FORESTS AS MONEY

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ABSTRACT

The elements of forest value are presented in terms of the money measure of a normalised forest management, suited for use as a standard of comparison, a basis of valuation or measure of report.

INTRODUCTION

There is nothing about the value of a forest that is immutable. It emerges slowly out of the future amid changing circumstances, receding as fast as it is gathered in. It has constantly to be refashioned out of the wit and resource of those having an interest in it. A forest value will depend on some assumptions as to what will happen. As to this there may be many opinions, none attended by any certainty. There is a good case for a standardisation of content and form; a presentation of the elements of value, providing a basis from which to work or in which to show shifts taking place or anything in the way of realization; something suited for use in common by the varied interests whose interaction will determine what the forest value will become.

A first step is to order the forest description by the components of value: yields, prices, costs, taxes, in customary standard form, as in Table 1. These data have then to be rearranged to represent flows of value.

THE STRUCTURE OF OUTPUT VALUE

Suppose we had a forest with 40 ha at each of ages 1 to 25, and otherwise described as in Table 1, Case 1.

Forty hectares could be cut, producing a revenue and becoming available for regeneration. Forty hectares would be present for each of the other costs of initiating growth. The forest would be the same at the end of the year as at the beginning. If repeated indefinitely, this cycle of events can be represented by:

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TABLE 1: REALIZABLE YIELDS (m^3/ha) AND REALIZABLE PRICES ($/$m^3$)

Age	*Yield*	*Price*	*Age Class*	*Yield*	*Price*
15	221	2.39	28	559	11.15
16	250	4.02	29	580	11.33
17	279	5.33	30	600	11.50
18	308	6.41	31	620	11.65
19	336	7.31	32	639	11.78
20	364	8.06	33	657	11.89
21	391	8.68	34	675	11.99
22	417	9.22	35	692	12.08
23	443	9.67	36	709	12.16
24	467	10.06	37	725	12.22
25	491	10.39	38	741	12.29
26	514	10.68	39	756	12.34
27	537	10.93	40	770	12.39

Initiation Costs		*Joint Costs*	
regeneration	$250/ha	protection	$5 000
age 1	$ 50/ha	maintenance	$5 000
age 5	$100/ha	planning	$5 000
		administration	$7 500
		land tax	$7 500
			$30 000

land	$500/ha
revenue tax*	$0.45/$ of revenue
advanced off-set*	$0.45/$ of cost
discount rate	$0.05/$/year, mid-year basis

*This tax treatment is that of New Zealand prior to 1986. It is retained for simplicity of illustration.

annual cut: 40 ha at age 25 (m^3)	19 640
gross revenue: 19 640 m^3 x $10.39	$204 060
revenue tax	$—91 827
initiation costs: 40 ha x $250	
40 ha x $50	
40 ha x 100	
joint costs: 1000 ha x $30	$—46 000
advanced tax set-off	$+20 700
	$—25 300
net annual income	$86 933
discount rate	5%
capitalisation factor, mid-year basis	
1.0247 x 1/0.05	20.494
capital value (residual interest)	$1 781 605

This presentation has much to commend it. It is simple in structure and content. It uses concepts and a formality familiar in many statements on similar subjects. It puts the emphasis where most people would expect to find it; first, on the quantity of wood available for use; secondly, on whether the stumpage price is enough to meet expenses of maintaining the forest and leave a surplus; thirdly, on the value of expected future surpluses. It narrows from the widespread interest in wood usage to that benefit arising uniquely from the forest and in the hands of those on whose decision its future management rests.

These are advantages not lightly dismissed. While the presentation may not represent the yield or management of this or any other year, for there is no reason to suppose the forest would keep its present state of regularity, it does represent the position if this were to remain unchanged. Regularity of management is here assumed not for its probability but for advantage. It provides a useful standard against which to compare an alternative or by which to represent the forest interest to those interacting with it. Real forests will not have the regularity of the present one but there are good grounds for extending the assumption to these too.

Continuity and balance of growth and usage are generally assumed when managing forests. There would be little purpose to it unless present stock and future growth were to be used, and more likelihood of this if usage were continuous. The realisation of forest values depend on whatever is necessary to bring this about. The requirement is a broad one, applying to all forests and all usage. The usage from a particular forest may be far from balanced or continuous. But then any such necessities should be made clearly apparent for the forest value is conditional upon them.

The normal forest, one with an equal area in each age class to rotation age, as in Case 1, provides an idealised standard of continuity and balance. Actual forests are unlikely to have this regularity but that normal forest which is the equivalent of any actual forest, its ENF, can be determined (Allison, 1985).

A normal forest defines a standard of content for future cash flows.

NORMAL MANAGEMENT

If a forest happened to be normal it would only stay so under a particular course of management, which can be called a normal management, and which must consist of:

(1) The taking of a normal yield, the cut which would leave the ENF rotation unchanged from one year to another.
(2) A continuity of regeneration of areas cut and, on the average, its management to realise the presently predicted yields and prices.
(3) A continuation of management activity, jointly over all stands, as will continue the level of protection from loss and the efficiency and control assumed in the forest description.
(4) A continuation of present liabilities to taxation and similar obligations.
(5) No change in the present total area of the forest.

For a forest which is not now normal, but represented by its ENF, the only modification to these rules would be a continuation of the management of existing stands, as would lead to their having the yields and prices predicted for them in the forest description.

In all things, except the capacity of its usage system, normal management can reference the present. Unlike any opinion as to what management might become, this is something accessible to objective assessment, any charge something to take into account as and when it occurs.

If valuation were the immediate objective, a disregard of the present usage level, in favour of assuming an annual cut of the ENF yield, leading to clearfellings at ENF rotation age, might seem a disadvantage capriciously introduced. But the greater the difference between these levels of cut, the greater is the practical advantage. The difference must have its effect on the forest, either increasing or decreasing maturities, and must be resolved by an increase or decrease in usage, before value can be arrived at. The assumption of ENF yield represents the position if a balance between forest growth and usage were to be struck now, a standard against which to measure change toward something else.

Two forests of more likely age class distribution than Case 1, otherwise as described in Table 1, might be as follows:

Case 2 —	age class 14	613.04	
	age class 15	386.96	total 1000 ha
Case 3 —	age classes 1 to 15 each	46.70	
	age classes 16 to 25 each	19.96	
	age classes 31 to 35 each	20.00	total 1000 ha

Scale apart, Case 2 is much like the forests of the central North Island as they were about 1945; Case 3 more as they are today.

The forests in all three cases have the same ENF with an area of 1 000 ha, a rotation of 25.00 years and an annual yield of 19 640 m^3. For every year in which 19 640 m^3 was cut from the Case 2 or 3 forests they would move closer to the regularity present in Case 1.

All three cases have the same ENF and the same normal management. The capital value of the ENF is then also the same. An annual cut of 19 640 m^3, at an ENF rotation price of \$10.39/m^3, produces an annual net income of \$86 933.

MONEY MEASURE OF ABNORMALITY

Under a normal management a net revenue of \$86 933 would arise annually from Case 1 but not from Case 2 or 3. In these an ENF yield would not, at first, be cut at ENF rotation age. The yield per hectare and the price would be different. Although not illustrated, the price could also differ, even if the wood were of ENF rotation age, for it may not have the quality of the standard regeneration. In the shorter term also, areas coming up for regeneration and other activities for initiating normal growth trends will not be normal in Cases 2 and 3. The costs necessary to produce the predicted yields and prices of existing stands may not be the same as for the regeneration standard. These differences have to be taken into account as something qualifying the capital value of the ENF.

The differences, for the first year, would be:

Case 2, year 1:		
cut 19 640 m^3 at age 15, 221 m^3/ha	=	88.869 ha
revenue difference (normal—actual)		*$*
19 640 at 25, \$10.30/m^3 \$204 060		
19 640 at 15, \$ 2.39/m^3 \$ 46 940		157 120
initiation cost difference (actual—normal)		
(88.869 — 40) ha x \$250	=	12 217
(0.00 — 40) ha x \$ 50	=	—2 000
(0.00 — 40) ha x \$100	=	—4 000
		163 337

In Case 3, the oldest trees being older than ENF rotation age, revenues are \$32 667 more, costs \$1 847 less, than normal the net revenue \$34 514 greater. Table 2 sets out 50 years of difference in cash flow under a normal management, between these forests

and their ENF. They are called abnormality cost schedules. They reflect the approach to normality when the forests are cut at the ENF yield. Abnormality costs are negative when cutting is in areas older than ENF rotation age, positive when less. The differences become smaller over time as normality is approached and beyond two cycles they are immaterial.

TABLE 2: ABNORMALITY COST SCHEDULES

Case 2				*Case 3*			
Year	*$*	*Year*	*$*	*Year*	*$*	*Year*	*$*
1	163 337	26	14 387	1	—34 514	26	—5 802
2	133 208	27	12 117	2	—34 836	27	—4 282
3	104 923	28	8 374	3	—33 742	28	—2 688
4	81 646	29	7 794	4	—24 296	29	—832
5	62 310	30	5 180	5	—14 082	30	881
6	63 023	31	2 505	6	—11 889	31	1 470
7	53 934	32	375	7	—7 079	32	1 907
8	39 896	33	—87	8	—1 064	33	2 057
9	27 658	34	—1 765	9	6 834	34	1 837
10	17 441	35	—3 094	10	8 202	35	1 544
11	8 849	36	—4 036	11	7 510	36	1 239
12	1 515	37	—4 628	12	6 938	37	946
13	—5 104	38	—4 859	13	6 954	38	638
14	—10 826	39	—4 848	14	6 348	39	344
15	—15 865	40	—4 554	15	5 504	40	79
16	—20 018	41	—3 998	16	4 563	41	35
17	—23 908	42	—3 197	17	3 578	42	—146
18	—27 354	43	—2 165	18	2 559	43	—322
18	—30 359	44	—141	19	1 468	44	—457
20	—32 921	45	2 457	20	320	45	—547
21	—35 253	46	4 550	21	128	46	—582
22	14 167	47	4 148	22	—834	47	—614
23	24 136	48	3 143	23	—1 997	48	—604
24	22 920	49	2 170	24	—3 217	49	—538
25	15 975	50	1 509	25	—4 494	50	—413

NORMAL EXCHANGE VALUE

The capital value of the ENF is the stream of normal annual net revenues discounted and summed, the same in all three cases at $1 781 605. The abnormality cost schedule represents the stream of annual differences from normal and to put them on the same basis we can discount and sum them. In Case 1 there are no differences. In Case 2 the discounted sum of abnormality costs is $594 158 and in Case 3, —$114 176. As the schedules are made up of prices subject to revenue tax, or costs subject to advanced tax

set off, they must be reduced by 45%; for Case 2, $326 787; Case 3, $—62 797.

The presentation can now be completed:

	Case 1	*Case 2*	*Case 3*
	$	$	$
ENF capital value	1 781 605	1 781 605	1 781 605
Abnomality cost	0	326 787	—62 797
Normal exchange value	1 781 605	1 454 818	1 844 402

The final result is called the normal exchange value of the forest, NEV, being the present net worth of a normal management in terms of units of exchange.

The same results could have been obtained from a single schedule of cash flow under a normal management. But there are advantages in the separation of the ENF and abnormality components. With the ENF the annual yield and maturity and their relationship can be simply represented in the presentation. The abnormality cost schedule summarises variation in shorter term maturities and cash flow which may be of importance. Unlike the ENF component, the abnormality cost is not a permanent element of forest value. If actual management were to approximate the normal, then each year one year of abnormal cost would pass into revenue. After a time, only the ENF value component would remain. This effect may be of importance when explaining a difference in NEV from one year to another or when basing decisions on future forest values.

A common problem with present net worths, particularly when concerned with a span of time as great as that in forestry, is the complexity and subjectivity of content and of assumption entailed. Rarely will these be the same from one period to another nor, if they were fully appreciated which is not often the case, might they be accepted as reasonable by many of those expected to take the calculation into account. The NEV solves this difficulty with a standard set of simple assumptions suited to consistent use. NEVs can then be compared, one point in time to another.

When a choice has to be made between complex alternatives it can be useful to reduce both to single figures. But forestry is rather the management of a process through changing circumstances, with many small decisions to be made sequentially rather than a few large ones all at one time. It is then better to retain the basic structure of elements so as to monitor how they are changing and with what effect on the whole.

VALUATION

A normal management is unlikely and the NEV is not the value of the forest. The NEV is a device for the representation of forest states and the measurement of change. But it does present the factual basis out of which the real value must emerge and the NEV does approach forest value if the forest approaches a sustainable balance with its usage system. Such a balance is generally an assumption or object of management however indirectly approached or however far from achievement. Forest value is more nearly the net present worth of the cash flow expected while a balance is brought about and thereafter maintained.

To retain an objective standard, some rules are needed to distinguish values which exist at a point in time from what is yet to be brought about. Changes for which there is specific evidence of commitment can be assumed but all else is best represented, as in the NEV, on a basis of continuity. When values can be represented in mass terms, detailed planning need not extend beyond the period of reasonable certainty. The NEV is a suitable value with which to close a short-term cash flow, over which the specific changes are introduced.

Forest value then becomes the present net worth of an interim cash flow and closing NEV. Table 3 illustrates this with a short-term cut in the Case 1 forest. Any difference between the present net worth and the initial NEV represents a balance over and above

TABLE 3: CASH FLOW and TERMINAL NEV

Year	*Cut* (m^3)	*Net Cash* ($)	*ENF Rotation* (yr)	*ENF Yield* (m^3)
0			25.00	19 640
1	16 367	69 144	25.31	19 681
2	16 604	71 204	25.61	19 720
3	16 832	73 014	25.89	19 756
4	17 051	74 759	26.15	19 788
5	17 251	76 392	26.39	19 818
Terminal NEV				$$1 889 108
discounted to the present				$1 480 168
Discounted cash flow				$ 322 644
Present net worth				$1 802 811
Initial NEV				7 781 605
Change				$ 21 206

a return at the set rate of discount, in this case owing to the value of increasing maturity.

PRESENTATION

Change Reports

A commonly needed comparison is of the same forest from one time to another. The ENF and NEV are suitable measures of report which can be produced with consistency and without delay on completion of the update of a forest description. The forest in Case 2 is the more interesting example. There being no stands over 15 years of age, it is the least likely to follow a normal management. Changes in dollar values, after tax, over a year might be:

CASE 2 FOREST REPORT 1983-4

Effect	*Equivalent Normal Forest*		*Net Cash*	*Normal Exchange*
	Rotation (yr)	*Yield (m^3)*	*($)*	*($)*
At 31/3/1983	25.00	19 640		1 455 044
To mid-year ($)				+35 938
Ownership			—4 125	—84 539
Natural increase	+2.22	+265	—16 908	+199 028
Usage 2210 m^3	—0.26	—19	+1 568	—11 214
Improvement:				
Yield	+0.02	+3	—550	+774
Prices			—550	+807
To end year ($)				+39 417
At 31/3/1984	26.98	19 887	—20 565	1 635 255

Inflation is assumed at the rate of 5% a year. Its effect is introduced in two half-year steps of 2.47%, at the beginning and end, so that changes in NEV are comparable with the average dollar of the current year.

The most sensitive changes may be shifts in ownership which take place whenever there is a change in tax rates, in any imposed condition of management and on any real change in costs or prices. The effect can be shown clearly. Residual forest values are much exposed to such changes as each crop takes many years to mature. An increase of $7.50/ha in land tax has been used in illustration.

The natural increase is that which would take place if usage were zero; an imaginary step introduced as a basis for isolating the effects of other events. The increase comes from the extra mean

annual increment and higher prices of an ENF rotation of 27.22 years, modified by a change in the abnormality cost.

The comparison of actual usage to ENF yield is an index of uncertainty in the forest value. Actual usage is the objective measure of the capacity of the existing usage system. A cut of 2210 m^3 from 10 ha is shown compared with the normal of 19 640 m^3. The wood cut is only 15 years old. As 15-year-old stands are growing rapidly in volume and price, the net cash gain on cutting them is much less than the loss of potential value on doing so.

There must be some place in a report on changing forest values for any contribution of forest managers. That recent practice will continue is subsumed under the normal forest management, the ENF and NEV are sensitive to any departure from it. Shown are an increase in yield on 10 ha, age 14, adding 5 m^3 to the increment of the next five years at a cost of $100/ha. A second operation, also on 10 ha, age 14, costing $100/ha, improves prices to be expected after age 20 by $0.50/$m^3$.

Reporting Shifts in Value

To show the shifts taking place in forest value to best advantage, the NEV should be presented in standard form to which users can become accustomed. The NEV comes always with the same conventional content, determined on objective standards. The essential structure of interacting interests is retained, not lost in over-

TABLE 4: CASE 2 FOREST — SHIFTS IN VALUE 1983-4

Dollar value at Normal Exchange Value	*31/3/1983*	*31/3/1983*	*31/3/1984*
	31/3/1983	*31/3/1984*	*31/3/1984*
Area (ha)	1 000	1 000	1 000
Equivalent normal forest:			
Rotation (years)	25.00	25.00	26.98
Yield (m^3/yr)	19 640	19 640	19 887
Stumpage ($/$m^3$)	10.39	10.91	11.472
Gross revenue ($)	204 060	214 263	228 131
Tax ($)	—91 827	—96 418	—102 659
Initiation costs ($)	—16 000	—16 800	—15 566
Joint costs ($)	—30 000	—31 500	—39 638
Advanced tax set-off ($)	20 700	21 735	24 638
Net revenue ($)	86 933	91 280	95 360
Capitalisation factor	20.494	20.494	20.494
Capital value ($)	1 781 605	1 870 692	1 954 308
Abnormality cost ($)	326 787	343 127	319 053
NEV ($)	1 454 818	1 527 565	1 635 255

summarisation; users can see what elements need to be changed to bring about some improvement. Its basis is a continuity of present management, any change in NEV depending on a departure from current practice, the most manageable standard. A suitable presentation, supplemented with appropriate notes explaining the reasons for changes, which present readers should have no difficulty in supplying for themselves, would be as in Table 4.

Reports of the kinds illustrated can be produced either in prospect or in retrospect, for however far backward consistent data extends and forever far forward is the planning horizon.

CONCLUSION

The normal exchange value straddles the conventional boundaries of management economics and accountancy for forests, combining some of the standard measurement constructs of each discipline into the one.

The ENF and the NEV summarise the main elements of forest production and value. Some claim can be made for their satisfying desiderata of accounting for stewardship and of presenting information on which policy decisions can be based and controlled: (1) formality, some evidence of authority in presentation and documentation; (2) similitude, a reflection of reality; (3) objectivity, an openness to independent validation; (4) relevance, a bearing on the direction of affairs; (5) consistency, that changes over time may be determined on comparing one report to another; (6) materiality, that all of importance is included, but; (7) parsimony, the exclusion of all that makes no difference to the purpose in hand; (8) timeliness, that reports can be available in time to be useful; (9) uniformity, where reports have to be aggregated or one forest compared with another.

ACKNOWLEDGEMENTS

Acknowledgements are due to N.Z. Forest Products Ltd for permission to publish, and for providing the milieu in which the ideas presented could be developed.

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