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THE PROFITABILITY OF LARGE-SCALE AERIAL FERTILISING

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Summary

The recent considerable increases in fertiliser costs are looked at in the light of the corresponding marked increase in timber prices. The change in discounted revenue resulting from improved crop growth is shown graphically, and an outline of present ideas on crop response is given. With the aid of the ready-reckoner graph, the reader can make his own judgements about profitability.

Introduction

Many assessments of the profitability of large-scale fertiliser application have been made in the past decade, some of which have been published in this Journal (see References). By 1972 many people had concluded that fertilising was generally profitable on many of the poorer soils, particularly the peats of South and West Scotland. But massive rises in the price of fertilisers since then have made application costs seem excessive in view of the long delay before any return is received on this large investment. It is hoped that this paper will help forest managers to make decisions about their fertiliser programmes.

Timber Prices

Data on timber prices for the last four years have been taken from South Scotland Standing Sales. They are given for illustrative purposes only, and should not be taken as accurate estimates of prices. A published price index would have been used, but none of these included the recent steep rise in prices which developed in the winter of 1973/74.

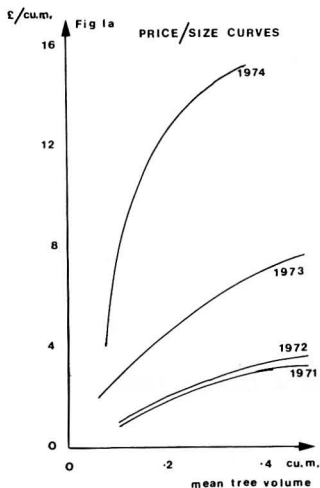
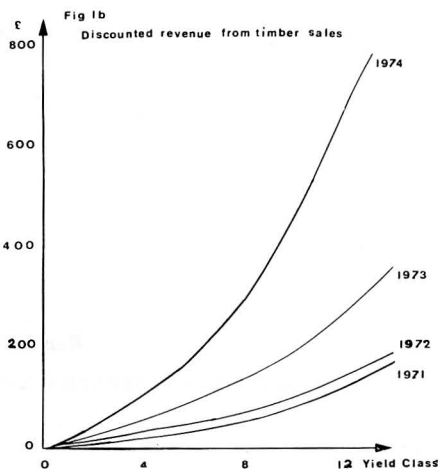


Figure 1a shows the relationship between price at stump and average tree size. Figure 1b shows the revenue obtained from selling the timber from stands of Sitka spruce of various yield classes, for each different price curve, discounted to year of planting. A 5% discount rate was used, and it was assumed that the crops would be managed according to Forestry Commission management tables, with a rotation of about 50 years.

These figures are only provided as a guideline and they should be used with care.

Fertiliser Costs

1974 costs are as follows:—

Fertiliser	Cost/tonne	Cost/ha	Spreading Cost	Other Cost	Total
P	£35	£14	£4	£3	£21
PK	£35	£21	£6	£3	£30
N	£55	£25	£5	£3	£33

The table below shows the cost, discounted to year 0 at 5%, of various applications.

Single Applications

Fertiliser	Cost £/ha
P at Planting	21
P at Year 10	13
PK at Planting	30
PK at Year 10	18
N at Planting	33
N at Year 10	20

Fertiliser regimes recommended by Forestry Commission

Site Type	Application Year							Total Cost £/ha
	0	4	6	10	12	16	20	
Surface Water Gley	P							21
Flushed Peat	P			P/PK				36
Peaty Gley	P			P/PK				36
Podsol, Peaty Ironpan	P		2,4-D		P			52
Unflushed Peat	PK	2,4-D	PK		PK	N	NP	125

This allows £25/ha for 2,4-D application.

1972 costs were approximately half 1974 costs.

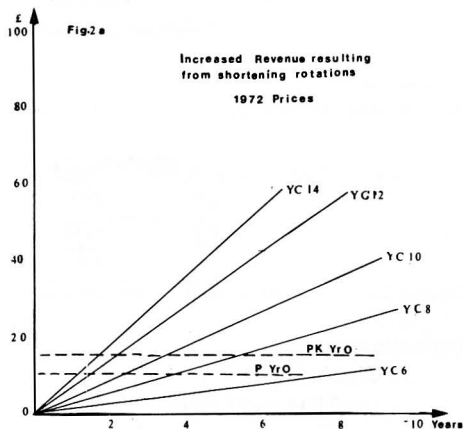
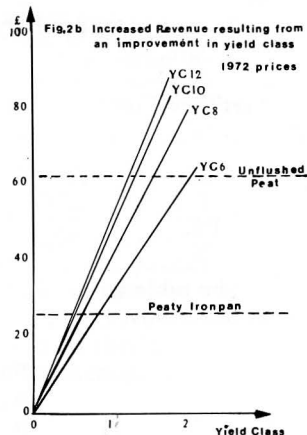
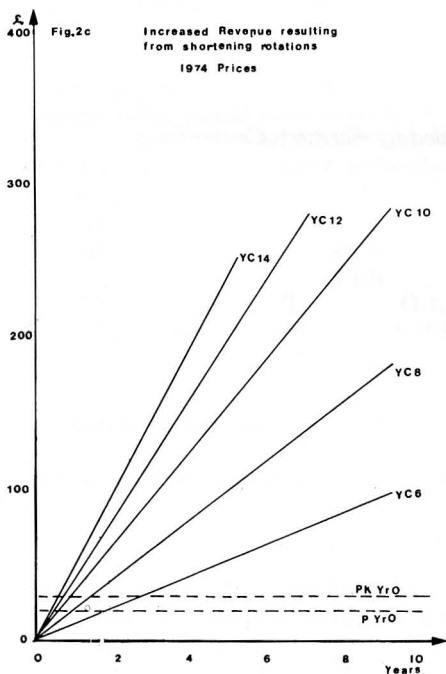
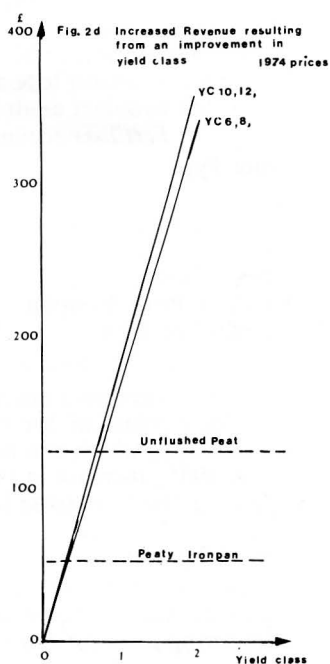
An increase of 50p per gallon in fuel costs increases the total cost by about 2½% which can be regarded as insignificant.

A 100% increase in the price of fertiliser increases total costs by about 75%: a 200% increase by 150%.

Roading Costs

In calculating the increased revenue resulting from improved crop growth, the increased cost of roading has been allowed for, using the following assumptions:—

1. Roothing density: 20m/ha.
2. Cost of Roads: £4500/km.
3. Roads built at time of first thinnings as given in Forestry Commission Management Tables (1972).
4. The possible extra expense involved in improving the roads for fertiliser delivery has been included in fertiliser costs.



Fertiliser Profitability

In order to reach conclusions about the profitability of fertilising and its sensitivity to changing prices, it is necessary to make assumptions about the response of crops to fertilisation. As any assumptions would not be acceptable to everyone the data have been presented in a form which leaves it to the reader to make them. The next section consists of a short summary of present ideas which is intended to help the reader make sensible assumptions.

The crop improvement can be expressed either as increased yield class, or as years saved before harvesting begins. For example if a crop of yield class 6 was fertilised, it might increase its effective yield class by one yield class to 8. Alternatively, the fertiliser might give the crop a boost for a few years, so that it remained in yield class 6, but all yields (and hence revenues) were advanced by, say, three years.

Figure 2 shows the increased revenue discounted to year 0 resulting from either an improvement in yield class, or an advancement of all revenues, using both 1972 and 1974 prices. The graphs also show the cost of typical fertiliser applications. Obviously if the fertiliser is applied later in the rotation, the discounted cost is less. In figures 2b and 2d, the yield class is the yield class before fertilisation. The graphs are drawn as straight lines for simplicity, although they should be slightly curved. The resultant loss in accuracy is negligible.

Response to Fertiliser Application

There is plenty of evidence that many tree crops show considerable short-term improvement in growth after fertiliser application. Papers by Davies (1969), Dannatt, Davies and McCavish (1971) and Byrne (1972), show the impressive response of certain Sitka spruce crops in west and south Scotland for the first four years after fertiliser application, and these authors point out that if this growth rate is maintained, presumably by applying more fertiliser, improvements of two, three or even four yield classes can be expected on the right sites.

Unfortunately there is no experimental evidence of the long-term response of crops to fertilisation, particularly to repeated applications, and so any estimates of long-term response must be pure speculation. It is widely believed that the effect of one fertiliser application disappears after no more than ten years, and in many cases the crops are thought to return to their original growth pattern after only five years, but this depends so much on the type of fertiliser, the age of the crop, the site conditions and other factors that it is dangerous to make generalised assumptions. Even the work which has been done on response to single fertiliser applications is based solely on the treatment of young crops, whose volume growth rate is uncertain anyway. Although their height growth can be measured, it is only possible to estimate volume growth. It will be many years before reliable estimates of crop response are available.

The present accepted procedure in the Forestry Commission is to assume that fertilisers do not affect yield class, but that crop development is advanced by fertilising, or that a delay is avoided. An unpublished paper by John Everard explains how this advancement can be forecast by using foliar analysis, and it seems that phosphate application often advances a young deficient crop by three to five years. Work by John Mackenzie on deep unflushed peats suggests that a nitrogen application can easily advance a crop by six or eight years.

Tony Cooper, working on data from phosphate fertilising on trees from five to 30 years old, in West Scotland, and assuming that there is no effect on growth after 10 years, concludes that the improvement in growth over all yield classes from one application is approximately equivalent to half a yield class.

Returning to the unflushed peats, John Mackenzie suggests that a regime of PK at year 0, 2,4-D at year 4, PK at year 6, N at years 10 and 14, P at year 17 and N at years 19 and 25, could enable spruce of yield class 12 to be grown in South Scotland whereas otherwise yield class 6 or less could be expected.

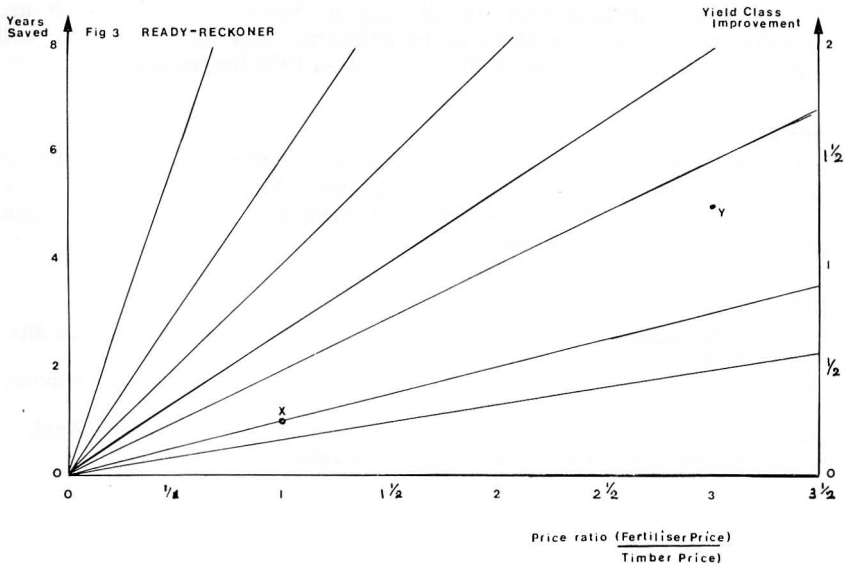
It is important to remember that no one is recommending that fertilisers should be repeatedly applied automatically, as each proposed application should be treated on its own merits, but the regimes proposed by some research workers are forecasts of what will probably be required. When estimating the improvement expected, each case should be considered separately. A single nitrogen application on a *Calluna* checked crop might give a response of two yield classes; a PK application on a deficient crop might advance yields by five years; repeated applications on a peaty ironpan soil might increase yields by one yield class; while on better sites there may be a negligible response.

Ready Reckoner Graph

This is an aid to determining if a fertiliser application is still profitable after a change in prices. It is used as follows:—

- (a) Choose the base prices for fertilisers and timber, e.g. 1974 prices.
- (b) Decide what crop improvement is necessary to pay for the fertilisation at these prices, e.g. from figure 2.
- (c) Define this point on the graph, using price ratio of 1. The line through this point and the origin is the break-even line for this fertiliser application. All points to the left of this line are profitable; all points to the right are unprofitable.
- (d) Decide what yield improvement is expected from the fertiliser application (in the same terms as (b)), by making an assumption or using experimental evidence.
- (e) Forecast what change in price ratio is expected. (Price ratio is defined as fertiliser cost divided by timber price: e.g. doubling fertiliser cost makes ratio 2; doubling timber price makes ratio $\frac{1}{2}$).

- (f) Find the point defined by (d) and (e) and see if this is profitable.
 (g) It is easy to discover what change in crop improvement, or price ratio, will make the application profitable or unprofitable.



Example:

- Using 1974 prices.
- From figure 2c YC 10, PK at year 0, one year saving is needed.
- This is point X.
- A five-year saving is expected.
- I forecast that timber prices will remain constant, but fertiliser cost will increase by 200%, i.e. ratio is 3.
- Point Y.
- This is profitable even if the saving is only three years, or if fertiliser costs rise by 400% (by extrapolation).

Conclusion

The recent doubling of fertiliser prices led some people to question the profitability of fertilising. When this is seen in the context of a quadrupling of timber prices the doubts about profitability diminish. The marked increase in both fertiliser prices and timber prices is partly a result of political activity as well as the increasing demand but prices will probably continue to rise. This state of rapidly increasing prices means that it is impossible to be certain that fertilising will continue to be profitable, but I think that it is highly probable that it will do so for at least the next

five or ten years. This optimistic view is supported by the rapid rate of inflation facing us at present, which means that all revenues in cash terms will be considerably more than estimated, and hence the profitability will be greater.

I therefore conclude that on all sites in South Scotland which are deficient in nutrients, or likely to be deficient, large-scale fertilising will continue to be at least as profitable as it was in 1972 for several more years.

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