and I had hoped that both papers might have referred to them. I should like to pay tribute to the excellence of the papers and to suggest that these matters might, perhaps, be the subject of further papers by Mr Gray and Dr Jack.

*Dr Jack* I am pleased Professor Clear and other speakers have emphasized the very important effect of land quality, as restriction to "poor agricultural and marginal" sites severely constrains the creation of an economic forest enterprise. The integration of agriculture and forestry on hill land, and the comparative economics of both methods of land use on similar sites are being investigated in detail in Wales and some results should appear in the near future.

When considering and comparing employment levels in agriculture and forestry one must be careful not to place too much emphasis on past practice which did not have the benefit of recent technological advances and which may have been strongly influenced by outside factors such as land tenure, etc. While economists may not care to look far ahead, forestry is such a long-term project that forest managers must try to be far-seeing and in this respect the U.S.A. have made consumption forecasts with upper and lower limits up to 2000 A.D. Various workers, including the Economics Section of the Forestry Commission, are presently trying to put a value on recreational and other indirect benefits of forestry. Considerable advances are being made in forest research, including tree breeding and manuring, and results of experiments are generally analysed on the basis of any economic advantage. Most forest authorities are today using modifications of the Faustman Formula to determine optimum management techniques and some are, indeed, using the tool of linear programming.