LEASING OF FOREST LAND ON A ROYALTY BASIS

M. B. GRAINGER*

SYNOPSIS

Because of the long deferment of income, the leasing of land for forestry on a royalty basis (share cropping) offers some advantages. This paper proposes as its basic principle that the economic rental be converted to a predetermined percentage of future stumpage value. A royalty formula is developed from a forestry model described by Ward et al. *(1966). This royalty in turn depends on a broad land classification which recognizes six classes according to topography and vegetation. The methodology of the study defines the relative investment of the two parties and thereby fixes their respective interests in the crop. The formula is designed for tended radiata pine forests only, and assumes an average distance of 30 miles from forest to relevant sawn timber price point f.o.r. There is provision for review after 25 years. Royalty varies between 1% and 25% of stumpage value, depending on land category.*

INTRODUCTION

Early in 1965, A. D. McKinnon (then Director of Forest Economics) formally proposed that the Forest Service should investigate leasing undeveloped land on a royalty basis as a means of getting it into production. He suggested that a peppercorn rental should apply during the non-productive years, and that royalty be paid on all forest produce harvested; liability would be expressed as a percentage of the stumpage value. More conventional methods for making land available on leasehold had already been considered but had been rejected because associated problems complicated their application to forestry. In particular there were three considerations which prompted the search for a new formula:

Firstly, the conventional type of lease, based on an agreed annual rental, posed a number of problems. Future markets are obscure, yields are uncertain, and the rural land valuation system has its roots in agriculture, not forestry.

Secondly, if (as a practical alternative to a fixed rental) some system of direct profit sharing between lessor and lessee at the harvesting stage were to be considered, it would be necessary for the lessee to maintain meticulous cost records covering the whole of his expenditure over a period of about 30 years. Division of overhead costs in particular could present serious problems, and inflation would destroy comparability.

*Forest Economist, Forest Research Institute, Rotorua.

Thirdly, the major obstacle in forestry is undoubtedly the lack of any income during a long period of heavy expenditure. Therefore postponement of the rent collection would ease the lessee's burden, at least to some extent, and thereby encourage investment in forestry.

The theory behind the exercise was simple. By selecting an appropriate forestry model, the economic rental could be assessed and then could be expressed as a predetermined percentage of the ultimate stumpage value of all produce from that forest for the term of the lease. This was merely a question of mathematics. Then, provided the model was typical, it would be reasonable to expect that such a percentage royalty would be acceptable for a fairly wide range of sites and circumstances so long as the more important variables could be allowed for in the formula. Unit stumpage values at the time of harvest could be easily established and verified either by open tender, or by negotiation, or by the standard Forest Service timber sales formula. The intention was that, from the inception of each lease until first royalties should accrue from utilization thinnings, a "peppercorn" rental of five cents per acre per annum would apply.

From the outset the magnitude of the problems and several questions having a vital bearing on the approach were clear. What management regimes to allow; how many physical variables to recognize; what rate of interest to apply; what to do about the impact of taxation; and how to retain the benefits arising from "locality value" strictly for the lessor alone. *Prima facie,* it seemed impossible to develop a royalty formula that would effectively interpret the effect of all major variables, except at the cost of a formula far too cumbersome to be useful. As the study progressed this was quickly confirmed. However, in due course support for the general principle of leasing on royalty was found in the southern states of U.S.A.; the Calcasieu Paper Company was actively leasing forest land on a basis of share-cropping or timber royalty (Wright, 1966), and the manager of their wood and land department had written enthusiastically in favour of the system. The company even furnished the N.Z.F.S. with a copy of one of their leases covering a term of 60 years. Problems notwithstanding, therefore, the local study went ahead; the terms of reference included the dictum "rough justice for all" rather than precision at the cost of an unduly complex royalty formula.

THE FOREST MODEL

It did not take long to find out what this implied. Initially the formula would have to be based entirely on a tended sawlog regime as currently accepted. Later it might conceivably be possible to show that, because royalty is a ratio and not an absolute value, the formula actually had wider applications. A measure of compromise between important variables was necessary. Consider the significance of the following:

(1) *Initial vegetation* clearing costs can vary from nil to $40 per acre, so can very considerably affect the cost of the lessee's investment.

(2) *Topography* has an important bearing on the cost of land preparation, forest establishment, and also the subsequent management of the forest as a going concern.

(3) *Location.* Distance from market or price-point has an important influence on stumpage values and therefore can considerably affect the value of the land.

(4) *Tending.* The intensity of tending has a major influence on both cost and revenue because tending can vary from nil to about 100%.

(5) *Roading.* Unit cost of construction and maintenance can vary greatly depending on topography, soil, and access to road metal supply.

In theory the five items listed here represent the essential minimum to ensure reasonable accuracy, but even this very limited number presented problems. Roading, for instance, is an important and also a very sensitive cost element; therefore, it was very desirable that the royalty formula should cater for roading variability. However, to do so would mean that a roading pattern and associated local costs had to be worked out for each area of undeveloped land as and when that area is appraised for leasing. This seemed altogether too premature for such estimates to be reliable (even if they could be conveniently prepared) so, reluctantly, any idea of trying to incorporate variable roading costs in the leasing formula had to be abandoned. "Locality value" promised to be even more elusive, since by the very nature of things it could depend very largely on markets and price-points not yet in existence. The significance of transport as an economic variable was beyond dispute, but (as later discussion will show the problem finally proved to be insoluble.

The decision, therefore, was to design a royalty system to suit an average sawlog forest of tended radiata pine situated at some agreed average distance from future markets. There will always be cost variations between individual forests, but much of this variability is likely to be more or less casual in nature. To achieve a workable leasing formula, we necessarily had to assume close uniformity of equipment, labour quality, methods and techniques, managerial ability, and forest working plan as between any series of potential leasehold forest areas; this postulation implied that there would be no *need* for the general run of forest expenditure to differ unduly from one forest to another. The criterion was to be an average efficient forestry enterprise managed competently. Pre-existent physical differences were a totally different matter; the leasing formula must at least recognize the economic effect of variation in topography and initial vegetation.

The only authentic economic model available in sufficient detail at the time was one constructed for a joint land-use study based on the Maraetai Block at 1962 price levels. This study, which was made in association with Lincoln College, covered an area of 25,000 acres and specified a radiata pine forest with sawlog stands on a 36-year cycle. Approximately 10% of the area was devoted to a pulpwood rotation of 20 years, but because sawlogs were restricted to the three lowest logs from each tree, the forest yield was approximately 50% sawlogs and 50% pulpwood. This forest model was "borrowed" for the purpose of the leasing study, but since it featured a State forest it had to be adapted to simulate a leasehold property operated by private enterprise and subject to tax law. The cost structure was used as it stood, but a few changes in the revenue flow were made to make the model more representative of the general run of lands likely to be offered on lease (Appendix 1).

Since then research has shown that far better economic results can be achieved by a totally different management regime based on wider initial spacings and shorter rotations; as a result, a totally new Maraetai model has come into existence since the royalty formula was developed. This does not affect the validity of the formula for leasing which is designed to share the forest crop equitably under conditions of rising profitability.

RATE OF FINANCIAL RETURN

The factor which makes the greatest single impact in the economic value of land for forestry is the financial return which the grower expects from his investment. The higher the rate of financial return demanded, the lower will be the value of the land itself. Here is the basic principle which determines land value: the investor who provides the capital necessary to render the land productive is entitled to his agreed financial return. Any residual income remaining, after all expenses have been paid and after the capital investment has been rewarded, represents the rental value of the land itself. It follows, therefore, that a realistic rate of return must be agreed before the value of the land and its equivalent in royalty can be calculated. This poses a very real problem because there is no recognized criterion which will effectively establish the rate of return for forestry under New Zealand conditions. In the original Maraetai study, the need to select a single and truly representative rate of interest on capital did not arise; in that case-study three alternative rates were selected somewhat arbitrarily for the specific purpose of comparing farming and forestry. Now we need to know what particular rate of interest is most appropriate for determining the actual price that can be paid for forest land.

The first fact to be recognized is that forestry hitherto has been singularly unrewarding as a commercial enterprise. When isolated from allied processing and end-use activities, it has failed to yield an acceptable tax-free return on the invested capital. On past performance, and as judged by prospects when the leasing study was undertaken, forestry as a solo enterprise was incapable of a better return than pastoral farming; it certainly could not match the financial yields shown by industrial and commercial investments. If comparable rates of return were to be used, the effect on most areas of potential leasehold forest land would be negative land values and therefore zero royalty. Generally, agriculture is a potential competitor for any large block of undeveloped land; therefore it seemed evident that the choice of interest rate really rested on the principle of competitive land-use. If forestry were to justify its tenure of such lands, we must impute to it an interest rate that would enable it to compete for the land it requires.

So the mathematics of the exercise began with the acceptance of this principle; the basic economic model must reflect a financial return equal to the rate that could be expected from the same land under the appropriate pattern of efficient farming. Even then the choice of interest rate was not easy, for published financial results displayed quite a measure of variability for farming. However, the N.Z. Meat and Wool Board had made a series of systematic economic surveys, so these results were chosen in preference to others. The figures indicated that land of the Maraetai category might reasonably earn an average of approximately 6½% as a farming investment; so 6½% became the criterion against which the economics of the forestry investment (and by implication, the rental value of the land) would be measured.

That, then, was the background against which the leasing of land on royalty was examined. As long as the ratio of revenue to expenditure showed no significant improvement, it was necessary to think in terms of a financial return of only 6½% (before tax); otherwise land values for forestry purposes would be depressed in comparison with agricultural values. So this rate of return was written into the arithmetic of the model. At the same time, it was recognized that 6½% was totally unsatisfactory for risk capital and therefore had to be regarded as a bedrock minimum imposed under duress. As soon as the level of forest revenue should improve substantially in relation to forest expenditure, the lessee (as the risk bearer) must be the first to benefit by way of a higher return on his investment. This was regarded as axiomatic, and it implied that the royalty formula must be sufficiently flexible in operation to satisfy this requirement. The evidence suggested that a percentage royalty scale would do this quite effectively; that is to say, even though the basic model itself with its 6½% return on capital might soon be outmoded, the ratios developed therefrom could be equally valid for higher net revenues and commensurately higher rates of financial return on the lessee's investment.

THE SIGNIFICANCE OF TAXATION

The 1965 Budget introduced a tax concession whereby forest expenditure by companies could be claimed as a deduction against any income received from other sources — thereby reducing very considerably the *real* cost of any investment in forest extension. Because this concession was specifically designed to encourage private afforestation by public and private companies, it seemed only reasonable that the grower should literally enjoy the full benefits thereof — irrespective of whether the land itself be freehold or only leasehold. If the lessee were to be denied either the whole or even only part of this tax advantage, we would be in the invidious position of using an investment concession as a means of inflating the value of unimproved forest land. So in constructing the economic model the lessee was credited with the full face value of his investment — thereby placing him on an equal footing financially with any other forest owner who might acquire additional freehold land on terms permitting him to enjoy the full tax advantage. Not all items of expenditure are deductible, but to the extent that afforestation costs can be charged against current income the financial return to the lessee is of course better than 6½% (before tax).

There was a further facet of taxation to be considered before the true value of the lessee's investment could be calculated. The traditional text book approach to land expectation value (LEV) for forestry has been to compound all forest expenditure at the agreed rate of interest until culmination of the investment period. This procedure is eminently satisfactory when it is a question of economic comparisons, but it can be wholly inaccurate if we wish to know the absolute value of land to an individual user. The effect of taxation is to reduce the real rate of growth for any investment expressed in terms of a nominal rate of compound interest. The point can be demonstrated very simply: if a public company were to invest its own funds in 6½% debenture stock, the company would have to pay tax at the rate of approximately 50 cents for every dollar of interest so earned. It follows that the company's net cumulative earnings available for further investment or re-investment after payment of tax would represent only 3¼% on the original capital investment. So the investment can grow at the rate of only 3¼% annually. (We necessarily have to assume that the average forestry company will be integrated with processing and will pay tax at maximum rate.)

This principle governs the construction of the economic model. The lessee's investment cannot be credited with any interest that would be lost to taxation if that interest were literally receivable in cash. So the true value of the lessee's investment is found by compounding all expenditure at 3¼%. The effect is that, although the face value of the financial return is 6½% before tax is paid, the resultant value of the land itself in this model is largely a reflection of compounding at only 3¼%.

The question may be asked whether the same principle would apply if the lessee company were to use loan funds at 6½% interest to finance its extension programme. The answer, of course, is: Yes. Any interest paid on loan money is a deductible expense for tax purposes, so the cost of interest payments is effectively halved by tax savings. By the time the loan is eventually repaid, therefore, the true value of the forest investment is the original cost plus interest at $3\frac{1}{4}\%$. As a lessee, the Forest Service is not affected by taxation as private enterprise is; in such cases "notional" taxation is imputed because it would be quite impracticable to differentiate.

The incidence of taxation must also be considered when accounting for forest income during the development phase. In the Maraetai land-use study (and hence, by implication, the economic forest model) the forest begins to earn a net annual income from year 20 onwards. However, the Maraetai forest investment account was not closed off until year 40 when the forest will finally achieve approximate stability of annual earnings and of annual operating expenses. The economic model likewise illustrates the capital investment at the end of 40 years when the forest is functioning as a fully productive "going concern". But royalty payments must commence with first utilization activities; therefore the royalty percentage must be as valid for thinnings as for the final crop.

The analytical technique was to segregate all forest income during years 20 to 40 and then to assume that this income is progressively invested in debentures at $6\frac{1}{2}\%$ interest; the interest in turn is likewise re-invested at the same rate. Taxation claims naturally have to be satisfied, both in respect of the initial net forest income and subsequently in respect of the interest earned on the debenture stock. This procedure gives the compounded value of all intermediate net income at the end of year 40, but it is nothing more than an analytical device to assist in equating all forest income to a constant annual stream in perpetuity from year 41 onwards. The basic principle is this: if each year's income from thinnings is invested and then the interest thereon apportioned in perpetuity, the effect is precisely the same as apportioning the initital capital sums individually as they are earned by the forest.

The effect of taxation is that only 50% of the net forest income is available for investment in the notional debenture stock. Likewise only 50% of the interest thereon is available for re-investment. Therefore, in the economic model, the correct result is found by compounding one-half of the net forest income during years 20 to 40 at $3\frac{1}{4}\%$.

DISTANCE FROM PRICE-POINT

As distance from markets is one of the really critical factors in the economics of forestry, it was obvious that transport differentials could exert a major influence on the value of forest land and therefore on the equivalent royalty percentage. A great deal of thought was given to this matter, and every effort was made to find a practical means of catering for this important variable so that the royalty for any given leasehold forest property would reflect any inherent advantage or disadvantage arising from geographical location. Unfortunately, the problem proved to be inordinately difficult for three particular reasons.

(1) We cannot predict with any assurance of accuracy 20 to 30 years ahead just where the output from any given forest will be marketed.

(2) The existing system of wholesale sawn wood price-points is likely to change considerably in conformity with the changing deployment of forest resources over the same period.

(3) Even if the early markets could be predicted with acceptable accuracy, it is most unlikely that the marketing pattern would remain unchanged over the duration of a long lease.

The principal problem arises from the inability of the existing price-point system to serve satisfactorily the enlarged commercial forest estate of the more distant future. On a long-term basis, some changes in the price-point system must certainly be expected. Similarly in the case of markets: the lessee may have well-defined intentions at the time the lease is signed, but circumstances can change and the lessee company may be operating on a different marketing policy by the time harvesting begins. A further factor is this: proximity and remoteness are both questions of relativity; remoteness in particular will be a diminishing handicap because the effluxion of time will bring changes that will almost certainly greatly reduce, and in some cases even neutralize, present disadvantages in relation to markets.

For royalty purposes, therefore, the analysis was based on the modified Maraetai model as it stood. This means that, for the greater part of the utilization phase, the royalty formula assumes each prospective leasehold forest to be situated 30 miles from the relevant price-point. But to cater for any substantial departure from this assumed average location an escape clause was provided for; each lease could make provision for a review of the royalty rate on request after the lapse of 20 to 25 years. The detailed processing of the basic data is accordingly set out *in extenso* in Appendixes 1 to 4 so as to facilitate any such future review of the royalty formula. Appendix 4 shows that, for a leasehold forest of easy topography, similar in all respects to the basic model, the lessor would be fairly rewarded by a royalty of 20% of all stumpage value. But differences in topography and vegetation can materially affect the economics of a project; therefore royalty must be related to an appropriate system of land classification.

LAND CLASSIFICATION

In designing a land classification system for leasing purposes, it is important that each category should be reasonably easy to identify and demarcate in the field. Topography has an almost infinite number of variations, but from a forestry viewpoint any plantable land will fall broadly into three distinct categories:

(1) Land plantable by machine.
(2) Other land suitable for tractors.
(3) Land unsuitable for tractors.

There are also many types of ground cover ranging from grass and bracken to dense and heavy indigenous second growth. So the range of preparation costs for the various vegetation classes is quite wide. Further analysis showed that, on a fairly broad basis, the vegetative cover can be grouped into five major classes according to the type of cover and the treatment required.

Vegetation class	*Preparation*
1. Light scrub, bracken, etc.	Burn only
2. Medium scrub	Crush and burn
3. Heavy scrub	Cut and burn
4. Sand dunes	Plant marram and lupin
5. Indigenous bush:	
(a) new cut-over	Burn and bulldoze
(b) old cut-over	Rootrake
(c) non-merchantable bush	Fell and burn

The most significant factor when topography class and vegetation class are combined to provide a practical land classification system is the manner in which each combination affects the expenditure of the lessee. Costs can, and do, vary a good deal even within any given category; so we cannot do better than indicate the order of the cost relationship that normally characterizes the several land classes and distinguishes them from one another. It should be clearly understood, moreover, that, although in this analysis a representative cost is allotted to each land category, the cost figures themselves are purely a means to an end; once the land classification formula is complete these costs cease to have any relevance — and of course they would very soon be out of date. One important criterion is that the final form of the land classification system should be capable of providing a symmetrical formula that will give equal intervals between royalty rates for the respective land classes. Based on a scrutiny of representative data, cost relativity as between the various categories of terrain and land cover is shown in Table 1.

Theoretically, the combination of 3 topographical classes with 7 vegetation classes would give 21 land classes which, in turn, would call for as many distinct royalty rates. Fortunately, a systematic grouping of these combinations on a broad cost basis enables the number of land classes to be reduced to 6; within each of these main classes there are several sub-classes which carry the same royalty percentage. Table 2 sets out the resultant classification in detail and becomes the basis for the physical assessment of any prospective leasing area. The inclusion of the cost index at this stage

TABLE 1: APPROXIMATE COST OF PREPARATION AND ESTABLISHMENT

Description (1)		Vegetation Class (2)	Cost Per Acre in $ Machine Planting Terrain (3)	Other Tractor Terrain (4)	Non-Tractor Terrain (5)
Preparation:					
Light cover	....	1	2	2	4
Medium scrub	....	2	10	10	16
Heavy scrub	....	3	20	20	24
Sand-dunes	....	4	20	28	—
Indigenous bush	....	5 (a)	—	24	28
Indigenous bush	....	5 (b)	—	34	—
Indigenous bush	....	5 (c)	—	30	30
Establishment:					
Light cover	....	1	20	30	34
Medium scrub	....	2	20	30	34
Heavy scrub	....	3	26	30	34
Sand-dunes	....	4	20	28	—
Indigenous bush	....	5 (a)	—	30	36
Indigenous bush	....	5 (b)	—	30	—
Indigenous bush	....	5 (c)	—	30	38

Note: Where sand-dunes are already stabilized, the cost of preparation shown above will not apply (refer to class 1 (b) in Table 2) unless there is a cover of heavy vegetation to be removed before planting can commence.

is merely to demonstrate how the numerous categories of land can be legitimately grouped under the 6 classes. The basis of this grouping is the average cost of preparation and establishment (Table 1) which can be summarized as follows, in rounded figures designed to establish equal cost intervals between land classes:

Land class	*Approximate cost per acre* $
1	20
2	30
3	40
4	50
5	60
6	70

The next step is to classify the Maraetai Block (which has been used for the economic model) in accordance with Table 2. The 6 land classes have the appearance of a discrete series; however, when several classes have to be weighted and averaged to provide a single equivalent class for a composite land area, it is obvious that we cannot avoid running into decimals.

TABLE 2: CLASSIFICATION OF FOREST LAND FOR LEASING ON ROYALTY

Land Class (1)	*Topography Rating* (2)	*Present Vegetation Category* (3)	*Preparation* (5)	*Definition* (6)	*Cost Index* ($)* (4)
1 (a)	Machine planting	Light scrub, bracken, grass, etc.	Burn only	Very easy	22
(b)	Machine planting	Stabilized sand-dunes	Nil	Very easy	20
2 (a)	Tractor	Light scrub, bracken, grass, etc.	Burn only	Easy	32
(b)	Machine planting	Medium scrub	Crush and burn	Easy	30
(c)	Machine planting	Sand-dunes	Plant marram and lupin	Easy	34
3 (a)	Non-tractor	Light scrub, bracken, grass, etc.	Burn only	Average	38
(b)	Tractor	Medium scrub	Crush and burn	Average	40
(c)	Tractor	Non-merchantable indigenous bush	"Ball & chain" and burn	Average	44
(d)	Tractor	Sand-dunes	Plant marram & lupin	Average	44
4 (a)	Non-tractor	Medium scrub	Cut and burn	Difficult	50
(b)	Tractor	Heavy scrub	Cut and burn	Difficult	50
(c)	Tractor	Cut-over with resid. merch. timber	Burn (after logging)	Difficult	54
(d)	Tractor	New indigenous cut-over (1-2 yr)	Burn	Difficult	54
(e)	Tractor	Merchantable indigenous bush	Burn (after logging)	Difficult	54
5 (a)	Non-tractor	Heavy scrub	Cut and burn	Very difficult	58
(b)	Non-tractor	New indigenous cut-over (1-2 yr)	Burn	Very difficult	64
(c)	Non-tractor	Merchantable indigenous bush	Burn (after logging)	Very difficult	64
(d)	Non-tractor	Cut-over with resid. merch. timber	Burn (after logging)	Very difficult	64
(e)	Tractor	Old indigenous cut-over (10-15 yr)	Rootrake	Very difficult	64
(f)	Tractor	Non-merchantable indigenous bush	Fell and burn (refer 3 (c) above)	Very difficult	60
6	Non-tractor	Non-merchantable indigenous bush	Fell and burn	Marginal	68

*The Cost Index is included at this stage merely to support and explain the grouping of the various land categories. For practical use in the field the Cost Index is replaced by the royalty scale as discussed in the closing sections of the paper.

Since the 6 land classes reflect equal intervals in the cost of preparation and establishment, the classes themselves can be directly weighted to give an overall land classification; moreover, equal decimal intervals can be interpolated between classes. So for all practical purposes the 6 land classes can be regarded as a continuous series. The class numbers are not mere ciphers but are quality indexes, each of which will shade decimally into the next lower class. From the description given in the Maraetai land-use study, this block of land can be broadly classified (according to its state prior to development) as shown in Table 3. This procedure of directly weighting several land classes will not be necessary once the requisite royalty scale has been established; thereafter it will be more convenient to weight the relevant royalty rates on a percentage basis as shown in Appendix 5.

In this case the decimal is of no significance whatever, so the weighted overall classification for the entire Maraetai Block is Class 2. We have now established the first connection between land category and royalty percentage; for forestry purposes Class 2 land will carry a royalty value of 20%. From this point it is a simple matter to expand the royalty scale upwards to Class 1 land and downwards to Class 6 by using the basic cost differentials for preparation and establishment. The land in the economic model is valued at $40 according to

TABLE 3: LAND CLASSIFICATION FOR MARAETAI BLOCK

Area (thousands of acres) (1)	*Topographical rating* (2)	*Preparation required* (3)	*Land Class* (4)	*Weighted Class* (5)
12	Machine planting	Burn only	1	12
4	Tractor terrain	Burn only	2	8
7	Tractor terrain	Crush and burn	3	21
2	Non-tractor terrain	Fell and burn	5	10
—				—
25				51

Hence Average Land Class: 51/25 = 2.04 (say Class 2).

TABLE 4: ROYALTY VALUE BY LAND CLASS

Land class	*Land value per acre (undeveloped)*	*Royalty as a percentage of stumpage value*
	$	%
1	50	25
2	40	20
3	30	15
4	20	10
5	10	5
6	2	1

Appendix 4, carries a royalty of 20%, and the cost differential per land class is $10. Land value and royalty, therefore, will vary as shown in Table 4. From this point onwards the land values should be completely ignored; they are solely a means to an end and moreover are relevant only within the confines of this particular study and the unit stumpage values employed. The end result of the study is the royalty scale; it should now be substituted for the cost index in Table 2 — thereby making Table 2 self-contained as a practical formula for the classification of forest land for leasing. Use of the formula is demonstrated in Appendix 5.

For practical reasons, Class 6 land (which otherwise would show nil value) has been assigned a nominal value of $2 per acre and 1% royalty. The reason is that, although this land is so marginal that it will usually be regarded as unplantable, it is likely to have a positive value when included as small areas in better land.

VALIDITY OF THE FORMULA

The royalty scheme was conceived and designed as a bold and imaginative plan to bring undeveloped land into production by sharing its productivity between lessee and lessor according to their respective interests. It postulated an equally bold hypothesis, namely, the relative investment of owner and grower in leasehold forestry can be expressed as a constant ratio for any given combination of topography and initial ground cover. This was later qualified by limiting the royalty formula to tended radiata pine sawlog regimes and deferring any consideration of individual locality advantage until commencement of harvesting. By adopting a policy of "pay as you earn", leasing on royalty promised to alleviate the hardship of the non-productive years inseparable from any investment in afforestation. It filled a gap in national land valuation processes which hitherto had failed to produce an effective formula for the valuation of forest land as such. It safeguarded the long-term ownership of both public domain and Maori lands while fostering their development and use by competent forestry organizations.

The search for a royalty formula had to accept the cold economic fact that, on the price levels of the day, forestry as a solo commercial enterprise was quite unprofitable. The growing of trees for production of market logs held little hope of a return better than 6½% on the investment; this was much too low to attract risk capital. But there was good reason to believe that on a relatively long-term basis a substantial improvement in forest profitability could be expected. It was this expectation that gave substance to the royalty proposal. The formula accepted the contemporary fact of a sub-standard return on forest capital, but expressed it as a percentage of the available forest income. Should that income substantially improve in relation to costs, the lessee's percentage would give him a larger absolute sum, which in turn would reflect a proportionately higher rate of return on his investment. So leasing on royalty promised advantages to both parties. The land owner's interest would be protected against the eroding impact of inflation on the conventional type of fixed annual rental; the lessee's interest as risk-bearer would be protected against a continuance of poor rates of financial return if and when the economics of forestry should materially improve.

The ink was scarcely dry on the draft royalty proposals before research showed that returns from forestry could be improved without waiting for the expected long-term upswing of prices. The royalty formula came in for a good deal of criticism — particularly from Treasury officers who contended that it could not be reconciled with the latest forest models. The facts do not support this criticism which seems to have originated in a misunderstanding of underlying principles and aims. By systematically commuting the prevailing low return on capital to a percentage share of total stumpage value, the royalty formula was in effect providing for a flexible rate of financial return on the forest investment. Had the quest for a leasing formula been deferred until 1968, a return of 6½% before tax could no longer have been regarded as realistic; so the interest rate used to develop a royalty formula from the 1968 Maraetai model would necessarily have been higher. Consequently there is no reason to expect that the resultant royalty scale would have been significantly different. It is well known that the effect on LEV of higher stumpage values or quicker returns is very soon neutralized by higher interest rates — and royalty is merely another way of expressing LEV.

It must be remembered that land value can rarely be precise in an economic sense. Being a residual value, it is critically dependent on the rate of economic interest applied to the capital employed in development. There is something very simple and tangible about a firm capital value, as for agricultural land, and a fixed equivalent monetary rental. But forestry differs considerably from agriculture. What is land really worth for such a distant crop? What will be the yield and the market value? How can such future productivity be effectively expressed in terms of the present? What about the great changes in accessibility that will take place over the term of the lease? How can traditional valuation procedures be effectively reshaped to cope with the problems of forestry leaseholds? These were some of the unanswered questions that prompted the Forest Service to seek a new approach whereby the rewards of leasehold forestry could be appropriately shared as and when they should ultimately materialize.

In broad principle, leasing on royalty is no different from share-milking which is so characteristic a feature of the New Zealand farm economy. The formula implies average efficiency, average accessibility, and an average of at least 50% of tended forest, but the nominal royalty scale is not mandatory for any given piece of land; it is a basis for contractual offer, negotiation, and acceptance. If there are exceptional circumstances, the indicated royalty percentage can be suitably varied. Because the royalty formula recognizes the relative investment of lessee and lessor in terms of a rate of financial return which moves with the profitability of the investment, it can accommodate widely varying circumstances. It must be emphasized that the formula retains no connection whatever with the original 1962 Maraetai model beyond the fact that that model happened to be used to analyse the basic relationships in a forestry investment.

CONCLUSION

Leasing on royalty is essentially simple in operation: the owner takes a fixed share of the crop. The fact that the royalty system is actively in use by at least one large pulp and paper company in U.S.A. suggests that it might serve an equally useful role here in New Zealand. The formula purports to give the land owner a fair and reasonable rental for his property over the full term of any lease which allows for at least two full rotations. Even if appropriate valuation techniques for leasing forest land on a more conventional basis should be developed at the national level in the immediate future, leasing on royalty could have advantages as an option available to prospective lessees of undeveloped State forest land.

REFERENCES

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APPENDIX 1: DETAILS SHOWING HOW THE REVENUE IN THE "MARAETAI LAND-USE STUDY" HAS BEEN ADJUSTED DOWNWARDS FOR THE LEASING MODEL IN ORDER TO REFLECT MORE AVERAGE CIRCUMSTANCES

(a) *Period from year 20 to year 37*:

During these years the only forest revenue is from the sale of pulpwood. The assumption is that transport costs are increased by 0.625 cents per cubic foot because of longer road haul to the pulp mill. Hence pulpwood stumpage value is reduced from 3.75 cents to 3.125 cents/cu. ft. (Maraetai revenue is reduced in the ratio of 6:5.)

(b) *Period from year 37 to year 40 inclusive*:

From year 37 onwards, when sawlogs and debarked slabs add to the revenue stream, there are further adjustments to be made to the basic Maraetai data. The assumptions are as follows:

	\$ per acre/ annum
(1) Longer road haul for sawlogs raises the unit cost from 3.67 cents to 3.92 per cubic foot and reduces forest revenue by	0.30
(2) Loading of all sawn wood on rail at official loading point cancels the Maraetai positive D.I.F. of 5.83 cents per 100 bd. ft and reduces forest stumpage values by 0.375 cents/ cu. ft	0.40
(3) A reduction of one-third in the sales value of debarked sawmill slabs reduces the sum credited to forest revenue (per medium of additional stumpage value) by	0.50
(4) The reduction in the stumpage value of pulpwood referred to under (a) will reduce forest revenue by	0.80
Total decrease in revenue:	2.00

Note: The overall effect of the changes in transport costs is to increase the basic 25 mile average haul of the Maraetai land-use study to an average of 30 miles (60-mile round trip).

APPENDIX 2: FOREST MODEL USED FOR THE DEVELOPMENT OF THE LEASING FORMULA

(a) *Expenditure to year 40 @ 6½% before tax*

Year	*Annual costs* $000s	*Total compounded cost @ 3¼% after tax** $000s
1	138.20	480
2	63.80	214
3	76.20	248
4	88.80	280
5	78.80	242
6	121.40	358
7	94.60	270
8	90.40	248
9	96.40	258
10	96.60	252
11	129.00	324
12	149.80	366
13	142.60	338
14	142.20	326
15	142.80	318
16	144.80	312
17	144.80	304
18	140.60	284
19	124.60	242
20	116.60	220
21	205.60	376
22	199.00	352
23	197.20	336
24	188.00	312
25	188.00	302
26	120.60	188
27	129.40	196
28	120.40	176
29	129.40	184
30	121.80	168
31	130.60	174
32	129.60	168
33	137.20	172
34	137.20	166
35	136.60	160
36	133.40	152
37	131.40	144
38	398.80	424
39	227.40	234
40	227.40	228
Total expenditure in year 40 @ 6½%		10,496

*Assuming taxation at the rate of 50 cents in the $.

Note: This list of expenditure excludes certain overhead costs, fire expenditure, contingencies, and working capital which are introduced separately in Appendix 4.

APPENDIX 3: FOREST MODEL USED FOR THE DEVELOPMENT OF THE LEASING FORMULA (cont'd)

(b) *Revenue to year 40* (Treated as an Investment Account earning 6½% (before tax) in perpetuity).

		Revenue to be compounded			
Year	*Gross forest revenue* $000s	*Non-tax* revenue* $000s	*Net† profit after tax* $000s	*Total revenue* $000s	*Compounded total revenue @ 3¼% after tax* $000s
20	44	44.00	—	44.00	83.20
21	164	164.00	—	164.00	300.00
22	164	164.00	—	164.00	291.00
23	204	197.00	3.40	200.40	342.00
24	204	188.00	8.00	196.00	325.00
25	210	188.00	11.00	199.00	320.00
26	210	120.60	44.60	165.20	258.00
27	212	129.40	41.40	170.80	258.00
28	212	120.40	45.80	166.20	242.40
29	212	129.40	41.20	170.00	242.00
30	184	121.80	31.20	153.00	211.20
31	200	130.60	34.60	165.20	220.00
32	200	129.60	35.20	164.80	213.00
33	200	137.20	31.40	168.60	211.00
34	206	137.20	34.40	171.60	207.80
35	194	136.60	28.60	165.20	193.40
36	162	133.40	14.40	147.80	168.60
37	162	131.40	15.80	147.20	161.80
38	862	398.80	231.60	630.40	674.00
39	860	227.40	316.40	543.80	560.00
40	852	227.40	312.20	539.60	539.60
Total accrued net invested revenue in year 40 @ 6½					$6,022‡

*Revenue in this column is offset against forest expenditure and therefore is compounded at full face value.

†Remaining revenue is subject to tax as profit, and therefore is reduced by 50% in this column before compounding.

‡This "investment" earns an annual income of $392,000 from year 41 onwards.

Note: (1) "Gross Forest Revenue" is the revenue ex Maraetai land-use study duly reduced in accordance with the explanatory notes in Appendix 1.

(2) The method of dealing with the revenue from thinnings and from pre-year 41 clearfellings is purely an analytical technique for commuting all early forest income to a uniform annual sum in perpetuity as from year 41 onwards.

APPENDIX 4: ASSESSMENT OF ROYALTY PERCENTAGE & LAND VALUE

(a) *Lessee's Direct Investment*:

		$
Capitalized expenditure (Appendix 2)		10,496,000
Other costs (overheads, contingencies, etc.)		1,074,000
		11,570,000
Less logging (capital & accumulated operating)		480,000
Lessee's net forest investment		11,090,000

(b) *Annual Forest Income (after year 40)*:

Interest @ 6½% on accrued income (Appendix 3)		392,000
Pulpwood 3,350,000 @ 3.125 cents/cu. ft		104,000
Sawlogs 3,150,000 @ 23.125 cents/cu. ft		728,000
Slabwood 690,000 @ 3.75 cents/cu. ft		26,000
Total income (year 41 onwards)		1,250,000

(c) *Less Annual Costs*:

Operating costs	$260,000	
Logging profit	48,000	
Lessee's interest @ 6½%	720,000	
		1,028,000
Margin (Rent)		222,000

(d) *Derivation of Stumpage Value*:

Gross annual income		1,250,000
Less: Logging costs	$94,000	
Logging profits	48,000	
		142,000
Equivalent annual stumpage value		1,108,000

(e) *Apportionment of Stumpage Value*:

Lessee: Annual forest costs	$166,000	
Return on capital	720,000	
		886,000 (80%)
Lessor: Rental as per (c) above		222,000 (20%)

(f) *Royalty & Land Value*: The lessor's share is 20% of the stumpage value and is worth $222,000 annually. This represents 6½% on the compounded land value after 40 years; so the land value in year 1 is:

$$\$\frac{222{,}000 \times 100}{25{,}000 \times 6.5} \text{ discounted @ } 3\tfrac{1}{4}\% = \$40 \text{ per acre}$$

In the case of this particular forest model based on the Maraetai Block of 25,000 acres, where topography is mainly very easy and land preparation costs are very light, the lessor will receive the full economic rent for his land if he exacts a royalty equal to 20% of the stumpage value of all produce extracted from the forest — from and including first utilization thinnings.

APPENDIX 5: METHOD OF APPLYING THE ROYALTY FORMULA

An area of 10,000 acres is offered by the Forest Service on a 60-year lease to a wood processing company. A field appraisal gives the following land classification:

Tractor terrain:	3,000 acres	light scrub:	Class 2
Tractor terrain:	4,000 acres	medium scrub:	Class 3
Tractor terrain:	1,000 acres	new cut-over:	Class 4
Non-tractor terrain:	2,000 acres	heavy scrub:	Class 5

The royalty assessment is worked out thus:

	Acres				*Weighted Royalty* %
Class 2:	3,000	30%	@ 20% Royalty		6.0
Class 3:	4,000	40%	@ 15% Royalty		6.0
Class 4:	1,000	10%	@ 10% Royalty		1.0
Class 5:	2,000	20%	@ 5% Royalty		1.0
	10,000	100%		Royalty	14.0%

In this case the lessor is entitled to 14% of stumpage value.