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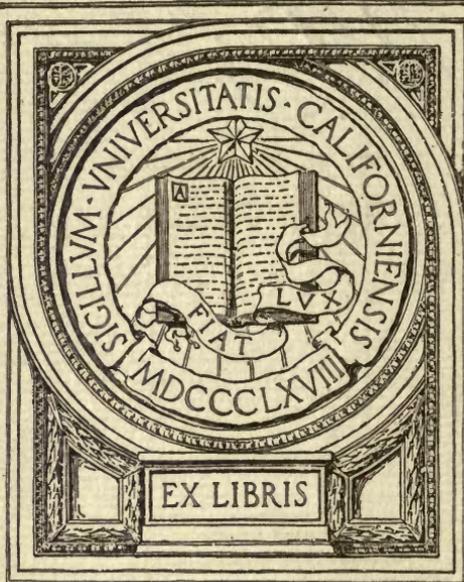
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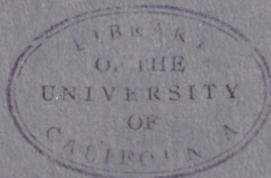
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as Related to the Interest Rates Available
to Various Forest Owners**

BY
BURT P. KIRKLAND

Associate Professor of Forestry
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THE COST OF GROWING TIMBER IN THE PACIFIC NORTH- WEST, AS RELATED TO THE INTEREST RATES AVAILABLE TO VARIOUS FOREST OWNERS

BURT P. KIRKLAND, Associate Professor of Forestry

The cost per acre of growing timber anywhere depends on five main factors, viz. (1) The value of the land, (2) The cost of stocking it with young trees, (3) The administration of the operation and protection of the young timber, (4) The taxes, (5) The rate of interest. The cost per thousand feet depends in addition upon the productivity of the land involved. For the purpose of this discussion, however, the statement may best be put in another way, namely, that the costs per acre are as follows: (1) Interest on the value of the land, (2) The cost of stocking it with young trees, (3) Interest on this amount from time of stocking to maturity, (4) The annual expenses for administration and protection, (5) Interest on each annual expense from time of expenditure to time of maturity of the timber, (6) The annual taxes, (7) Interest on each annual tax from time of payment to maturity of the timber. The total of these costs per acre, divided by the average product per acre gives the cost of producing 1,000 board feet of timber.

The amounts for some of these items vary with natural conditions, and of others, with the ownership of the land. Thus state or federal ownership modifies the element of taxes and changes the rate of interest. Private ownership might facilitate administration in some ways, though it can hardly be expected to reduce the cost, owing to the smaller areas administered. The amounts of the various items under various conditions and forms of ownership are discussed below.

Interest on the Land Value

The cost of cutover lands of supposed agricultural value, or of a nature such that the seller can convince the inexperienced buyer that they have agricultural value would probably run from \$10.00 to \$50.00 per acre in Washington, where the values are not influenced by proximity to centers of population or other advantages of a similar nature. Hillsides, appearing even to the unpracticed eye too steep for agriculture, may be purchased for \$3.00 to \$5.00 per acre. The higher values first mentioned are undoubtedly beyond any present use value of the land for agriculture, but the optimism of the West can be depended upon to maintain them, because the buyer of land has sanguine ideas as to the income to be derived. If the land is to be used for forestry we must concede that current values must be met. Land which is held at over \$10.00 per acre should have agricultural value, and for the present at least, should be considered in that class and no attempt made to use it for forestry. The writer, therefore, believes that in Washington fair values for forest soil would be \$10.00 per acre for Quality I, \$5.00 for Quality II, and \$2.00 for Quality III, referring to three quality yield tables for Douglas fir prepared by the U. S. Forest Service.* These tables classify quality of soil for forest purposes according to its actual productivity. In growing timber it must be remembered that the soil is not used up by the growth of the timber. The

*These yield tables, prepared by E. J. Hanzlik of the U. S. Forest Service are as yet only in manuscript form. (See page 5.)

charge against the growing timber for one rotation, or single crop, is therefore not the soil value, but only the interest on that value for the term of years it takes the timber to grow. Since the timber is not an annual product, the interest cannot be secured annually, but must accumulate until the timber is cut. Hence compound interest is used. What this will amount to at rates applicable to forestry will be discussed later, and shown specifically in the tables forming part of this discussion.

Cost of Stocking Land With Trees

While space is not here available to take up in detail the cost of stocking the land, there is good evidence that \$5.00 per acre is a fair average figure. Although planting on a bare area will cost nearer \$10.00, few areas need be chosen which do not bear some young growth or contain some seed trees which will assist artificial regeneration. Areas that have not been cut over can seldom be stocked any cheaper by natural regeneration than by planting, since the value of the seed trees that must be left will usually bring the cost up to the average figure mentioned above unless there are an unusually large number of worthless trees of the desired species which may be used as seed trees. A skillful combination of planting with natural regeneration from stands not yet cut, and artificial regeneration by planting or seeding should bring the operation within this cost.

Unlike the land cost, the expense of stocking the land with trees has to be repeated every time the timber is cut. This amount must, therefore, be charged against the product of each planting.

Interest on Cost of Stocking Land

The interest on the cost of stocking the land might have been included with the foregoing item, but it is here treated separately in order that all interest charges under various kinds of ownership may be segregated. As in the case of interest on the land value, compound interest must be used. The amount of this item at various rates will be shown specifically in tables forming part of this discussion.

The Annual Cost of Administration and Protection

Kellogg and Ziegler maintain that the annual cost of administration and protection can be handled for five cents per acre.* An analysis of the actual conditions will show that five cents is not sufficient for safety. It must be remembered that this includes office expense, supervision, fire patrol, patrol against trespass, and all other overhead expenses. Although forest fire insurance is not at present one of the expense charges included in this item, the practicability of insuring forests by an enlargement of the scope of the forest fire protective organizations is such that it is bound to come in the near future. Hence this figure should also be high enough to include forest fire insurance. In the case of the state or the federal government, the losses from fire must be charged to this item. Whatever amount accumulates between planting and cutting a single crop must be charged to that crop. The writer does not therefore, believe that the low figure generally assigned to the annual cost of administration and protection is sufficient, but will assign 20 cents per acre per annum as a reasonable, though entirely sufficient amount. The total first cost, or principal sum of this item per acre charged to a single crop of trees

*"Cost of Growing Timber," by R. S. Kellogg and E. A. Ziegler.

will be the annual charge (20c) multiplied by the number of years the crop takes to grow.

Interest on Administration Costs

Compound interest at the chosen rate on each annual amount from the time it is expended until the timber is cut must be calculated. This may be done by compound interest formulae, or taken from such tables as those in Schenk's "Forest Finance."* The specific amounts under certain conditions will be considered later.

Annual Taxes

The annual taxes is a difficult item to foresee. At present taxes in Washington are all considered under the general property tax (a most unscientific system) averaging perhaps 1 per cent to 2 per cent on the actual value of the property. Since, owing to the urgent need of schools, roads, etc., in a pioneer community, and the absence of improved property, taxes may now be thought to be high. A rate of 1 per cent on the actual value of the property may perhaps be considered a fair figure when the future is to be taken into consideration.

Even if this figure is conceded fair, our difficulties have really just begun because of the changes in value that will take place with time, due to the growth of the stand and to changing land values and stumpage prices, to say nothing of continual changes in assessment methods. The following figures are, however, intended to represent a fair approximation of the values to be expected on Quality I Forest Soil, which, as already stated, is considered to be worth \$10.00 per acre.

(1) Up to the 20th year of the stand only the soil value of \$10.00 per acre would generally be considered by assessors. During this period the taxes at 1 per cent would be 10 cents per acre.

(2) From the 21st to the 30th years of the stand perhaps \$10.00 per acre might be added to the valuation because of the young stand, making taxes 20 cents per acre per annum.

(3) From the 31st to the 40th years of the stand, since it is not yet in the saw timber class, it can best be estimated in cubic feet. It will now contain (on Quality I Soil) 4,000 cubic feet per acre, or about 40 cords, which as pulpwood would be worth, say 50 cents per cord, bringing the total value of land and timber up to \$30.00 per acre and the tax to 30 cents per acre per annum during this period.

(4) From the 41st to the 50th years the volume will be about 20,000 ft. B. M. per acre, worth on the average (considering increased stumpage prices in the future) at least \$3.00 per M., or \$60.00 for the whole stand. Hence soil and timber would be worth \$70.00 per acre and the annual tax 70 cents.

(5) From the 51st to the 60th years the stand would contain an average of about 35,000 ft. B. M., with a stumpage value of say \$8.00 per M., hence the total value of stand and soil, \$290.00, and the annual tax \$2.90 per acre.

To recapitulate, the taxes on Quality I Forest Soil by the general property tax are estimated somewhat as follows:

1st to 20th years,	10 cents per acre per annum.
21st to 30th years,	20 cents per acre per annum.
31st to 40th years,	30 cents per acre per annum.
41st to 50th years,	70 cents per acre per annum.
51st to 60th years,	2.90 cents per acre per annum.

*"Forest Finance," by C. A. Schenk.

Considering the smaller volumes and poorer qualities with the Quality II soil the taxable values would be worth only about two-thirds as much, and with Quality III soil one-third as much; hence taxes may be assumed to be only two-thirds and one-third as much respectively, both as to first cost and interest accumulated. Taxation will be further discussed on the basis of the cost tables forming part of this discussion, after those tables are presented.

Interest on Taxes Under General Property Tax

Compound interest must be computed on the amounts paid in taxes from the time paid until the timber is mature. The specific amounts depend on the interest rates and the age to which timber is held, and will be considered hereafter.

Matters Which Influence the Above Elements of Cost

(a) *Ownership.* The chief classes of forest owners as affecting these elements are the federal government, the state, municipalities, large corporations, small corporations, and individuals. The chief items affected by ownership are:

(b) *Taxes.* The federal government pays 25 per cent of the gross yield directly to the states and expends another 10 per cent on roads, but as the roads are of equal value to the forests only the 25 per cent paid to the states will be considered as a gross yield tax. Lands owned by states and municipalities are also in a sense not subject to tax, but in another sense if we assume that the land would be worked under forest management either publicly or by private owners we may conclude that the state and municipality will lose tax revenue by reason of their land ownership, because of withdrawing lands from taxation, and must therefore make up from their forest revenue the deficit in their general fund as discussed hereafter.

If the federal government and the private owner pay 25 per cent of the gross yield of the forest for taxes, the state and municipality should set aside 25 per cent of the gross forest revenue from stumpage for their general fund. If the municipality is the owner it might be required to pay the state such a part of the 25 per cent set aside as the state's share of the taxes amounts to, and which will otherwise be lost by holding the land in public ownership. If the state were the owner it should pay the municipality, or local taxing body its proper share of the 25 per cent. Of course in practice this system of book-keeping might not be carried out in detail, but in effect it would be, if the practice of forestry proceeded profitably.

(c) *Interest.* This varies more widely with ownership than taxes. The fact that individuals, states, and the nation have to pay different rates is so well known as to need little comment except to name an average rate for each. The writer considers the following a fair average rate for each class of owner:

Federal Government	3	per cent.
State (Washington)	4	per cent.
Municipality	4½	per cent.
Large Corporation	4½ to 5	per cent.
Moderate Sized Corporation	6	per cent.
Small Corporation and Individual	7	per cent.

Naturally no owner will, from the standpoint of financial investment, care to engage in forestry unless he can make as high a per cent on his capital as he will have to pay for borrowed capital, or at which

he can lend his money. Hence the above rates will be used in calculations.

(d) *Length of Time Between Planting and Harvest.* This influences the amount to which the interest charges on the various items will accumulate. In previous calculations the writer has found the best available evidence seems to indicate about 60 years as giving the highest profits from the use of the soil for private forestry, while 80 to 100 years is more profitable for government forestry. In order to make a comparison as favorable as possible to private forestry, 60 years is chosen for the length of rotation. Specific costs are figured on this basis using the various interest rates already named.

Influence of Yield Per Acre on Costs Per Thousand Board Feet. Except for the interest on the soil value and the taxes with interest thereon, the foregoing elements of cost per acre will not vary widely on different qualities of soil. It is, of course, common knowledge that the yield on different soil qualities will vary greatly. This variation is even greater than generally supposed. The United States Forest Service has made a careful study of this subject in Western Washington and Oregon, the results of which have unfortunately only in part been published. In this study measurements were taken of stands on a wide variety of soils which were classified into three qualities on the basis of the yields found. Quality I or first quality 44 M. per acre, Quality II or medium quality 32 M. feet per acre and Quality III or poorest quality 16½ M. feet per acre for the same period. Obviously, then, if the cost per acre of growing the timber remains little changed for the different qualities the cost per 1,000 feet B. M. will be much less in the case of large yields, just as would be the case in an agricultural crop. These results are brought out in tables about to follow, in which the yields shown by the U. S. Forest Service study are used as authoritative.

Results of Foregoing Elements Presented in Tabular Form. The definite results of the foregoing elements have been worked out mathematically for each item and are presented in the following tables in order to show their relationships, and make comparisons of different interest rates and tax systems as simple as possible. The itemized and total costs to owners working under different interest rates are presented in a single table for each of the soil qualities already mentioned. Costs on Quality I soil are presented in Table I, on Quality II soil in Table III, and on Quality III soil in Table V. The intervening tables present summaries of those mentioned in which the first costs, the interest charges and the tax costs are segregated and their percentage relations to each other computed.

On Quality II forest soil the costs per acre are reduced slightly owing to lesser soil value, and hence to less taxes due to the lower soil value and the smaller volume of stand of timber. The land is considered worth \$5.00 and the taxes to be two-thirds of what they were on Quality I. The yield according to yield tables prepared by the U. S. Forest Service will be 32,000 ft. B. M. per acre at 60 years. The costs will be as shown for different owners in Table I.

Comparing Table III with Table I, it is seen that where interest rates are low, costs per acre are not reduced much below Quality I, but as yield is less the cost per M. is raised, except in the case of 6 per cent and 7 per cent interest rates. Where interest is high, reduction in land

TABLE I.

Estimated average costs per acre and per M. feet B. M. of growing Douglas fir on Quality I, or best quality forest soil, under a 60 year rotation, computed for interest rates securable by various classes of owners.

ITEMS—	Federal Govt.	State	Municipality	Large corporation	Medium sized corporation	Small corporation and individual
Estimated interest rate for various classes of owners	3%	4%	4½%	5%	6%	7%
*Compound interest on \$10.00 soil value, 60 years	\$ 48.91	\$ 95.19	\$130.27	\$176.79	\$319.88	\$ 569.48
Cost of stocking land with young trees	5.00	5.00	5.00	5.00	5.00	5.00
Compound interest on cost of stocking	24.46	47.59	65.14	88.40	159.94	284.74
Sum of annual charges for administration and protection (20c per year for 60 years)	12.00	12.00	12.00	12.00	12.00	12.00
**Interest on all amounts spent on administration and protection from time incurred to time of cutting	20.61	35.60	45.90	58.71	94.62	150.71
Taxes under general property tax when owner subject to them				43.00	43.00	43.00
Interest on taxes from time planted to time of cutting timber				***52.04	77.40	114.42
Yield tax of 25% on final product	†36.99	†65.13	†86.10			
Total per acre	\$147.97	\$260.51	\$344.41	\$435.94	\$711.84	\$1,179.35
Cost per M. when product is 44 M. per acre. The probable yield as shown by U. S. F. S. yield tables	\$ 3.37	\$ 5.92	\$ 7.83	\$ 9.91	\$ 16.17	\$ 26.80

*See interest table in Schenck's Forest Finance, Column IV.

**See interest table in Schenck's Forest Finance, Column V.

***There are at least two methods of computing compound interest on the taxes. The simplest method for purposes of this discussion is to analyze as follows, using the 5 per cent column in Table I. Consider that from the 1st to the 60th year, 10c per annum is paid for taxes. Referring to an interest table, we find that compounded for 60 years this accumulates to \$35.36, including principal and interest. Beginning with the 20th year, an additional 10c per acre is paid for the remainder of the rotation, or 40 years. This amounts to \$12.08 during the 40 years. Beginning with the 30th year, another 10c is added to taxes for the remainder of the rotation. This accumulates to \$6.64 in the remaining 30 years. Beginning with the 40th year, 40c is added to taxes for the remainder of the rotation. This accumulates to \$13.24 in the 20 years. Finally in the 50th year \$2.20 more is added to the taxes, which in the 10 years remaining accumulates to \$27.72. The total taxes and interest thereon for the rotation amount to \$35.36 plus \$12.08 plus \$6.64 plus \$13.24 plus \$27.72 equals \$95.04, the total accumulated taxes, both principal and interest. Take therefrom \$43.00, the principal sums paid, and there remains \$52.04, the accumulated interest on the taxes.

†This figure represents the cost to the owner of a 25% yield tax when the various items of cost of production are as shown in the same columns. Since a 25 per cent yield tax takes 25 per cent of the product, it is evident that the cost of the tax to the owner would be one-fourth of the total cost of production, including taxes. All the costs aside from the yield tax would then amount to three-fourths of the total cost and the yield tax would be one-third of the other costs. It is thus that the cost of the yield tax is computed in these tables, that is to say, one-third of the costs aside from taxes is the cost of the 25 per cent yield tax in each case. In case stumpage sells at more than the cost of production all the profits on 25 per cent of the yield go to the state

TABLE II.

Summary of Table I.

Showing segregation of all first costs and all interest charges and per cents of total costs due each segregation.

ITEMS—	Federal Govt.		State		Municipality		Large corporation		Medium sized corporation		Small corporation and individual	
	% of total due to each item	3%	% of total due to each item	4%	% of total due to each item	4½%	% of total due to each item	5%	% of total due to each item	6%	% of total due to each item	7%
Estimated interest rates for different owners		3%		4%		4½%		5%		6%		7%
Total first cost per acre of planting and annual charges, except taxes, for 60 years	12	\$ 17.00	6.5	\$ 17.00	4.9	\$ 17.00	3.9	\$ 17.00	2.4	\$ 17.00	2.4	\$ 17.00
Accumulated compound interest on land value. Cost of planting and annual administrative charges per acre for 60 years	63	178.38	68.5	241.73	70.1	323.90	74.3	574.44	80.7	1,004.93	85.2	
First cost of taxes under certain property tax for certain owners							43.00	10	43.00	6	43.00	3.6
Accumulated compound interest on tax cost. General property tax							52.04	11.8	77.40	10.9	114.42	9.7
Yield tax of 25% for public ownership	25	36.99	25	65.13	25	86.10	25					
Total cost per acre	100	\$260.51	100	\$344.41	100	\$435.94	100	\$711.84	100	\$1,179.35	100	

Cost per M. when product is 44 M. ft. B. M. per acre....\$ 3.37

\$ 5.92

\$ 7.85

\$ 9.91

\$ 16.17

\$ 26.80

and profits will be made by the owner only on the 75 per cent remaining to him. That is, the figures shown in these tables represent the cost of the tax, but its actual amount will depend on the stumpage values at the time of cutting.

value brings about a much lessened interest charge so that costs are reduced more than yield. This results in a slightly smaller cost per M. on this Quality of soil.

On Quality III forest soil the costs per acre are again reduced slightly, owing to reductions in soil value and in taxes due to a lower soil value and a smaller stand of timber. The land is considered worth \$2.00 and the taxes to be one-third of what they were on Quality I. The yield will be only 16,500 feet per acre at 60 years, according to Douglas fir yield tables by E. J. Hanzlik, of the United States Forest Service. The costs of artificial planting would be increased on Quality III because of the unfavorable soil conditions and also because trees should really be planted thicker. On account of the low yield per acre natural regeneration might be the most profitable.

The costs for different owners are shown in Table V.

TABLE III.

Estimated average costs per acre and per M. ft. B. M. of growing Douglas fir on Quality II or medium quality forest soil under a 60 year rotation, computed for interest rates securable by various classes of owners.

ITEMS—	Federal Govt.	State	Municipality	Large corporation	Medium sized corporation	Small corporation and individual
	3%	4%	4½%	5%	6%	7%
Estimated interest rate paid by owner.....	3%	4%	4½%	5%	6%	7%
Compound interest on estimated soil value (\$5.00), 60 years.....	\$ 24.46	\$ 47.60	\$ 65.14	\$ 88.40	\$159.94	\$284.74
Cost of stocking land with young trees.....	5.00	5.00	5.00	5.00	5.00	5.00
Compound interest for 60 years on cost of stocking land.....	24.46	47.60	65.14	88.40	159.94	284.74
Sum of annual charges for administration and protection for 60 years (20c per acre per annum).....	12.00	12.00	12.00	12.00	12.00	12.00
Compound interest on all amounts, spent on administration and protection from the time incurred to time of cutting.....	20.61	35.60	45.90	58.71	94.62	150.71
Taxes under general property tax.....	.....	.....	.....	**28.66	**28.66	**28.66
Interest on Taxes.....	.....	.....	.....	**34.70	**51.60	**76.28
Yield tax 25% on final product.....	*28.84	*49.27	*64.39	.....	.....	.....
Total per acre.....	\$115.37	\$197.07	\$257.57	\$315.87	\$511.76	\$842.13
Total cost per M. on basis of 32 M. per acre yield in 60 years.....	\$ 3.61	\$ 6.16	\$ 8.05	\$ 9.87	\$ 16.00	\$ 26.31

*See foot-note under Table I.

**Since, as stated on page 5, the value of the yield on Quality II soil, though three-fourths as much in quantity, will on account of the smaller sized timber not be more than two-thirds as much in value as the yield on Quality I, the taxes have been assumed to be only two-thirds as great. These figures for both the taxes and the interest thereon have therefore been derived directly from corresponding values in Table I by computing two-thirds of each value there as the correct figure for this table.

TABLE IV.

Summary of Table III.

Showing segregation of all first costs and all interest charges and per cents of total costs due each segregation.

ITEMS—	Federal Govt.		State		Municipality		Large corporation		Medium sized corporation		Small corporation and individual	
	% of total due to each item	3%	% of total due to each item	4%	% of total due to each item	4½%	% of total due to each item	5%	% of total due to each item	6%	% of total due to each item	7%
Interest rate												
Total first cost of stocking and annual costs except taxes ..	15	\$ 17.00	8.6	\$ 17.00	6.4	\$ 17.00	5.4	\$ 17.00	3.3	\$ 17.00	3.3	\$ 17.00
Accumulated compound interest on all amounts invested except taxes	60	130.80	66.4	176.18	68.6	235.51	74.6	414.51	81	720.19	85.6	720.19
First cost taxes under general property tax												
Accumulated compound interest on taxes. General property tax	25	48.27	25	64.89	25	34.70	11	51.60	10.1	76.28	9	76.28
Taxes under 25% yield tax	100	\$197.07	100	\$257.57	100	\$315.87	100	\$511.77	100	\$842.13	100	\$842.13
Total cost per acre		\$ 3.61		\$ 8.05		\$ 9.87		\$ 16.00		\$ 26.31		\$ 26.31

INFLUENCE OF THINNINGS

On Quality I Soil. Where thinnings are possible the costs may be reduced by utilizing thinnings about the 30th, 40th, and 50th years. Other studies by the writer, based on number, volume, size, etc., of trees per acre shown by Forest Service yield tables, would seem to indicate pretty clearly that on Quality I soil, timber of at least the values indicated in Table VII, may be removed in thinnings where they are utilizable. There is furthermore very little doubt that all thinnings from young stands originated now or hereafter may be utilized because even now demands for pulpwood, ties, and mine timbers are capable of using all of this type of timber within easy reach of transportation.

Tables VII, VIII, and IX show possible deductions from cost due to this source of income, but the data along this line are not as reliable as other cost data because of uncertainty as to the future price of wood.

TABLE V.

Estimated average costs per acre and per M. ft. B. M. of growing Douglas fir on Quality III, or poorest quality, forest soil under a 60 year rotation, computed for interest rates securable by various classes of owners.

ITEMS—	Federal Govt.	State	Municipality	Large corporation	Medium sized corporation	Small corporation and individual
Interest rate	3%	4%	4½%	5%	6%	7%
Compound interest on soil value (\$2.00) for 60 years	\$ 9.78	\$ 19.03	\$ 26.05	\$ 35.36	\$ 63.96	\$113.90
Cost of stocking with young trees	5.00	5.00	5.00	5.00	5.00	5.00
Compound interest on cost of stocking	24.46	47.60	65.14	88.40	159.94	284.74
Sum of annual charges for administration	12.00	12.00	12.00	12.00	12.00	12.00
Compound interest on all amounts spent for administration and protection from time incurred to time of cutting	20.61	35.60	45.90	58.71	94.62	150.71
Taxes under general property tax—when owner is subject to them .....	.....	.....	.....	**14.33	**14.33	**14.33
Compound interest on taxes .....	.....	.....	.....	**17.35	**25.80	**38.14
Taxes under 25% yield tax. Final product	*23.95	*39.74	*51.36	.....	.....	.....
Total cost per acre ..	\$ 95.80	\$158.97	\$205.45	\$231.15	\$375.65	\$618.82
Total cost per M. on basis of yield, per acre, in 60 years, 16,500 ft. B. M.\$	5.80	\$ 9.64	\$ 12.45	\$ 14.01	\$ 22.77	\$ 37.50

*See footnote (**), Table I.

**As stated on page 8 the value of the yield on Quality III, or poorest quality forest soil, will not be more than one-third that on Quality I soil, hence the taxes under general property tax may be assumed to be only one-third as great. These figures for both taxes and interest thereon have, therefore, been derived directly from corresponding values in Table I by computing one-third of each value there given as the correct figure for this table.

TABLE VI.

Summary of Table V.

Showing segregations of all first costs and all interest charges and per cents of total costs due to each segregation, on Quality III. Forest Soil.

ITEMS—	Federal Govt.		State		Municipality		Large corporation		Medium sized corporation		Small corporation and individual	
	% of total due to each item	3%	% of total due to each item	4%	% of total due to each item	4½%	% of total due to each item	5%	% of total due to each item	6%	% of total due to each item	7%
Interest rate												
Total first cost of stocking, and annual charges except taxes, per acre	17.7	\$ 17.00	10.7	\$ 17.00	8.3	\$ 17.00	7.3	\$ 17.00	4.5	\$ 17.00	4.5	\$ 17.00
Accumulated compound interest on all amounts invested except taxes	54.85	102.23	64.3	137.09	66.7	182.47	79.0	318.52	84.5	549.35	88.9	549.35
First cost of taxes under general property tax for certain owners						14.33	6.2	14.33	3.1	14.33	2.3	14.33
Accumulated compound interest on tax cost; general property tax	23.95	39.74	25	51.36	25	17.35	7.5	25.80	7.9	38.14	6.1	38.14
Taxes under 25% yield tax	23.95	39.74	25	51.36	25	17.35	7.5	25.80	7.9	38.14	6.1	38.14
Total cost per acre	\$ 95.80	\$ 158.97	100	\$ 205.45	100	\$ 231.15	100	\$ 375.65	100	\$ 618.82	100	\$ 618.82
Cost per M.	\$ 5.80	\$ 9.64		\$ 12.45		\$ 14.01		\$ 22.77		\$ 37.50		\$ 37.50

On Quality II Soil. The volume of the thinnings to be obtained on Quality II soils may be expected to bear the same proportionate relation to the volume of thinnings on Quality I as their respective total stands, i. e., as 32,000 is to 44,000, or 8 to 11. The thinnings on Quality II soil, however, will be of smaller sizes, hence less valuable. It seems safe therefore, to assume that the total value will not be more than one-half as great. Hence these thinnings will be expected to make only one-half as much from the total costs as on Quality I soil.

The amount to be deducted from the total costs per acre on Quality II soils because of the thinnings may then be determined directly by taking half the values deduced for thinnings and interest on Quality I soils as shown in Table VII. Table VIII shows these amounts per acre and the resulting amounts per M. ft. B. M.

On Quality III Soil. The volume of the thinnings to be expected from the Quality III soils may be determined by proportion just as they were for the Quality II soils. In this case it would be as 16½ is to 44. As a matter of fact, however, the small sizes grown on Quality III soil would greatly lessen the value of the yield from thinnings so that it may be doubted whether this would exceed one-third of the value of Quality I. Assuming it has one-third the value of the Quality I thinnings, the values of thinnings per acre with interest thereon for Quality III may be taken directly as one-third of the corresponding values in Table VII.

TABLE VII.

Possible Deductions From Costs Due to Thinnings—Douglas Fir—Quality I Soil

ITEMS—	Federal Govt.		Municipality	Large corporation	Medium sized corporation	Small corporation and individual
	State					
Interest rate	3%	4%	4½%	5%	6%	7%
Value of 30th year, thinning—4 cords pulpwood at 50 cents per cord	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00	\$ 2.00
Accumulated interest on this value, 30th year to 60th year	2.84	4.48	5.48	6.64	9.48	13.22
40th year thinning—5 cords pulpwood worth \$1 per cord stumpage	5.00	5.00	5.00	5.00	5.00	5.00
Accumulated interest for 20 years	4.05	5.95	7.05	8.25	11.03	14.35
50th year thinning—10 cords pulpwood worth \$1.00 per cord	10.00	10.00	10.00	10.00	10.00	10.00
Accumulated interest for 10 years	3.40	4.80	5.53	6.29	7.90	9.67
Total amount saved per acre when thinnings are utilized	\$ 27.29	\$ 32.23	\$ 35.06	\$ 38.18	\$ 45.41	\$ 54.24
Amount saved per M. ft. B. M. when final yield is 44 M. per acre .....	.62	.75	.79	.87	1.03	1.23

TABLE VIII.

Possible Savings in Cost Due to Thinnings on Quality II Soil

ITEMS—	Federal Govt.	State	Municipality	Large corporation	Medium sized corporation	Small corporation and individual
Interest rate	3%	4%	4½%	5%	6%	7%
Total amount saved per acre when thinnings are utilized	\$ 13.64	\$ 16.11	\$ 17.53	\$ 19.09	\$ 22.70	\$ 27.12
Amount saved per M. ft. B. M. when final yield is 32 M. per acre .....	.42	.50	.55	.59	.71	.85

TABLE IX.

Possible Savings on Cost Due to Thinnings on Quality III Forest Soil

ITEMS—	Federal Govt.	State	Municipality	Large corporation	Medium sized corporation	Small corporation and individual
Interest rate	3%	4%	4½%	5%	6%	7%
Total amount saved per acre when thinnings are utilized	\$ 9.09	\$ 10.74	\$ 11.68	\$ 12.73	\$ 15.14	\$ 18.08
Amount saved per M. ft. B. M. when final yield is 16½ M. per acre.....	.55	.65	.70	.77	.91	1.09

Certain Modifications of Costs

In General: It is believed that the costs given in the preceding tables represent as fair averages of the cost of growing timber by means of good forestry practice as can be given for the conditions on the west side of the Cascades in the Pacific Northwest. It is, however, obvious that average figures, no matter how correct, cannot be applied directly to all individual cases. In so far as the first costs in a specific case are known to be susceptible of modification, the final costs may be enormously modified. For example, it is entirely probable that much land which is already stocked with young growth could at the present time be bought at the rates specified in the tables, thus saving the cost of stocking entirely and perhaps several years' interest on other costs. This would greatly increase the possibilities of profit on the area in question, because in forestry every dollar saved at the beginning of the rotation may mean from \$5.00 to \$50.00 at the end, according to the interest rate. Likewise land already stocked with timber might be bought below the price specified, in which case, still more could be saved.

Certain owners might save all or portions of other costs, or find them properly chargeable to other lines of business which they conduct. Thus a coal mining company might find it necessary to hold a large area of coal lands, the surface of which is unsuited to agriculture, or other use except forestry. In this case it would be fair to charge all the land value to the coal, thus removing the heavy interest cost on land value from the forestry costs. On Quality I soil this would remove a charge of \$4.02 per M. from the cost of producing timber if the company worked with 5 per cent money. This would enable a company of this sort to produce timber as cheaply as the state.

In municipal forestry, a city finding it necessary to own land for watershed protection might practice forestry without charging interest on land value to it, and might also charge a large part of the actual administration cost to the water department because sanitary patrol is necessary anyway. This would reduce the cost of raising timber to a city below the average cost shown by the federal government, and make the industry one of great direct financial benefit.

When it is remembered that the logging and manufacture of this timber means that upwards of \$8.00 is paid out in wages for every thousand feet of timber manufactured, and that the city consumer may as a result of the local timber supply get the manufactured product cheaper, where the city already owns its watershed, no other argument for city forestry is necessary. To put the case in another way, it may be stated that since the average acre of forest soil will in this region produce about 500 feet of timber per annum, any city which practices forestry will for the average acre thus kept in forest produce raw material which will some time insure the payment of \$4.00 or more in wages for each year the land is kept producing forests. One hundred and fifty acres kept in forest will support at least the equivalent of one laborer and his family permanently, besides paying a handsome profit to the city. Municipal forests of this type are common in Europe, where profits as high as \$12.00 per acre per annum are now made. Of course, no such profit is possible at present in this country, but America is already well on the road to this condition.

Large Corporations

The large corporation can practice forestry because of its low interest rate and the economies in administration and protection due to the ownership of large areas. Where it has holdings in several localities its fire losses will not exceed the average losses of the community, so it will be cheaper for it to carry its own insurance than to pay premiums to a forest fire insurance company, even when the time comes that forest fire insurance is available. Even a heavy fire loss would not cause a correspondingly heavy immediate expenditure, as when a mill is destroyed, but would be made up gradually in growing a new crop. In spite of these facts the large corporation is not yet convinced that forest production would be profitable for it, although a study of the question gives convincing indications that it would be so, especially in the case of corporations which desired to make their life, and hence their investments, perpetual. However, the present political efforts looking toward the destruction of all large business enterprises may result in disintegrating these corporations so that their efficiency and command of capital will be so decreased as to

put them out of the class which might practice forestry successfully. Until these political questions are settled, therefore, it would probably be unwise for the large corporation to engage in an enterprise involving a continuous policy for so long a time as is required in forest production.

Railroad corporations not being so subject to this destructive action by government, because the problem of handling these natural monopolies is largely settled, do not labor under this latter disadvantage, though possessed of the other advantages of large corporations. They have also at least three additional advantages which would make it profitable to engage in forest production on lands already owned. The first is that they are large consumers, and the cheapest possible supply of timber is of enormous importance to their construction and maintenance departments. The second follows from this that since they are large consumers practically all selling costs would be saved to their forestry departments. The third reason lies in the fact that the railroad depends on adjacent territory for tonnage. Land adapted only to forestry will yield little tonnage any other way, but as already stated in the case of the municipality, in this region such land will under forest management yield at least 500 feet B. M. per annum on the average. This, then, means to the railroad that every acre kept under management will some time yield 500 feet of lumber, or from 1,500 to 2,000 lbs. of freight for each year that the forest crop is maintained. If this lumber should be shipped to the middle west it means a gross revenue to the railroad of perhaps \$5.00 or more per acre per annum, for transportation only.

The Small Owner—The writer believes that the forester can seldom advise the small owner, either corporate or individual, to practice forestry except in the case of the farm woodlot owner. The farmer consumes most of the product of his own forest, thus saving all selling costs, middleman's profits, and transportation to a distance. What he does not consume goes to his neighbor. To this strong economic position as to markets may be added several other advantages. Protection and administration costs nearly disappear because the farm woodlot is generally in sight of the residence and fields, and is surrounded by clearings, hence patrol is unnecessary and fires seldom will occur. Because of the small cutting areas necessary in the farm woodlot, reproduction will in nearly every case come naturally, without extra expense, providing grazing is properly restricted. Finally, though the farmer pays high interest rates when he borrows, he works principally on his own capital, on which he makes a very low rate as a rule. Hence in most cases his forest investment really comes in the low interest rate class.

These advantages place him in the best position of any private owner and the large product of farm woodlots in this country as compared with the National Forests indicate that their economic position is much stronger than the latter. Cuttings can be carried on annually in the farm woodlot in most cases, thus resulting in an annual income from it, and also in the most complete utilization, because windfalls and trees otherwise damaged can be utilized before they decay. Some of these advantages will not be realizable until the pioneer stage is passed, but this will undoubtedly pass with great rapidity in this state because of the many natural advantages it possesses for the settler.

In spite of the great possibilities of the farm woodlot, full produc-

tion is not likely to be realized unless some technical advice is available. Practically all governments have found it expedient to furnish this at government expense. This is now being done in the Eastern United States, and should be strongly recommended here. It may seem premature to take up such work at the present stage of farm development in Washington, but as a matter of fact, large farm areas are bound to suffer in the not distant future for want of timber because its obvious abundance led to the cutting of every tree for lumber. The down timber will disappear within a short time and leave no timber available on many farms, or at a convenient distance from them. Moreover, a farm woodlot may usually be established in a recently logged off area at no expense, while later, when all young growth has been destroyed, planting would be necessary.

It is, of course, obvious that if any owner can make forestry pay one per cent or more over the rate at which he can borrow money, he can on his own capital make two per cent or more above the interest rate at which he can borrow. For example, if a corporation can make capital invested in forestry yield six per cent and can borrow at five per cent, it can carry on an operation by borrowing 50 per cent of the capital required at five per cent and carrying the other 50 per cent by funds received originally from sale of stock. Since all the capital yields 6 per cent, while only 5 per cent interest is paid on half of it, the other half will receive 7 per cent. If it borrows two-thirds of its capital at 5 per cent, the remaining one-third receives 8 per cent dividends. In the same way if a state can make capital it uses in this way yield 6 per cent, though borrowed on 4 per cent bonds, the portion of its capital coming from its general fund would yield 10 per cent, i. e., 6 per cent earned by the general fund proposition itself, and 2 per cent additional from each of the thirds coming from bonds. By using its general credit the state could borrow all the funds on 4 per cent bonds and make 2 per cent on all capital borrowed without advancing a cent from its general fund. Or it may prefer to let its citizens have the wood products at cost and neither make nor lose money.

*Taxes as an Element in Cost of Producing Timber**

It should be noted first of all that taxes do not, as sometimes stated, make up the chief cost of the production of timber. They are in fact

*Many foresters in computing cost of growing timber, have treated taxes under the general property tax as an average sum paid annually throughout the life of a single crop. This introduces gross inaccuracy into the calculation of the interest charge on the taxes, making the taxes and interest thereon appear to be far greater than is the case in practice. This may account for the widespread idea that taxes are the chief cost in growing timber. A specific example as to what the effect of this method would be in the present computation is as follows:

The total first cost of taxation on Quality I soil in 60 years, as shown in Table I, on the basis of the tax estimates on page 6, is \$43.00. By the method of averaging the general property tax over the entire time of growing a crop this would amount to an average of 72 cents per acre per annum. Referring to interest tables we find that with 6 per cent interest \$1.00 paid annually and placed at interest for 60 years amounts to \$533.14 by the end of the period. Seventy-two cents paid annually would, therefore, amount to $.72 \times \$533.14$ equals \$383.86, total accumulated sum, both principal and interest. Deduct \$43.00, the principal, and we have left \$340.86, the accumulated interest. Compare this with \$77.40, the accumulated interest at 6 per cent when it is computed on the general property tax sums more nearly according to their actual incidence and the difference is striking. It is so great in fact as to make taxes together with interest thereon, appear as one of the most important costs in forestry, when such is not the case.

rather a minor charge, though undoubtedly making up a larger proportion of the cost of production than in some other industries. Mr. J. W. Brislawn, of the State Tax Commission, stated before the tax conference at the University of Washington, May, 1912, that the farmer pays approximately 6.48 per cent of his gross earnings for taxes.** Referring to Tables II, IV, and VI, it may be seen that the first cost of taxes under the general property tax amounts to from 3 per cent to 10 per cent of the cost of producing timber, hence not differing widely from taxes in agriculture. However, so far as the owner is concerned, the actual cost to him is more than twice as great because of the interest charges which accumulate on the tax payments before the timber crop can be harvested.

If the taxes were deferred until the crop is harvested it would be of advantage to the owner without an entirely corresponding loss to the state which works under a lower interest rate. A yield tax at the time of cutting, greater in the aggregate than the present general property tax, in fact large enough to entirely reimburse the state for the deferred payment, would be advantageous to the producer of timber.

Should the producer of timber be subjected to a yield tax it would need to be placed at much less than 25 per cent of the gross yield or it would cost the owner far more than the present system, interest included. By referring to the 6 per cent column in Table I, it may be seen that the amount of the general property tax and interest thereon is \$120.40. If a 25 per cent yield tax were computed, as in the 3 per cent to 4½ per cent columns, it would cost the owner \$163.81, a much greater amount than the present system. The main advantage of the yield tax then, unless the percentage were reduced, would be that it could be met easier when the timber was cut. This would be no great advantage except to owners who managed forests under intermittent yield, a poor system, and one not apt to be maintained by any owner. A properly managed tract will give a yield annually from some part of the tract. Hence this system is not considered by the writer to be of much value, unless the percentage of the yield taken were reduced much below that now paid by the federal government. Therefore, the state cannot hope to secure anything like the tax revenue from private lands in forest as it now secures from the National Forests; or rather as it will secure when cutting is in full force in the National Forests.

In this connection it should be emphasized that, as a matter of fact, it is a fallacy to assume that even the state can practice forestry without paying a tax. The presence of the utilized forest means people. People mean taxes for schools, roads, and general expenses of government. Hence the state must spend money for the ordinary purposes for which taxes are expended. If it does not take this money from its forest revenue it must come from general revenue. Hence in effect if the state undertakes to own productive property it must pay taxes which the private owner would have paid had the resource remained in private ownership. Since the state is an aggregation of citizens mostly taxpayers in some form, payment of these expenses out of general funds by the state is the same as paying a tax by the citizens.

**See p. 40. Taxation in Washington, University of Washington Extension Series No. 12.

Necessity for Securing Capital for Forest Production in the State of Washington

Production of timber, it appears from the foregoing, is mainly a question of the investment of capital either by the nation, state, individual, or some other owner. Those owners who must pay or can get high interest rates for the use of capital cannot wisely undertake the production of timber as an investment, even if they were content with such long term investments, which is seldom the case. High priced capital means high cost of growing timber even more strongly than it means high cost of production in other lines. Yet since the State of Washington has enormous areas fitted only for the growth of timber, or far better for such growth than for any other purpose, it seems exceedingly important that the capital be forthcoming. If capital is not secured, the state will be unable to utilize this area, unproductive for other purposes, and by so much fail to obtain the full productivity that its resources warrant. Failure of this raw material for industry means so much less industry, which is also a very important matter.

Sources of Capital for Forest Production

There are four sources of capital which may in a greater or less degree be relied upon for large scale forest production, viz., the nation, the state, the municipality, and the large corporation. As previously stated, the cost of capital to practically all others is so high that the well informed forester cannot conscientiously recommend forest production as a profitable or even a self supporting enterprise, except in the case of the farm woodlot. Of these four possible sources of capital the municipality may for the present be expected at the most to deal only with city watersheds, although it would be an excellent investment for many cities to secure adjacent tracts of rough lands for forest parks, which could serve, not only for park purposes, but also give revenue to the city. The large corporation cannot be relied upon to furnish the capital now nor at any time in the future until it is definitely decided whether it will have equal privileges with other owners.

It then devolves chiefly upon the state and nation to raise the necessary capital for this need, which a little careful consideration shows to be vital to the state. The State of Washington has done nothing in this line as yet and it will no doubt be difficult for it to devote large sums to this purpose. Instead, therefore, of there being any jealousy of the work of the federal government in forest production, it seems that intelligent cooperation should be the uniform rule. The writer expects to see the day when there will be a vigorous demand from the people through members of Congress for the expenditure of government funds for this purpose to the end that the resources of the state may be made as productive as possible. Certainly such productive expenditure is far more important to the state than federal expenditures on government buildings, which merely result in moving government offices out of private buildings, and by so much decrease the demand for space in the latter. The main advantage of these latter expenditures is the purely selfish one, that because of the supposed prodigality of the government, persons who have something to sell (either material or labor) may sell more of it at better prices for the construction of a government building than for a

private building to house the same offices. Forest production by the federal government means not only benefits from present expenditure of government funds in the state where they do not interfere with private enterprise, or even with investment by the state (because there is more to be done than both can do), but also that the productive results of these expenditures will mainly accrue to the state in the future because its citizens will receive wages for protecting, growing, and harvesting the timber, and when mature using it at reasonable cost primarily in wood industries, and ultimately in all the other industries of the state.

The federal government at present, however, has its hands fully occupied in the administration of the considerable areas already set aside for forest production. There is no probability that those areas will at present be extended by purchase of private lands, although a policy of acquisition of alienated lands inside the present boundaries of the National Forests would be very useful. Aside from the National Forests, irresistible logic leads to the conclusion that for the present nothing will be done to continue cutover lands and land unfit for agriculture, as producing areas, thus contributing to the industries and general welfare, unless it be done by the state.

Will a people, granted popular rule, make expenditures, the benefits of which will accrue in the more or less distant future, or will they only make expenditures of the hand-to-mouth sort? Will they use their natural resources with regard only for today, looting and destroying in any way to make today's profit the easiest at whatever expense to the future, or will these resources be conserved? This is undoubtedly the severest test of democracy, if not the supreme test, in the long run. If only today's needs are considered and resources destroyed without measures being taken for replacing the renewable ones, it needs no prophet to see that the power of a given area to support population must continually decrease. Place against this the fact that population normally increases and we cannot escape the conclusion that a continually lower standard of living must follow, together with a lower civilization as its inevitable result.

The United States, with its great resources and small population, has not felt the results of the enormous waste of its resources as yet. Certain eastern states are beginning to feel them in so far as it concerns their forest resources, and are taking steps, halting and inadequate so far, to provide for the future. It remains to be seen whether Washington will act in time or whether it, too, will wait until the damage done is so great as to render the cost of repair many times greater than it would be if immediate action were taken. It seems certain that a wider knowledge of the need and wonderful possibilities before the state will contribute to the desired end.

While it is not within the field of this discussion to make extended suggestions as to state policy, one point deserves mention. Referring to Table V, showing costs of production on the poorest quality soil, it may be noted that with private owners the cost of production runs from \$14.01 to \$37.50 per M. feet. As the material produced on this poor quality soil will be very small sized at 60 years of age and consequently of low value, it is unsafe for any private owner to expect to undertake production of timber in this soil quality unless in very exceptional cases. The state or federal government may do so with a reasonable expectation

of at least paying costs. Since this class of land is most certainly not agricultural in character, it would seem that this would be a wise point of attack in beginning a policy of purchase by the state for the purposes of forest production. Here at least is land which will produce nothing unless the state produces timber upon it. This it can do with benefit to its industries and without damage to any private interest. The extension of the purchase policy could be worked out as the needs of the future might suggest.

*Comparative Cost of Providing a Future Supply by Growing New Timber
and by Hoarding Old Timber*

This subject is introduced here because of the close relationship to the problem of growing timber. Most corporations, and to a large extent the federal government, proceed on the theory that the best way to insure a timber supply in the future is by hoarding mature timber. It is of interest, therefore, to apply the financial test to the cost of holding timber as compared with growing it. This can be done in several ways, one of which is by reducing to present value the stumpage price at which, in the foregoing tables, it has been shown that timber can be produced. In these reductions the same interest rate should be used as was used in computing the cost of growing timber.

Thus by reference to Table III, covering cost of growing timber on Quality II soil, we find that a corporation working under 5% interest can produce timber for \$9.87 per M. ft. B. M. on a 60 year rotation. It would then not be profitable to pay an amount for mature timber (not increasing its volume, but to be held 60 years) which would bring its cost to more than \$9.87 at the end of that time, except as the timber now mature would be of higher quality. The amount that could be paid per M. would be the present worth of \$9.87, less the present value of the cost of protection and taxes throughout the period. It is somewhat difficult to determine the latter costs, but a conservative figure may be ascertained. Since the researches of Prof. F. G. Miller show that timber is already taxed $\frac{1}{2}c$ per M. per annum on the average, and the fire risk and protection must also be counted, it seems that 3c per annum throughout the period would be a very low cost for this item. The solution then follows.

Referring to interest tables* we find that the present value of \$1.00 due 60 years hence will at 5% compound interest be \$.0535. The present value of \$9.87 will then be $\$9.87 \times \$.0535 = \$.53$. Referring to the same table, we find that the present value of \$1.00 due each year for 60 years is \$18.929. The present value of \$.03 due each year for 60 years would be $\$.03 \times 18.929 = \$.57$ —present value of the administrative costs, taxes and other expenses of holding the timber. Deducting the \$.57 (the cost of holding) from \$.53 (the present value of \$9.87, the cost of producing timber) we have $-\$.04$, that is, even if the timber were given to a corporation to be held 60 years it would be cheaper to grow it than to take the old timber.

To consider the holding of timber in private ownership for 60 years would be far fetched except perhaps in the case of the largest

*C. S. Schenck "Forest Finance," p. 39.

corporations, which could be placed on a basis of permanent investment. It would, however, easily be possible in many cases for corporations or companies wishing to insure a future timber supply to their mills to secure tracts bearing young growth at prices which would give the same advantage relative to the short length of time held that the above example gives for 60 years. For example, Douglas fir stands 10 to 50 years old can often be purchased at prices little greater than the land value. If the land value in such cases does not exceed \$10.00 per acre and the timber can be bought for \$10.00 per acre, the cost per M. of the stumpage at the end of 20 years would be as follows, where the interest rate is 6%. Interest on land value 20 years= $\$10.00 \times (1.06^{20} - 1) = 10.00 \times 2.21 = \22.10 . Cost of young timber is $10 \times \$3.21 = \32.10 . Cost of protection and administration for 20 years equals $\frac{20(1.06_{20} - 1)}{.06} = \7.36

Total cost per acre of the stand at end of 20 years equals $\$22.10 + \$32.10 + \$7.36 = \61.56 , total cost per acre. If the acre is well stocked and on Quality I forest soil it should yield 44,000 ft. B. M. per acre at the age of 60 years, thus the cost per M. ft. 20 years hence would be \$1.40. That is, it would have to sell for only \$1.40 per M. ft. to give the present purchaser on those terms 6% on his investment. Mature timber, no longer making growth, purchased now for even as low as \$1.00 per M. and held for 20 years on land worth \$10.00 per acre will cost as follows where the stand is 50,000 feet per acre and the annual expense of protection is 20c per acre. Cost of original stumpage payment per acre equals

$$\frac{\$50.00 \times 1.06^{20}}{.06} = \$50.00 \times 3.21 = \$160.50$$

$$\text{Use of land} = \$10 \times (1.06^{20} - 1) = \$10 \times 2.21 = \$22.10$$

Annual cost of administration and protection

$$= \frac{20(1.06^{20} - 1)}{.06} = \$7.36$$

.06

$$\text{Taxes at 2c per M. per annum} = \frac{1.00(1.06^{20} - 1)}{.06} = \$36.78.$$

.06

Total cost per acre at end of 20 years

$$= \$160.50 + \$22.10 + \$7.36 + \$36.78 = \$226.74.$$

$$\text{Cost per M} = \frac{226.74}{50} = \$4.57.$$

50

Of course this old timber will be more valuable material but not sufficiently so to make this as good an investment as the young timber even at the low price of \$1.00 for the old. Where \$2.00 is paid now the stumpage price must be over \$9.00 per M. in 20 years to make the purchase a 6 per cent investment. Of course, every individual case of this sort must be dealt with on its merits.

The comparative cost of insuring a future timber supply by growing timber or by storing mature stands is a more important question on state and federal lands than on private lands, because it is a reasonable conclusion from the tables of cost of growing timber that upon the state and nation will devolve this task. The state is already pursuing an active policy of sale of mature timber, but many people question the federal policy, which is providing for very few sales. There are on the National Forests large areas of mature and over-mature timber which could be sold for \$1.00 per M. feet or more in any normal times. These stands are

over-mature and tend rather to decrease than increase in volume. They average 40,000 to 50,000 feet B. M. per acre. The cost of holding a stand of this nature of 40,000 feet volume on Quality I soil would be as follows, figuring 3 per cent interest, a present value of \$1.00 per M., \$10.00 per acre for soil value and 20c per acre for protection and administration.

$$\text{Soil rent} = 10.00 \times 1.03^{60} - 1 = \$10.00 \times 4.892 = \$48.92.$$

$$\begin{aligned} \text{Future value of timber at compound interest for 60 years} \\ = \$40.00 \times 1.03^{60} = 40 \times 5.892 = \$235.68. \end{aligned}$$

$$\begin{aligned} \text{Protection and administration cost 20c per acre for 60 years} \\ = .20(1.08^{60} - 1) = \$32.61 \end{aligned}$$

.03

$$\text{Total cost of holding per M.} = \$317.21 \div 40 = \$7.93 \text{ per M.}$$

Comparing this cost with \$3.36, the cost of producing timber on the liberal estimates shown in Tabel IV it will be more than twice as expensive for the federal government to secure future timber supply by holding mature timber now worth \$1.00 or more per M. than it would be to cut off such timber and reforest so as to raise a new crop during the 60 years. It is, of course, freely admitted that the value of the old timber per M. feet would be greater than that of the young, but in no such proportion as indicated above. The cutting of old forests and the growth of the young on the ground thus vacated will also result in the area furnishing within the 60 years over twice as much volume of timber for use of the people. Seemingly this should be the chief consideration.

It is argued, of course, that the government does not intend to hold the old timber so long, and that by cutting in 20 to 30 years the government can make great profits by holding. This is too great a question to treat in detail here, but there seems to be no difficulty in demonstrating that this is poor financial policy. However, it is not necessary to resort to financial arguments to show that the policy of holding mature and over-mature timber is bad from the public standpoint, because in a great measure it defeats one of the principal objects of the National Forests, viz., to furnish a large volume of timber for use by consumers. This is defeated because the soil functions only for the storage of old timber, not for the growth of new. Proper forest management requires, however, that the old stand be removed gradually and replaced by new. Where the federal government does cut timber, effort is made to see that the ground is reforested.

With the state, the argument for immediate cutting of mature timber within reasonable limits is still stronger, because the interest rate is somewhat higher. The cost of holding mature timber, involving a large initial investment as compared with growing new timber is, therefore, still higher. The state's policy fails when it comes to growing the new timber, however. Nothing is as yet being done in this direction, so that land when cut over is not even functioning for storage of timber. The two policies may thus be contrasted, the state's being inadequate in the direction of growing timber after cutting, and the federal government in the direction of a reasonable amount of cutting so as to permit growth of new timber.

Summary of Principal Conclusions

1. The chief cost of producing timber is the interest on the capital involved.
2. It follows from (1) that the interest rate under which the forest owner works, to a large extent determines the cost of producing timber to the owner concerned.
3. Taxes, though important, are a minor cost as compared with interest charges.
4. The costs of production under high interest rates are so great as to bar forest production to those owners who cannot secure money at a rate not much, if any, higher than 5 per cent.
5. This makes forest production at a profit possible only to the federal government, the state, the municipality and the large corporation, and those owners exceptionally situated as to the ownership of land for other purposes, such as mining, in connection with farming, etc.
6. Since the federal government is already practicing forestry so far as its resources make practical at present, the large corporation is not likely to become interested under present conditions, and the municipality can engage only to a limited extent; there is little hope of introducing forest practice in adequate manner except through the state.

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