

SOME BASES FOR COMPARING THE RELATIVE ECONOMICS OF FARMING AND FORESTRY IN NEW ZEALAND *

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INTRODUCTION

In recent years increasing attention has been paid to two major problems facing the economy of New Zealand – the need to diversify exports and the need to increase considerably the present rate of industrial expansion. At an agriculturists' symposium on diversification in 1958, the authors (Thomson and Grainger, 1958) stressed the contribution which processed forest products could make if sufficient land were available, and suggested some of the economic criteria which could be considered in deciding on alternative forms of land use. In 1960 the noted economist Sir Douglas Copland, at a convention of the N.Z. Society of Accountants, gave far more cogent and more authoritative reasons for both export diversification and industrial expansion. He stated “. . . the purely farm economy, efficient as it is, cannot provide the basis for growth in numbers and in gross national product that are required if New Zealand is to keep pace with the rate of growth in the world around it”; and he came to the firm conclusion that the exploitation of New Zealand's exotic forest potential offered one of the best ways to help alleviate the situation. The same theme was elaborated and further developed by two contributors to the Industrial Development Conference last year – Mr C. R. Larsen (1960) of the Board of Trade, and Mr A. R. Entrican (1960), then Director of Forestry.

It would thus appear that economists and others are generally agreed on the need for an expansion of forest-based industries and hence for a corresponding expansion in the area under exotic forest. With the recent indication that forest policy envisages the establishment of a further 1,000,000 acres of exotic forest, it would appear that Departmental circles are in agreement also.

Nevertheless, despite this degree of official and technical “approval in principle” to allocating more land to forestry, the fact remains that the climate of public opinion is still generally unsympathetic to such a course. The old clichés and shibboleths are still trotted out, all based on the unproven assumption that grass is necessarily and always

* Paper presented at N.Z.I.F. symposium in Wellington, April 1961.

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a better form of land use than trees. As it was in the past, forestry is still regarded as the poor handmaiden of agriculture and is still expected to make do with unwanted agricultural leftovers. If it does want to encroach on land with even a low agricultural potential, it is expected to justify why it should do so. It is significant that agriculture is never asked to justify its occupancy of any piece of land. Old habits of thinking die hard, as indeed would be expected in a country which for 100 years has relied almost entirely on farm products for its wealth.

The problem is not confined to New Zealand. A recent and extremely interesting English paper (Walker, 1960), to which reference will be made later, starts off as follows:

Resources are rarely, if ever, allocated to alternative uses on economic grounds alone. . . . Economic, strategic, social and, in the case of land, ecological factors all influence the decision. How far economic considerations should influence resource allocation within an economy is always a matter for debate and yet it is most important that . . . the nation should know how resources would be allocated if economic criteria alone were applied.

This quotation serves as an excellent introduction, and we think, an adequate justification for the present paper. An attempt will be made here, not so much to prove conclusively that any particular form of land use is the best for any particular piece of land, but to suggest alternative criteria by which the economics of farming and forestry could be compared. We do not suggest that any one criterion is the best, as it depends so much on who is making the comparison, the individual or the nation. We give some limited and incomplete examples of different criteria in operation; and if at times they appear to favour forestry, then all we ask is that the figures and the arguments should be refuted or that more comprehensive studies should be made.

LIMITATIONS OF COMPARISONS

Before proceeding further it is as well to stress some of the difficulties inherent in comparing the economics of farming and forestry under contemporary New Zealand conditions. They are many and considerable and they impose severe limitations on the validity of any comparisons made. Some of the more important are:

Differential development. Grassland farming techniques in New Zealand are already well-developed and widely applied: the productivity of the land, in terms of both quality and quantity, is generally high. By contrast, forestry techniques, though developing rapidly, have not yet been reflected in optimum quantity production and certainly not in optimum quality production. The reason is simply the long life-cycle of trees compared with grasses, other crops or animals. Present forest utilisation, coming at the end of the first experimental rotation, has to deal with untended stands whose average

wood quality is poorer than it could have been, and without doubt poorer than it will be in the future. Current values are quite unrepresentative of what can be expected during the second rotation when mistakes in species siting and in stocking are corrected and when the stands will have benefited from intensive silvicultural treatment. Thus accepting current values for comparative purposes (and the authors see no alternative) is a procedure which unduly favours agriculture.

Price Control. Sawn timber has been under continuous price control since 1936 (longer than any other commodity) and New Zealand prices today are low by overseas standards. As a result values, whether expressed in terms of stumpages or of prices of end-products, are artificially debased. To quote from Mr Entrican's Industrial Development Conference paper:

Whereas post-war timber prices in North America and Scandinavia have risen anything between 40 and 90 percent above general wholesale prices, exotic timber prices in New Zealand have been kept below the level of general wholesale prices. In these circumstances it is hardly surprising that exotic stumpage values have been only a small fraction of the stumpage values overseas. In contrast, butter has been sold in New Zealand at well below production costs but subsidised to give a reasonable return to producers. In effect, timber has assisted in subsidising butter.

Thus price control, by depressing real forest values, renders it difficult to make comparisons which are equitable to forestry; and the effect of subsidies, direct and indirect, favours agriculture further still.

Price fluctuations. Owing to price-control, timber prices though they have risen have not fluctuated. World newsprint prices have likewise shown a steady non-fluctuating increase. World pulp prices have been subject to some ups and downs but they have been steady for the last five years. On the other hand wool has been subject to violent price fluctuations, as have dairy products to a lesser but still considerable degree. The difficulty therefore is whether to take for comparative purposes any given year, or whether to average the figures over a longer period such as a lustrum or a decade. Even if a representative period is selected, the comparisons will not necessarily be valid in the future; price trends can scarcely be prophesied as far ahead as a forest rotation.

Uniformity of comparison. So far, it has proved extremely difficult to make factual comparisons which are uniform in all essential aspects such as soil quality, climate, access to markets, and accuracy of physical and monetary yield figures. It is not difficult to get accurate figures for large forested areas: for these, the forester knows with some precision the proportion of land effectively utilised, the average production over the years, its average value, the number of men employed, the costs of establishing the resource and the costs of protecting, harvesting and marketing it. It is not so easy to select a large area of agricultural land which is comparable in the physical

aspects of soil, climate and topography; and it is less easy still to get valid financial figures, current and historical, which are applicable to a sizeable tract of farming land, as distinct from an individual farm. Herein perhaps lies a challenge to agricultural economists.

The time factor. One of the greatest difficulties is inherent in the time factor. Comparisons can be made between farms and forests as going concerns; in which case forestry is unduly favoured since it takes much longer to develop a forest and the land is financially unproductive for a much longer period; or the comparisons can cover the whole period from the start of development to some given point in time after the forest is a going concern. In the latter case the comparison is equitable; but the difficulties are to decide what point in time to choose and what rate of interest to use for compounding purposes.

RETURN TO GROWER

A common basis for comparison is the return to grower or "take home pay", i.e. the stumpage paid to the forester, compared to the wool, meat, or butter cheque received by the farmer. It is of course one of the more important criteria from the immediate viewpoint of the private landowner, but it is less important from a national point of view. Its value for comparative purposes is lessened by the already-mentioned difficulties of price fluctuation and artificial stumpage depreciation. Because stumpages are all-important in this context, it is perhaps as well to discuss them further. We have mentioned price control of sawn timber and the temporary poor average quality of exotic sawlogs as two factors which have kept stumpages low. There are others. Firstly, we are in an era which has a temporary glut of exotic forest produce. Owing to the mass plantings of the twenties and thirties, and the consequent imbalance of age classes, forest owners are forced to sell on a buyers' market. Hence the Japanese log trade, indefensible on most other grounds. The situation is not likely to last for another decade: demand will catch up with supply and stumpages will then tend to increase. Secondly, many of the large forest owners control their own industries and for various reasons find it convenient to express profits in the industrial rather than the forest side of the joint enterprise. When they come to buy in outside logs (or for that matter to sell their surpluses), the prices tend to be conditioned not by the traditional stumpage principle of residual value, or even by a true market value based on supply and demand, but by a habit of mind arising from their own internal accounting procedures. The end-result in some localities is a rather vague ruling rate which does not necessarily represent a correct value. A third consideration is that the largest sale of exotic wood in New Zealand was made on the basis, as stated in the published sale proposal, of selling logs with as low a stumpage as possible, in order to form as attractive an investment as possible. Moreover, the real

value of the raw material was stated to be in the sharing of manufacturing profits throughout the owner's participation in capital. There was therefore an openly-avowed unreal stumpage created. Because of the magnitude of the sale, this stumpage has had a profound influence on the development of a general ruling rate.

It is evident therefore that for a variety of reasons, exotic forest stumpages today are lower than they should be, and by comparison with the values of other products of the land, are certainly lower than they will be in the future. It is impossible to crystal-gaze and foretell how much lower. All that can be done is to use current stumpages, realising full well that by so doing the picture of forestry in the future is made unnecessarily gloomy.

The authors have not had the time to make anything but the most cursory study of current exotic stumpages. It is indeed extremely difficult to get average or representative figures, because of the great local variations which exist – variations brought about by the dominating effect of transport costs on timber prices. It is understood that Farm Forestry associations are assembling and publishing data on the returns from wood lots and farm forests to growers, and this should be of great value in building up the mass of local and detailed information which is now missing. Our own investigations indicate:

- (a) Radiata pine stumpages vary throughout the country from as little as one penny to more than one shilling per cubic foot. These values are produced from land which itself varies in its productive capacity from an M.A.I. of 100 cu. ft to M.A.I.'s of 300 cu. ft and over. Taking the combination of extremes (a highly-theoretical method of deriving upper and lower limits), the return to the grower can vary from 8s. 4d. per acre per annum to over £15 per acre per annum.
- (b) In central North Island, where the depressing factors have operated most strongly, the returns have generally been of the order of £2 to £4 per acre per annum, although in a few cases they have been much higher.
- (c) There is no information readily available on the average return to farmers *for comparable land* in central North Island.

The authors consider that here is a profitable field for further economic study. They suggest that such a study should take into account the all-important time factor, and another factor not yet mentioned, the effects on profits of differing tax procedures. If such a study were made it would be reasonable to expect the obvious result that sometimes forestry would be favoured, but far more often agriculture would. The value of the study would be in giving to individual land-owners a more precise lead than has been available hitherto on the gross returns which they could expect under the different forms of land use. But, for reasons given below, it would not give the final economic answer.

Processed versus Unprocessed Products. The "return to grower" basis, though it is of importance to the individual, is of much less national significance in a country such as New Zealand with a predominantly "peasant" economy. In the case of pastoral products, most of the value is inherent in the farm product when it leaves the farm gate: primary processing adds relatively little to it. The reverse is true for forest products, which have a low unprocessed and a high processed value. For butter, cheese and frozen meat, processing accounts for only about 15% of the total value; whereas for sawn wood the comparable figure is over 60%. The authors contend that this added value, as well as the value produced by the land itself, is of economic importance to the community.

It is however important that the point in the flow of production at which the value is struck should be carefully defined so that true comparability may be achieved. A logical price point is at the end of the first cycle of production. In the case of dairy and meat products, this is ex-dairy factory or ex-freezing works. For wool, the comparable price point would be ex-woollen mill, at which stage the product becomes available for general consumption. However, only 3% of New Zealand's wool clip is processed domestically; the remaining 97% is exported as raw wool and must therefore be considered on that basis. The comparable basis for forest products is ex-sawmill, ex-pulp and paper mill, ex-plywood factory or ex-round produce preservation plant. It should be noted that some pulp is exported without further processing; it is the pulp and not the paper value which in this case must be used. Apart from these two exceptions, the product in each case is in a form ready for final consumption or for further usage by the general public. From the view-point of the national economy, the authors suggest that this is the stage at which the economic contributions made by farming and forestry can best be compared.

Gross Value. Accepting the end of the first cycle of production as the price point, comparisons can be made either on a national, a regional, or an individual farm or forest basis. In the first place we will consider the relative gross values per unit area of land on a national (or rather, for reasons to be explained) on a North Island basis.

The value of farm production in 1956-57 (a good year for farming), as shown in the 1958 Year Book, was £349,000,000 derived from a total occupied pasture and arable area of 32 million acres, giving an average value of £11 per acre. This figure is however heavily weighted by the extensive area of unimproved tussock land in South Island, where the stock-carrying capacity is relatively low; whereas in North Island unimproved pasture forms a low proportion of occupied pasture and average production is therefore higher. Separate production figures are not published for North Island but a close

approximation can be made on the basis of the respective numbers of sheep, beef cattle, and dairy cows in each island. On this basis 13.8 million acres of pasture and arable farm land yielded products to the value of £239,000,000, which gives a North Island average production of £17 per farm acre. Since we are concerned with North Island districts this is the better figure for comparative purposes.

Turning now to the value of the forest output, it should be noted that the bulk of the exotic forest industries is located in the North Island. The pulp and paper industry was still developing rapidly in 1956-57 so that the 1957-58 year gives a better picture of relative forestry values without in any way putting farm production at a disadvantage; (farm products commanded higher prices in 1956-57 than during 1957-58). The value of forest products in 1957-58, suitably corrected to exclude indigenous woods, amounted to £22,000,000 for North Island; and the total area of exotic forest and farm woodlots in North Island during that year was 720,000 acres, as recorded in "Farm Production Statistics". Thus the contribution of the exotic forests to the national economy was £31 per acre – or little short of double the unit figure for farming. This comparison ignores the fact that the exotic forest estate is not yet in full production. It can be shown that the total utilisation of exotic wood in North Island was about 77 million cubic feet during 1959/60 against an overall annual increment (for the present forest crop) of not less than 110 million cubic feet: hence in effect only about 70% of the North Island forest estate, or the equivalent of 500,000 acres, is contributing to current production. This means that the true average value of forestry is more like £44 per acre, as against £17 for farming.

Comparison of contributions to the gross national product (on an average North Island basis) may be summarised as follows:

Farming	£17 per acre in 1956-57
Forestry	£31 „ „ in 1957-58
Forestry	£44 „ „ in the near future.

As previously indicated, these figures lose some validity through the use of figures for given years which may not be representative of a longer period. It would be of interest to compare production statistics for the last financial year, suitably adjusted by price indices over ten years, in order to give the comparison a wider framework and to eliminate partially the effects of price fluctuations. The authors suggest this as another exercise for anyone interested in further pursuing the matter.

It may be argued that the above set of comparisons is valid only after the forest is a going concern and that it ignores the lengthy unremunerative development stage. This argument is correct, although from a really long term national viewpoint, it is perhaps unimportant if land is unproductive for two or three decades – surely a very short

period in the history of a nation's land use. However, this factor should be taken into account. The time needed to break in new land for farming varies, but it would be fair to take five as the average number of years before farm land is fully productive. Forests grown on, say, a 40-year rotation are not fully productive for 40 years, but intermediate yields from thinnings will be forthcoming much earlier. It can be calculated that these should normally amount to at least 25% of total production. In effect therefore, the land will have been unproductive for 30, not 40, years. One can therefore make the following type of calculation:

- (a) *Over a 50 year period*, the total financial return would be:

Under agriculture	(50.5 years) \times £17 =	£765
Under forestry	(50.30 years) \times £44 =	£880
- (b) *Over a century*, the total financial return would be:

Under agriculture	(100.5 years) \times £17 =	£1615
Under forestry	(100.30 years) \times £44 =	£3080

These figures (based on current prices) should of course be refined by taking the actual prices received over the whole period under consideration, or otherwise adjusting by means of price index techniques. The forest figures (in respect to the unproductive period adopted) would vary according to site and to the proportions of different species used. Nevertheless they do suggest that, even allowing for the unproductive period, forestry can already claim to have created, on an average North Island basis, far more real wealth per unit area of land than has farming; and this despite the depressing price factors which have operated, and despite the fact that forestry is generally occupying much less fertile land.

Similar comparisons on a regional or individual property basis have not yet been made; it can be expected that they would show extremely variable results, with agriculture often being favoured particularly on the more productive soils; but in regions where forests are located close to ports or to centres of utilisation, with forests showing a far bigger margin than the average figures given above.

Gross Value – Local Example. Although firm comparisons are not available, detailed figures of the value of the gross product have recently been calculated for a large forest complex in central North Island, i.e. those parts of Kaingaroa and Whaka Forests known as the Murupara and Waipa Working Circles.

The total area of this complex, excluding unplanted land, but including roads, firebreaks, failed and other waste areas, village and industrial sites, etc., is 279,000 acres. The area supplies two major industries – one a sawmill with associated round produce preservation plant, the other a fully integrated pulp, paper and sawmilling industry. In the calendar year 1960, the ex-mill value of all products from these industries was £9,600,000, giving a return per acre of £34 10s. 0d.,

a figure slightly higher than the North Island average. The forests however were only partly used. The 1960 wood usage was 32.3 million cu. ft, compared with an immediate potential, which will be fully realised in a few years time, of 40.0 million cu. ft. In the near future, therefore, the return per acre will be at least £45. This estimate is conservative because future production will have a higher export content and hence will be more valuable. It is of interest to note that in 1960 exports amounted to £5,100,000 or 53% of the total value created. Thus, even allowing for a major satisfaction of domestic markets, the export earnings were more than £18 per acre.

These are actual and recent figures for a tract of land which includes tens of thousands of acres of inferior species (mistakes to be written off against the first experimental rotation), and tens of thousands of acres of extremely poor sites – sites indeed which are sub-marginal for forestry though they could grow quite good grass. If, as is hoped will be the case, the next rotation sees the sub-marginal areas converted to grass, the poor species converted to more profitable ones, and the forest generally converted through silviculture to a more productive state, then the enhancement in value per unit area of land will be 40% at a conservative estimate. These two Working Circles (totalling about a quarter of New Zealand's exotic forest estate) can thus look forward to a return of the order of £60 per acre per annum.

What could agriculture do if it occupied the same tract of land? The only figures that can be produced are those obtained from an agricultural source for farms of average efficiency on better sites of the same suite of soils. These figures are £24 per acre per annum for sheep farming and £46 for dairying. At the very most, only 10% of the forest land under consideration would be suitable for dairy farming. The weighted average therefore becomes £26 per acre per annum. In order to validate the comparison with forestry there should be deducted a percentage figure to account for unused land in roads, villages, community areas, waste areas outside farm boundaries, etc. No one has investigated what this percentage would be, but a figure of 10% is likely to be ultra-conservative. The adjusted estimate for farming returns is therefore approximately £24 per acre per annum.

The same agricultural source has estimated that more efficient farming and fuller use of all land inside farm boundaries could increase the gross returns by some 50% in the next few decades. We can arrive therefore at the following comparisons for this particular area of New Zealand.

Present Return per acre:

Forestry	.....	£34	10s.	0d.	(Actual data)
Farming	.....	£24	0s.	0d.	(Estimate only)

Foreseeable Future Returns:

Forestry	.....	£63	0s.	0d.	(Estimate only)
Farming	.....	£36	0s.	0d.	(Estimate only)

Except for the first figure, the authors freely admit a great deal of guesswork in these comparisons. They consider that the estimates have been "kinder" to agriculture than to forestry; and once again they suggest more detailed studies to refine the figures or to prove them wrong.

EXPORT EARNINGS

The preceding section hinted at another, though similar, criterion which could be used for comparative purposes, i.e. export earnings per unit area of land. It is scarcely necessary to stress the importance of this criterion to a country which relies so heavily on export earnings for its standard of living and which for this reason is basically so vulnerable in its economy.

Again the comparisons could be made on a national, a regional, or an individual property basis. Again also it is convenient (and more equitable) to base the national comparison upon North Island, instead of New Zealand as a whole.

The logical approach is to value all North Island farm production at unit export rates and divide by the occupied land area. If, because of the difficulty of accounting for all arable and poultry products on an export basis, we include only pastoral products and their derivatives we find that the 13.5 million acres of pastoral land in the North Island yielded products which, at 1956-57 export prices, would have returned £219,000,000. This gives a unit export value for North Island farm land of only £16 per acre per annum – though it should be stressed that this not only excludes all fruit and arable crops, poultry and bee products, but also the value of produce consumed on the farm and normally included by the Statistics Office in their assessment of farm production or income. If these other items could be included the unit figure would be higher than £16 but would scarcely exceed £20. Forest products are easier to assess on an export basis since there are fewer items involved. At export parity, the value of North Island exotic forest output in 1956-57 was approximately £21,000,000 from 723,000 acres, which gives a unit value of £29 per acre. Two years later, much the same area produced the equivalent of £27,200,000 or £37 per acre. These figures demonstrate the recent rapid increase in the utilisation of exotic forests, an increase which is still continuing. They make it clear that in a few years time, when industries will have expanded to take the full production from the forests, the export earnings will be over £40 per acre per annum, or more than double the contribution from farming.

An important qualification must be made. Comparisons of contributions to export earnings are only valid if they take into account the relative demands for import funds. Without doubt, the highly mechanised forest products industry creates bigger demands overseas for its equipment than does farming. This question has been studied

by one of the authors in a major survey of the economics of forestry in Hawke's Bay (Grainger, 1960). His researches indicated that the import requirements for farming amounted to 7 per cent of the total value of farm production, whereas for forestry the comparable figure was 15 per cent.

Using the above figures, a more equitable comparison of contributions to export earnings would be:

Farming £20 - 7 per cent. = £18 10s. 0d. per acre per annum

Forestry £40 - 15 per cent. = £34 0s. 0d. " "

Once again this comparison, startling though it is, holds good despite the depressing factors which have operated, and despite the fact that agriculture holds all, or nearly all, the better land. Future figures are likely to be even more startling. As an example, one ton of newsprint absorbs 120 cu. ft of wood - half the annual growth of an acre of radiata pine on an average site. At current export values, the export earnings of a given acre of radiata going to newsprint are theoretically £124 per acre per annum. In practice the produce from one acre would be shared between paper, pulp, and sawn timber; forests already established contain a proportion of species which are slower growing than radiata; and, as already stressed, the gross area of a forest, not merely the effectively stocked area, must be considered. Taking all these factors into account, it would be far from unreasonable to envisage future integrated industries with a desirable proportion of paper, pulp and sawn timber, which would create export values of at least £60 per acre per annum and possibly more. It is of interest to note that this figure approximates the £63 per acre already estimated for local gross value, though it has been derived by quite different means. Farming yields can and no doubt will improve, but the gap between £60 and the £20 North Island average, even adjusting for import requirements, would appear to be too wide to bridge. It is this sort of comparison which the authors claim to be relevant for uncommitted land close to industries, to centres of population, or to ports.

LABOUR EMPLOYED

The next basis for consideration is the direct employment of labour per given unit of land. It is of importance because, unlike other criteria considered to date, it does not entirely ignore the time factor. In other words, inasmuch as forests give continuous employment in establishment and tending from their very inception, the land is not in this sense made unproductive for the development period.

National basis. Using the same basis as that adopted for the value of production per unit area, i.e. inclusive of primary processing, the following approximate figures may be derived from published statistics. They refer to the year 1956.

<i>Farming</i>	<i>People Employed</i>
Farm work	137,000
Butter and cheese factories	5,314
Tanneries and wool scouring	1,254
Woollen mills	2,709
Meat processing	11,627
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	157,904
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To these should be added (1960 figures): Wool and grain stores - 2,861; and fruit and vegetable processing - 1,427; giving a composite total of 182,192.

<i>Forestry</i>	<i>People Employed</i>
Forest work	2,490
Logging	2,854
Sawmilling	6,236
Plywood and veneer	467
Pulp and paper	2,267
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	14,314
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These figures include employment in the indigenous timber industry, which is not relevant. Employment in processing exotic forest products may be approximated by deducting 50 per cent from the logging and sawmilling workers and 66 per cent from plywood employment. The revised total is 9,469, a figure which understates the true total by reason of the exclusion of workers engaged in the manufacture of articles from New Zealand pulp (separation not possible) and by reason of the increase which has taken place since 1956 (more recent figures not available at time of writing).

The statistics relate to the whole of New Zealand. Thus direct employment up to the end of the primary stage of production compares as follows:

Farming: 32,000,000 acres/162,192 men = 1 man per 197 acres

Forestry: 915,000 acres/9,469 men = 1 man per 96 acres

It will be seen that in 1956 forestry employed twice as many men per acre as farming; as would be expected if one considered the greater amount of processing involved in the former industry. Once again, by eliminating the effect of South Island tussock grasslands, North Island figures would give a more equitable basis for comparison. On the other hand, as previously stressed, the exotic forest estate is as yet not in full production. Amendments to take both factors into account produce very much the same result, i.e. double the manpower is used in forestry.

Local examples. Recent and accurate figures are available for the Murupara and Waipa Working Circles. This area of 279,000 acres employs directly 2,638 men, or one man per 106 acres (transport workers included). Within three years, the figure is likely to be 1 man per 90 acres or less. Other examples are:

One company forest (Bay of Plenty): 1 man per 120 acres

Two company forests (Hawke's Bay): 1 man per 100 acres

These figures in general confirm those given above for the national average.

Production per Employee. We are indebted to Mr C. R. Larsen for suggesting a further interesting basis for comparison – the value of the annual production per employee. His figures relate to integrated pulp and paper industries only and do not cover the whole field of forest products. In the paper already cited he states:

The five pulp and paper units . . . now control an investment of £40 millions and their initial capacity has an output of over £20 million annually. Existing plant can provide employment for approximately 4,000 workers, so capacity is equal to £5,000 per worker. The following broad comparison with farming shows that these . . . industries can produce three times as much per worker.

	<i>Pulp and Paper</i>	<i>Farming</i>
Capital per employee	£10,000	£10,000
Annual production per employee	£5,000	£1,350

Mr Larsen also points out that further additions of capital and labour to farming will not be as high in yield as this average. Forestry expansion is not so limited.

INVESTMENT COMPARISONS

None of the bases discussed so far has considered the important economic criterion of net returns after taking operating costs and interest into account; or, developing it a stage further, of the relative attraction of farming and forestry as long term investments. Comparisons along these lines are of the greatest importance to the individual land-owner, but they are the most difficult of all to make.

The agricultural community is quite used to thinking in terms of net interest earned, i.e. the difference between gross returns and all outgoings (including interest payments and managerial expenses) expressed as a percentage of the capital value of the land. Once a forest is a going concern and is on a sustained yield basis, it would be possible for foresters to calculate similar figures based on net operating profit and the capitalised value of the forest. Although simple interest would be used in both cases, the comparison would be valid only if the capital value of the forest included compound interest on all charges since its inception. The difficulty immediately arises as to what rates of compound interest should be used. If the forest enterprise has been financed from borrowed money the solution

is easy – the rate used should be at the rate actually paid. But in all other circumstances there is room for wide variation in the choice of rates. Should they be low because of the long term nature of the investment, or high because of the peculiar risks involved in forestry? Should they be the actual bank rates operative at the time the money was expended, or should they be what Professor J. J. McGregor (1960) in a recent paper on forestry and land-use describes as “national” or “opportunity cost” rates? The authors do not profess to know, but they are only too well aware of the enormous effect on costs that a difference of one per cent in the compound interest rate will make, even in New Zealand where rotations are relatively short.

The problem has been approached another way by Dr K. R. Walker in the paper already quoted. He was concerned with the allocation of land to forestry or agriculture in the hill country of Great Britain, and posed the question “How different would the allocation have been had economic criteria alone been applied?” To answer the question he made calculations of the relative productivity of forestry and agriculture in hill country, using data from farms covering 211,000 acres and forest land covering 101,000 acres. A forest cycle of 50 years was assumed. The comparison made was between the net value added in 50 years per 100 acres under forestry and the aggregate of the annual land products per 100 acres under agriculture, each year’s product accruing at interest from the year of origin to the fiftieth year. Then, to quote his paper –

The nett value added by land is obtained by exhausting the gross product (nett of direct subsidies) of all non factor and factor payments except payments to land itself. The residual is then a measure of the value added by land alone, or the price which might be paid for the use of the land. For forestry, nett product of land is equal to gross receipts (which accrue at compound interest from the year of origin to the fiftieth year) minus total costs, except payments to land (including compound interest payments) plus the value of capital recoverable in 50 years, valued at current prices. In other words it is necessary to construct a time-production and time-investment schedule over the 50 year forest cycle.

For the forestry calculations he had to make certain assumptions about wages, future extraction costs, housing costs (inasmuch as they were part of a national housing scheme, he queried their inclusion), and the relation of farm produce to forest produce prices. The calculations were repeated for different combinations of assumptions and different compound interest rates: specifically, interest rates from three per cent to seven per cent; present costs and prices; effects of increases in wage rates; effects of farm prices rising relative to timber prices and vice versa.

As a result of this exhaustive and intricate study he was able to draw conclusions about the rates of compound interest which the two different forms of land use could afford to pay. His results, as summarised in *Scottish Forestry* (Anon, 1960), were as follows:

The Forestry Commission would justify its claim for land in South, West and East Scotland if the compound interest rate was 4% or less, this being true even for the assumptions least favourable to forestry. At rates below 4% the nett values added by land in terms of timber are many times greater than the farm products. In the whole United Kingdom the Commission's best claim for land, on an economic basis relative to agriculture, is in East and West Scotland. Using 1953 timber prices, wages increased 30% above 1953 rates and housing costs included, the Commission could pay £26 per acre for land in East Scotland and £36 for land in West Scotland, pay 4% compound interest on a 50 year rotation and still produce more than hill farming. Dr Walker concludes that if the Government applied the economic test to the Forestry Commission's demand for hill land, the Commission would not be faced with a shortage of plantable land in blocks of economic size.

Most foresters have been taught during their formal training to make similar calculations for forest enterprises, deriving a land value by soil expectation formulae with assumed rates of interest, or giving an initial value to the land and deriving the compound interest earned by an analysis of earnings and outgoings at different stages of the crop. Some such studies have been made for N.Z. exotic forests, though none has been published. As far as the authors are aware, no one has ever attempted to do the same for agriculture, i.e. to set up time-production and time-investment schedules over a cycle equivalent to a forest rotation. Certainly no one has ever done both for the same type of country and arrived at the sort of comparison which Dr Walker has achieved. Our final suggestion to forest or agricultural economists therefore is that such studies should be made. We do not know whether the results would confirm or deny the advantages which other criteria appear to give to forestry – but we would be most interested to find out.

SUMMARY AND CONCLUSIONS

The difficulties inherent in making valid comparisons between the economics of farming and forestry in New Zealand have been itemised and discussed. In full realisation of these difficulties, the authors have suggested various economic criteria which could be used, and, where figures were available, have given examples of the criteria in operation. The return to grower basis has been scantily dealt with, and no definite results have been presented. Indeed it would be quite impossible to come to any general conclusion on this subject; individual and specific cases alone would have to be considered. For all other criteria illustrated, i.e. gross values (national or regional), import earnings, labour employed, and production per employee, the examples given would appear to show that there is ample economic justification for considering forestry to be not only as desirable a form of land use as agriculture, but in some ways, a much better one. And in all cases, the reason is the same – the fact that, unlike agriculture, forestry does not generally export its processing industries. It must however be stressed that the authors have not been able to

illustrate the final criterion suggested, i.e. net return, taking the time factor into account. It may well be considered that this criterion is economically of equal or even greater importance than any of the others considered.

If the conclusions have any validity they still cannot justifiably be translated into practice unless one major assumption is made. It is that there will be an adequate market for forest produce. This is not the place to elaborate on future market trends for either form of product. Such studies have been made by other authorities in other contexts and they may be referred to elsewhere in this symposium. All that need be said, is that the future market prospects for forest products, and particularly for derived products such as pulp and paper, are at least as good as those for agricultural products; and there are some reasons for considering that they may be better.

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