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To the Graduate Council:

I am submitting herewith a thesis written by Joseph Craig Allinder entitled "An Evaluation of the Property Tax System of Tennessee as Applied to Timberland--A Productivity Approach." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Forestry.

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140

AN EVALUATION OF THE PROPERTY TAX SYSTEM OF TENNESSEE
AS APPLIED TO TIMBERLAND--A PRODUCTIVITY APPROACH

A Thesis
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the Graduate Council of
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ABSTRACT

The enactment of the Property Assessment and Classification Act of 1973 created the need for a different method of assessing timberland. The Act exempted timber and provided for present-use assessments.

The history and evolution of the ad valorem tax system in Tennessee were examined. Attention was given to the biases of the unmodified ad valorem tax as applied to timberland.

The productivity concept was defined, and its variations were examined to determine which would be applicable for the assessment of timberland in Tennessee. Attention was given to the "bare-land", "modified", and "sustained yield" productivity approaches, and the market value adjustment approach. The "bare-land" and market value adjustment approaches appeared to best fulfill the requirements of the present law in Tennessee.

The "bare-land" and market value adjustment approaches were examined to determine whether either could be possibly implemented. The "bare-land" approach was found, theoretically, to be the most correct. This approach is similar to the income method of appraisal when land is assumed bare and its value is derived from expected timber production.

It was hypothesized that both approaches can be implemented, even though limitations could be associated with both.



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CHAPTER I

INTRODUCTION

I. LEGAL STATUS OF STANDING TIMBER

In Tennessee timber has been traditionally defined as real property, which means its value was considered in the determination of the taxable value of realty. From 1835, when Tennessee adopted its Second Constitution until enactment of The Property Assessment and Classification Act of 1973 (hereafter referred to as The Act) timberland was legally taxed according to its market value. The Act exempted timber from the assessment process.

II. PRESENT TAX SYSTEM

The passage of Resolution Number 74 of the Constitutional Amendment in August of 1972 which replaced Article II, Section 28 of the active Constitution of 1870 provided for differential assessment. Timberland was initially not considered, but later included in the broader farm property classification, which is assessed at the lowest level, 25 percent of assessed value.

The Act, which was passed in 1973 to implement The Amendment, provides for the exemption of timber and the

opportunity for present-use assessment. The Act states that real farm property will be assessed without undue consideration of speculative value. This provision allows farm property, including timberland, to be assessed at some value other than its market value. Thus, The Amendment and The Act comprise a present tax system for timberland of differential and present-use assessment with timber exempt.

III. PROBLEM

The problem created by the passage of The Act is that no method has yet been developed to implement it with respect to timberland. The present method of assessment does not fulfill the provisions of The Act, because standing timber value and speculative values can be included in the assessment process.

IV. STUDY OBJECTIVES

This thesis was written to serve as a pilot study in the development of methods to assess timberland in accordance with The Act. The objectives are as follows:

1. To examine the history and evolution of the property tax system in Tennessee, particularly with respect to forestland, and discuss the problems and biases that helped justify modifications in the tax system.

2. To define the general productivity approach to the assessment of forestland, and examine some of its variations.
3. To explore the possibility of adopting two variations to the productivity approach and examine some of the methods that could be used to implement these variations in Tennessee.

V. DEFINITIONS

Present-use value. Present-use value refers to value that accrues to timberland from the production of timber.¹

Timberland. An area either supporting or that can be expected to support a stand of trees, that is not used for any purpose found incompatible with timber production.

Standing timber value. Standing timber value is the stumpage value attributable to existing merchantable timber on a property.

Timber-growing value. Timber-growing value as used here, refers to the value that growing a crop of timber from bare land adds to the land. This value can be found

¹The author is aware that other values may be associated with the use of timberland, such as recreational value; but the complexity of determining them jointly is beyond the scope of this study.

by discounting the income stream from a property to the present, provided the assumption is made that the present condition of the land is bare.

Market comparison method of appraisal. Sales of comparable properties are analyzed from gathered price data to arrive at a value for a subject property (36).

Income method of appraisal. A future expected net income stream from a subject property is discounted to the present value (36).

Market value. Market value is that price in terms of dollars that a willing seller will accept from a willing buyer assuming both parties are fully informed, act intelligently and that sufficient time is had to consider the transaction (36). Market value may include speculation and other factors that do not contribute to present-use value.

CHAPTER II

HISTORY AND EVOLUTION OF THE CURRENT TAX SYSTEM IN TENNESSEE

I. LEGAL PROVISION FOR TAXATION UNDER THREE CONSTITUTIONS

The first Tennessee State Constitution, adopted in 1796, provided for a specific tax on all land. The Constitution specified "that no one hundred acres shall be taxed higher than another, except town lots which shall not be taxed higher than two hundred acres of land each" [47, p. 2]. This meant that 100 acres of poor timberland was taxed the same amount as 100 acres of good farmland. This method of taxation was later deemed inequitable because it placed an equal burden on properties of diverse values (47).

The Second Constitution, adopted in 1835, provided for ad valorem taxation.

All property shall be taxed according to its value; that value shall be ascertained in such a manner as the legislature shall direct, so that the same shall be equal and uniform throughout the State [47, p. 4].

Value has traditionally been interpreted as market value.

The 1870 Constitution provided for ad valorem taxation with one notable exception. The direct product of the soil was exempted. A specific definition of the direct product of the soil was not included in the Constitution.

Even though no provision was made for the taxation or exemption of timber, by custom timber was defined as real property. It was not, then, classified as the direct product of the soil.

II. DEVELOPMENTS FROM 1870 TO 1966

In *Benedict et al. vs Davidson County et al.*, (1902) 110 Tenn. (2 Cates) 183, 67 SW 806, timber was defined as not being the direct product of the soil (29). This court case reinforced the custom of taxing timber as real estate.

Two studies of the tax situation in Tennessee, one in 1920 and the other in 1931 indicated that standing timber was being taxed. Brannon, in 1920, reported that timber was not assessed scientifically. The general practice was for the owner and assessor to estimate the timber value (7). Though this did not provide an accurate assessment of timber value, it does indicate timber value was considered. In 1931, Boyer, in a study in Overton County found that standing timber was being taxed (6).

As the property tax became a less important part of state revenues, the state exercised less control over the

assessment and taxation process. This led to inconsistencies in assessment among the counties (47).

By 1948, according to Marquis' study, standing timber was not being formally recognized in the assessment process. The usual practice was to

place all forest land, regardless of its productive capacity or value of merchantable timber on it, into one class and to assess it at a uniform amount [29, p. 4].

In 1956, it was reported that it was not possible to determine, from the records maintained in most of the counties whether standing timber value was assessed separately from the land value or whether it was assessed at all (34). The practice of disregarding standing timber in the assessment practice generally persisted up until at least 1966.

III. RAILROAD SUITS OF 1966

As a result of the suits by the Southern and L and N Railways versus the State Board of Equalization in 1966, the state was forced to take action in order to assure uniform assessment ratios or face additional suits and perhaps a collapse of the property tax structure. The state attempted to provide for full value assessment throughout the State. Timberland, then, was to be assessed at its fair market value.

Timber was considered realty subject to market value assessment. Since standing timber can contribute to the value of the land supporting it, timber value should be considered in the determination of the market value of a timbered property. In fact, many stands of timber increase in value annually. Absolute adherence to the law would require the reassessment of some areas of timberland each year, to reflect value changes attributable to growth.

IV. CONSTITUTIONAL AMENDMENT

The passage of The Constitutional Amendment, in August of 1972, provided for differential assessment. Property was classified into four subclassifications according to use and assessed as follows:

- a. Public Utility Property . . . 55% of its value;
- b. Industrial and Commercial Property, . . . 40% of its value;
- c. Residential Property . . . 25% of its value
- d. Farm Property . . . 25% of its value
[41, pp. 35-36].

For purposes of assessment, timberland was included in the farm property classification.

Backers of the amendment predicted property tax cuts for farmers and homeowners (26). However, increased tax rates in most counties were expected to partly offset reductions in the assessment ratios (26).

It appears that the assessment of timber was to be continued under The Amendment. Van Mol reported, in September of 1972, that guidelines for assessing timberland were to be included in an assessment manual being developed for statewide use (51). The main result of applying these guidelines would have been to value the standing timber in addition to the land supporting it.

V. PROPERTY ASSESSMENT AND CLASSIFICATION ACT OF 1973

The Property Assessment and Classification Act of 1973, enacted to implement the Constitutional Amendment, dictated two important changes in the assessment and taxation of timberland; the exemption of standing timber; and assessment without undue regard to speculative values. That is "present-use" versus "highest and best use" assessment.

Exemption of Timber

The Act exempted "All growing crops of whatever kind, including timber, . . . in the hands of the producer or his immediate vendee" [41, p. 23]. This means standing value should not be included in the assessment of timberland.

This exemption is not an entirely new concept but a broadening in the definition of the direct product of the soil

to include timber. As previously stated the 1870 Constitution exempted the direct product of the soil, but timber was not included in the original definition.

Since tracts of virgin timber, for the most part, have not existed in the state for many years, owners must incur costs to grow timber. It has and should be defined as a growing crop and not real estate (29).

Although timber is classified as a growing crop, it may add value to the land that supports it. This should be evident where merchantable timber exists. If standing timber on a property is worth \$100 per acre, it should add this much to the market value of the land. The fact that precommercial timber contributes to land value is not as evident. However, a stand of pole-sized timber would be expected to contribute something more in value than a sapling stand, when the land is held for timber production.

Exempting standing timber is one step in the direction of assessing forestland at some value other than market value. When existing standing timber value is disregarded the assessed value will not be the same as market value.

Present-Use Assessment

The Act has provided the opportunity for present use by eliminating market value as the basis for assessment. It states that:

The value of all property shall be ascertained from the evidences of its sound, intrinsic and immediate value, for purposes of sale between a willing seller and a willing buyer without undue consideration of speculative values [41, p. 37].

The Division of Property Assessment, created by The Act, has the responsibility of determining how forestland will be assessed. As of July, 1973, no specific determination had been made public, concerning the assessment of forestland.

VI. RATIONALE FOR TIMBER EXEMPTION AND PRESENT-USE ASSESSMENT

The ad valorem tax can place a disproportionate burden on owners of forestland. The timing of the tax and the ad valorem method of valuation are the principal reasons for this unfair burden, or bias. High, or excessively burdensome taxes can encourage landowners to manage their forestlands in a manner unfavorable to conservation. The exemption of timber, and present-use assessments can counteract the biases of the unmodified ad valorem tax system. These problems and biases created by ad valorem taxation will be discussed.

Problems High Taxes Can Create

The ultimate problem created by high taxes is they may encourage a landowner to abandon his timber growing

enterprise. A tax that encourages this is defined by Duerr as "confiscatory".

A property tax is a confiscatory tax when it promises to be as high as the property's net income before the tax--in other words when it promises to extinguish the value of the property. For forest property, confiscation results when the tax is high enough to wipe out just that part of the value that cannot be liquidated. Then the owner's tendency is to abandon the land or find another use for it after liquidating any merchantable timber [12, p. 437].

High taxes may also contribute to uncertainty. There is always the threat the taxes will go higher and reach the "confiscatory" level (12). So far as uncertainty is concerned, it resembles that arising from any other sort of cost, it militates against capital intensive investment and long term investment (12).

The uncertainty inherent in high taxes is increased when property is assessed at its market value and speculation is reflected in market value. Market value and taxes can increase significantly in a short time due to speculation, when it is prevalent in a locality.

Biases of Ad Valorem Taxation

The biases inherent in the ad valorem taxation of timberland contribute to creating high taxes on timberland, with subsequent inequities. These biases are discussed below.

Tax capitalization bias. The tax capitalization bias results when deferred yield properties are taxed annually. The tax payments on these properties must be carried at compound interest until income is received. Essentially the deferred yield property is penalized, when compared to an annual yield property, by the amount of interest that accumulates on the tax payment. The two assumptions necessary for this bias to be relevant are: money has value over time, and the yield from forestland is necessarily deferred. This bias and its ramifications were explored and described in detail by Fairchild and Associates (13).

Time bias. The time bias, as described by Duerr, results when today's assessed value takes into account the expected yields, and then the assessment is later increased along with the rise in property value (12). This creates double counting because these expected increases in value were already reflected in the original assessment (12). One of the ramifications of this bias is that it places a relatively lighter burden on owners reducing the intensity of management than on those increasing the intensity of management (12). Thus it discourages timber investment, or encourages depletion.

Timber exemption removes the variable nature of the tax. With timber exempt, the management practices of the owner will not affect the amount he is taxed. Also the

exemption of timber removes the double counting aspect of the bias.

Market value bias. Market value bias describes the situation that occurs when forestland is assessed at a higher value, using the market comparison method of appraisal, than it would be using the income method. This situation occurs when the value of forestland as determined by land sales is higher than the capitalization of its expected net income from growing forest products.

When the market value bias exists, present-use assessment is one way to eliminate it. Property is assessed and taxed on the basis of its use and not its market value.

Parcel bias. Parcel bias results when a property is overassessed in comparison to other properties. It has long been asserted that assessments tend toward the average, with low value properties being overassessed and high value properties being underassessed (13). When this is the case, forest properties may bear a larger tax burden, in relation to value, than more valuable properties.

A study, conducted for the County Tax Assessment Subcommittee in 1955-56 (34), indicated that the median ratio between assessed value and actual market value, determined from recent sales, was higher for timberland than any other type property in Tennessee. The ratios were:

"unimproved residential 29%, improved residential 20%, commercial and industrial 25%, farm land 24%, and timberland 30%" [34, p. 33]. No firm conclusions can be drawn from these findings, however, because a sufficient number of good recent sales of timberland were not available at the time the study was conducted.

VII. RECOMMENDATIONS OF EARLIER STUDIES

Boyer, in 1931, recommended the exemption of standing timber (6). From his study of the timber tax situation, which concentrated primarily on Overton County, Tennessee, he concluded that the annual taxation of standing timber promoted unwise deforestation (6).

Later, in 1948, Marquis also recommended the exemption of standing timber in Tennessee, but for a different reason (29). He found that changes in the value of standing timber were not reflected in the assessments. Exemption would legalize the existing practice, and remove future uncertainties (29).

CHAPTER III

PRODUCTIVITY APPROACH TO TIMBERLAND TAXATION

I. PRODUCTIVITY CONCEPT DEFINED

The productivity concept, as applied to forestland, is one in which taxable value is determined from the ". . . assumed net earning capacity in timber production under specified forest management assumptions" [59, p. 1]. It is termed the productivity concept, because taxable value is based on the productivity of a property, rather than current market value. There are many ways this concept can be applied. Several different approaches to implementation, and the explicit assumptions necessary to implement these approaches will be discussed. First, however, the enabling legal provision, present-use assessments and the conditional provision, timber exemption, will be discussed.

II. PRESENT-USE ASSESSMENTS

Present-use assessments can serve as a necessary vehicle to implementation of the productivity concept. Present-use assessments are where "tax assessors are required to value certain classes of land . . . at current

use and not some alternative higher and better use" [4, p. 4]. The productivity approach is one method that can be used to measure the value of timberland for growing crops of timber. When timber production is the current use of timberland, application of the productivity approach determines present-use value.

A problem of equitability arises when speculators and others convert land taxed under present-use provisions into higher uses. The problem is, they often realize large capital gains from the sale of properties which were taxed on the basis of present use. Such practices make present-use assessment a weak stop gap measure in land use planning and control, merely slowing the pace of land turnover.

"Fourteen states have adopted deferred or rollback tax arrangements along with their present-use provisions in an attempt to overcome this problem" [4, p. 5]. These rollback provisions require landowners to pay taxes

. . . equal to their tax savings for the last, two, three, five, or seven years, depending on the state, and sometimes at interest . . . when land is converted to higher uses [4, p. 5].

Tax savings are determined by carrying two values on the taxbooks, then subtracting the assessed present-use value from the market value.

III. TIMBER EXEMPTION

Timber exemption, either in conjunction with present-use assessment, or individually can be used to implement the productivity concept. Since timber is not valued, the assessment is based on the bare land value. When market value assessments recognize only the value of the land for timber production and timber value is subtracted from market value, the resulting assessed value should be that value attributable to the productivity of the bare land. However, when market value is influenced by nontimber values, such as speculation, exempting timber will not provide assessments based on the productivity of the bare land.

IV. EXPLICIT ASSUMPTIONS FOR IMPLEMENTING

DIRECT APPROACHES TO PRODUCTIVITY

VALUATION

Direct Approaches Defined

Direct approaches as defined here, are those in which the value of timberland is directly derived from capitalization of assumed net value yield. To determine value by these approaches several assumptions must be made regarding net value yield. In addition, a capitalization rate must be chosen.

Site Quality

Site quality must be determined to implement a productivity approach. Site quality is the major determinant of the physical yield that can be produced. Physical yield is important in determining the value that ultimately will be capitalized. For illustration, Table I gives the expected yields per acre for even-aged upland oak stands. As an example, with no thinning site index 55 land can only be expected to produce 900 board feet per acre in 60 years, while site index 75 land can be expected to produce 9,288 board feet. This is over 10 times as much board feet yield for the better land in the same time period assuming the absence of a hardwood pulpwood market to utilize all wood fibre produced.

Site index is one method commonly used to measure site quality. Essentially site index is the expected height of dominant trees in a stand at some specified index age, normally 50 years. Site index can be determined directly by measuring height and age of dominant trees, then using site index curves (8). Indirect measurements can be used including plant indicators, soil types, and other soil-site relationships (18). The point, however, is that site quality must be determined in some manner.

TABLE I
YIELDS PER ACRE FOR UPLAND OAK; NO THINNING

Age (years)	Basal Area Square Feet	Trees No.	Average Tree Diameter ^a Inches	Yields		Board Feet
				Cubic Feet	Cords	
SITE INDEX 55						
20	55	2,500	2.0	60	0.6	--
30	75	1,260	3.3	583	5.3	--
40	87	790	4.5	1,320	12.1	--
50	97	480	6.1	2,150	19.7	400
60	104	357	7.3	2,520	22.9	900
70	108	295	8.2	2,730	24.4	2,800
80	112	242	9.2	2,880	25.6	5,400
SITE INDEX 65						
20	59	1,880	2.4	178	1.6	--
30	81	930	4.0	1,200	10.6	--
40	96	505	5.9	1,840	18.2	440
50	105	342	7.5	2,800	26.9	2,150
60	111	262	8.8	3,300	30.8	5,160
70	115	215	9.9	3,700	33.3	7,200
80	117	187	10.7	3,950	35.6	8,200
SITE INDEX 75						
20	70	1,425	3.0	694	6.4	--
30	89	680	4.9	1,670	16.7	--
40	101	400	6.8	2,440	23.7	1,380
50	110	279	8.5	3,315	30.1	4,100
60	114	222	9.7	4,140	37.7	9,288
70	117	187	10.7	4,760	43.0	11,200
80	120	166	11.5	5,160	46.5	12,500

^aThe diameter of the tree of average basal area.

Source: Samuel F. Gingrich, 1971, Management of young and intermediate stands of upland hardwoods, US Dep Agr Forest Serv Res Pap NE-195, p. 3.

Management and Cost of Management

The kind and intensity of management must be known, since the management practices implemented can greatly influence expected yield. For example, Table II gives the expected yields per acre for upland oak, when the stand is thinned at 10 year intervals. The cumulative expected yield for site index 55 land is 8,340 board feet per acre, when thinned, as compared to 900 board feet per acre when no thinning is carried out. Thinning, in this case, produces more than nine times the board feet yield that would result from no thinning (about a 17 percent increase expressed in cubic feet).

The cost of the management practices undertaken is an important factor in the estimation of expected net value yield. It should be evident that costs will definitely influence net value yield. This is particularly true for deferred yield properties, where a discount rate is applied. The costs incurred and timing of these costs will also influence the management practices that are implemented.

The property tax is a cost of ownership, but should not be included in the calculation of taxable value, in cases where timber is exempt. The tax does not increase as a result of stand growth. Therefore, the time bias is not present. On the grounds of equity the tax should reduce the net income of all properties by the same amount.

TABLE II

YIELDS PER ACRE FOR UPLAND OAK. THINNED EVERY 10 YEARS

Age (Years)	Basal Area Square Feet	Average Tree Diameter Inches	Yield		Basal Square Feet	Thinning Yield		Cumulative Total Yields (Cut Stand Plus Residual Stand)			
			Cubic Feet	Cords Feet		Board Feet	Square Feet	Cubic Feet	Cords Feet	Board Feet	Cords Feet
SITE INDEX 55											
10	20	1.9	--	--	--	--	--	--	--	--	--
20	48	4.1	515	5.0	--	7	--	--	540	5.0	--
30	58	5.9	1,190	9.9	240	20	--	--	1,560	14.1	240
40	64	8.0	1,640	15.0	1,560	19	4.2	--	2,360	22.8	1,720
50	71	10.6	1,990	18.3	3,800	16	3.6	160	3,125	30.5	4,550
60	75	13.0	2,280	20.7	6,540	16	4.4	590	3,900	37.8	8,340
SITE INDEX 65											
10	23	2.1	--	--	--	--	--	--	--	--	--
20	51	4.5	775	6.8	--	8	1.2	--	900	8.0	--
30	59	6.4	1,445	13.1	540	25	3.8	--	1,940	18.1	540
40	66	8.6	1,920	18.0	2,280	21	3.8	280	2,880	26.8	2,560
50	72	11.0	2,340	21.8	5,250	19	5.2	970	3,875	35.8	6,500
60	76	13.7	2,655	24.3	8,940	18	5.8	1,810	4,860	44.1	12,000
SITE INDEX 75											
10	25	2.5	--	--	--	--	--	--	--	--	--
20	55	5.4	1,060	9.6	--	12	1.6	--	1,260	11.2	--
30	62	7.4	1,920	17.5	1,380	30	5.2	60	2,640	24.3	1,440
40	71	10.5	2,550	23.0	4,840	22	5.6	500	3,880	35.4	5,400

TABLE II (continued)

Age (Years)	Basal Area Square Feet	Average Tree Diameter Inches	Yield				Basal Square Feet	Thinning Yield		Cumulative Total Yields (Cut Stand Plus Residual Stand)		
			Cubic Feet	Cords Feet	Board Feet	Cubic Feet		Cords Feet	Cubic Feet	Cords Feet		
50	75	13.2	3,025	26.8	10,300	22	745	6.8	1,540	5,100	46.0	12,400
60	78	15.5	3,360	29.7	13,200	21	925	7.8	3,540	6,360	56.7	18,840

Source: Samuel F. Gingrich, 1971, Management of young and intermediate stands of upland hardwoods, US Dep Agr Forest Serv Res Pap NE-195, p. 9.

The expected physical yield depends on the site quality and management practices undertaken. "We have only limited knowledge about yields of hardwood species at different levels of site quality, or at different intensities of silviculture" [8, p. 36]. Generally better information is available for softwood species. This does limit the management practices that can be assumed, and the site variation that can be recognized. With the information available, however, yields can be estimated, for both hardwood and softwood stands.

A value must be placed on the expected yield. This value will depend on what type forest products are grown, the quality of those products, the accessibility and logging chance of the area, the location of the area with respect to available markets, and of course, the prevailing market prices of the forest products produced.

Capitalization Rate

A capitalization rate, or discount rate, must be applied to determine value by the direct approach. Capitalization is defined here as the process of discounting a series of payments to one point in time (13). For assessment purposes, the present is the desired point in time (13).

V. DIRECT APPROACHES TO THE APPLICATION OF THE PRODUCTIVITY CONCEPT

The three direct approaches discussed here are modifications of the income approach to valuation. In all three, value is derived from assumptions made concerning expected yield for broad productivity classes, rather than the expected value yields produced by an individual property. The direct approaches differ from each other in the assumptions made concerning timing of the yield and stocking of the stands being appraised.

"Bare-Land" Approach

The first approach to be discussed is one where ". . . land value is determined as the discounted present worth of anticipated net income from future timber crops" [59, p. 7]. It is termed the "bare-land" approach because taxable value is determined from land that is assumed bare, regardless of actual stand conditions (59). That is, anticipated income is assumed to be delayed until a stand can develop. In the case where intermediate cuttings are not expected, the first anticipated income is at rotation length.

The "bare-land" approach can be applied when the required information, value and timing of yield and costs and timing of costs, is available. Several formulas can be used to capitalize the expected net value yield.

The process illustrated here involves discounting the future expected income and costs to the present. The present value of future returns or costs from reducing unending series of periodic yields, with the first yield at the end of the first period is $V_0 = V_n \left[\frac{1}{(1+i)^n - 1} \right]$ where V_0 = value now, V_n = value n years from now and every n years thereafter, n = years until first yield or cost and between yields or costs thereafter, and i = the interest or capitalization rate (27). When more than one periodic return is realized during a rotation period, such as from thinnings, all returns and costs must be discounted and summed. Finally discounted costs must be subtracted from discounted value yield.

A generalized formula is:

$$V_0 = R_t \left[\frac{1}{(1+i)^t - 1} \right] - Cn \left[\frac{1}{(1+i)^n - 1} \right] ,$$

Where R_t = the incomes occurring t years from now and every t years thereafter, and Cn = the costs occurring in year n and every n years thereafter.

The proper timing of costs and revenues must be used for this formula to produce the bare-land value. A waiting period equal to the time bare-land would take to produce must be applied.

As an example, suppose one wanted to determine the present value of an unending series of timber sales of \$400 per acre, spaced at 60 year intervals, when annual costs average only a low \$.10 per acre, and when the interest rate is 5 percent. Income of \$400 occurring in 60 years and every 60 years thereafter and costs of \$.10 occurring every year are capitalized through use of the formula:

$$V_o = \$400 \left[\frac{1}{(1 + .05)^{60} - 1} \right] - \$.10 \left[\frac{1}{(1 + .05)^1 - 1} \right] .$$

$$V_o = \$22.62 - \$2.00.$$

This approach, then, results in the productivity value of the bare land. It is the present net worth of all future rotations. If the land being valued were bare, the income approach and bare-land productivity approach should both give the same value, provided the same assumptions were made concerning future costs and returns.

Sustained Yield Approach

The "sustained yield" approach is one in which the property is assumed to be producing an annual income (59). This approach differs from the bare-land approach in the assumptions of an annual return, rather than a periodic delayed return. For even-aged stands on equally productive sites this means that a portion of the area, found by taking

the reciprocal of the rotation length, is assumed to support timber ready to be harvested during any given year. This approach, then, assumes the property already supports a crop of timber.

The "sustained yield" approach can be applied by capitalizing the value of average annual net yield. The one step process is accomplished by the following formula:

$$V_o = \frac{\text{Value of Average Annual Yield} - \text{Average Annual Cost}}{i}$$

The same example used to illustrate the "bare-land" approach is used again with the sustained yield approach, except with different assumptions concerning the timing of income. With this sustained yield approach 1/60 of the periodic yield is realized annually. Average annual yield is \$400/60 or \$6.67. When average annual cost remains \$.10 per acre, value is determined as follows:

$$V_o = \frac{\$6.67 - \$.10}{.05}$$

$$V_o = \$131.40 .$$

Through the use of this approach, productive value of land assumed to be producing an annual yield, can be determined. This value is the present net worth of an expected annual income that occurs each year from the

present into infinity; however returns in the distant future contribute very little to present value. For example the value of a \$100 payment 160 years in the future when discounted at 5 percent is only about \$.04.

Modified Productivity Approach

The "modified productivity" approach is one in which ". . . periodic value adjustments are made in the assessed value to reflect changes in stand conditions" [59, p. 7]. This approach is more nearly like the unmodified income approach since assessed value changes over time, in response to actual changes in stand conditions. However, as in the other approaches the expected yields are those obtained under assumed conditions, which probably will not be the same as the actual yield of a given property. Williams and Canham recommend the calculation of multipliers to achieve the necessary value adjustments needed to reflect changing stand conditions (59).

Calculation of a modified productivity value can become quite complicated because of the variation in the timing of expected yields. For this reason a general formula has not been included here. However, the value can be derived by discounting expected value yields and costs to the present and subtracting costs from yields. For practical purposes yields and costs occurring in the distant future can be disregarded.

The same example that served to illustrate the previous two approaches is used again. This time, however, costs and revenues occurring more than 150 years in the future are disregarded in the first two calculations of value. Three values have been determined for this approach.

1. Value when rotation age is 5 years away =
\$329.82.
2. Value when rotation age is 30 years away =
\$95.77.
3. Value when rotation age is 60 years away =
\$20.62.

The use of the "modified productivity" approach can cause the taxable value of a property to change considerably over time. However, fluctuations of the magnitude presented in the example would only be expected to occur when the entire property is managed as a single unit. That is where timber is allowed to grow to rotation age on the entire property, then harvested.

Approaches Compared

Very different values can result from the same land, from the use of these three approaches. This variation is due to the assumptions concerning the timing of the value yields and timing of costs. The variation that resulted from applying the three approaches to the same example is illustrated in Table III.

TABLE III

COMPARISON OF THE ASSESSED VALUES DERIVED FROM USING
THREE PRODUCTIVITY APPROACHES

Approach	Calculated Value		
	Years Until Rotation End		
	5	30	60
Bare land Productivity	\$ 20.62	\$ 20.62	\$ 20.62
Sustained Yield	131.40	131.40	131.40
Modified Productivity	329.82	95.77	20.62

Use of the "bare-land" approach results in the lowest constant value, because timber values are excluded from the residual value. Use of the "sustained yield" approach results in a constant value, but one considerably higher than obtained using the "bare-land" approach. This is because growing stock values are included in addition to the bare-land value. Use of the "modified productivity" approach results in widely varying values over time. It most closely approximates the income approach over time. Now that the direct approaches to the implementation of the productivity concept have been examined the indirect approach will be discussed.

VI. EXPLICIT ASSUMPTIONS FOR IMPLEMENTATION OF INDIRECT APPROACH TO PRODUCTIVITY VALUATION

Indirect Approach Defined

The indirect approach, as defined here, is one in which an attempt is made to adjust market data in such a manner that the taxable value determined reflects the present-use value of the property. Since application of the productivity concept also attempts to estimate present-use value, productivity value is indirectly estimated by this adjustment of market data. The variation of the

indirect method discussed here is the one where market data is adjusted in such a way that standing timber is exempted from valuation.

Comparable Sales

Good comparable sales data are necessary for the determination of value. It should be evident that adjustments cannot be made without first having good sales data to adjust. Often bare timberland either is not sold or is converted to non-forestry uses.

Timber Value

When timber is exempt from taxation, timber value must be determined, then removed when using the indirect approach. Accomplishment of this requires two assumptions: the buyer and seller were aware of the timber value; and the timber value is known to the appraiser.

Identification of Speculative and Nontimber Growing Values

The assumption, that the influence of speculative and nontimber growing values in a sale can be determined, must be made. Conversely, it must be assumed that present-use value can be determined. Assessors, and particularly landowners have long believed that market values in many areas were "too" high. For the indirect approach to be applicable some estimate of the magnitude of the value, if

any, attributable to factors not related to timber-growing values must be made.

VII. EUROPEAN EXPERIENCES

West Germany, Switzerland, Finland, Sweden, Norway, and Austria are among the European countries that use a productivity approach (59). A brief discussion of the specific methods used in West Germany, Switzerland, and Finland is presented here for purposes of illustration.

West Germany

A modified "sustained yield" approach is used in West Germany to determine taxable value. The approach is modified by making adjustment for actual stand conditions (59).

Sustained yield values are developed and revised by Federal authorities (59). These values are "based upon the net money income realizable under sustained yield management" [59, p. 10]. Studies of actual sustained yield forests, undertaken periodically, provide information concerning annual net returns (59). Base values have been developed for each of 74 sections of the country by capitalizing this net annual yield at 5.5 percent (59).

These base values

. . . are modified to fit specific tracts, based on actual species composition, age class distribution, site quality, and density of stocking. Wood product prices and management costs reflect

broad regional averages rather than the experience of the specific enterprises [59, p. 10].

Switzerland

Switzerland also uses a "sustained yield" approach, which is modified for actual stand conditions. Official valuation is ". . . based upon average net earning capacity under sustained yield management capitalized at 4%" [59, p. 11]. Detailed tables have been prepared to enable tax officials to adjust the valuation of individual properties for the following factors: site quality, timber volume, timber species and quality, stocking density, logging chance, accessibility, and distance to railway or mill (59).

Finland

In Finland a "sustained yield" approach is used. A full normal sustained yield is assumed and the owner of ". . . a poorer stand pays the same as one with a better stand . . ." when the land supporting these stands is comparable [59, p. 12]. The "sustained yield" approach then, is not modified to reflect actual stand conditions. However,

areas that are unproductive by reason of rock, swamp, snow, wind exposure, or other factors including forest fires are treated as wasteland and excluded from the tax base [59, p. 12].

Productive value of forest land is determined for six different site classifications within nine designated

regions of the country (59). Site classes are differentiated by reference to ground vegetation (59). Theoretical yield is determined on the basis of expected normal yield by site (59). Stumpage prices, used to value this normal yield, are adjusted by zone, to reflect logging and transportation costs (59). Once gross value yield is determined a deduction of 25 percent is made to cover management costs (59). Capitalization rates from 8 to 11 percent have been used in the past to determine taxable value (59).

VIII. TWO AMERICAN APPROACHES

State of Florida

In Florida the sustained yield productivity approach is used to assess most forestland. Implementation is accomplished through the use of an assessment manual in which productivity values are enumerated. There are two requirements that must be met for forestland to be assessed by this method. These are: classification by the assessor, and annual application by the owner.

"The Manual provides per-acre values for four species of pine and for hardwoods in three² regions of the state . . ."[59, p. 9]. These values were determined in the following manner. One, available yield data were used to estimate the average annual per acre growth in cords by

²The forest survey region of southern Florida is excluded.

site, for each of the four pine site classifications and the one hardwood site classification. Two, average stumpage prices, by region of the State, and by species, were used to value this annual growth. Three, average annual, per acre growth value was reduced by \$1.50 per acre for pines and \$.25 per acre for hardwoods to reflect management costs. Finally, this net annual, per acre income was capitalized at 7 percent to determine value. Tables IV and V illustrate the values that were listed in the Assessment Manual in 1965.

The actual process of determining species composition, and site quality, or site index, is the responsibility of the local assessor. Once this has been done he can determine taxable value, by multiplying the per acre values included in the manual by the acreage represented.

No specific adjustments are made for accessibility, logging chance, or timber quality. The factors are supposedly reflected in the regional stumpage prices.

State of Maine

The "sustained yield" approach is also used in the state of Maine. "The value of the annual net wood production for each forest type is capitalized at 10% to find the full valuation per acre for each forest type" [3, p. 164].

TABLE IV

LISTED VALUE PER ACRE FOR "FULLY STOCKED" PINE LANDS IN THREE FLORIDA
FOREST SURVEY UNITS BY SITE INDEX CLASSES

Dominant Species	Site Index Class	Florida Forest Survey Units		
		Northwest	Northeast	Central
Slash Pine	80	\$81	\$78	\$56
	70	58	56	38
	60	38	36	23
	50	22	21	11
Loblolly Pine	80	65	63	45
	70	45	43	30
	60	30	28	18
	50	15	14	9
Longleaf Pine	80	67	64	45
	70	45	44	29
	60	28	26	15
	50	12	11	4
Sand Pine	70	16	16	11
	60	9	9	6

Source: Ellis T. Williams, 1966, State guides for assessing forest land and timber, US Dep Agr Misc Publ 1061, p. 20.

TABLE V
VALUE PER ACRE OF HARDWOOD LAND IN FLORIDA DERIVED USING THE
SUSTAINED YIELD APPROACH

Florida Forest Survey Unit	Average Annual Growth (Cords)	Value Per Cord	Gross Annual Income	Annual Expense	Income	Value Per Acre
Northwest Florida	.43	\$4.59	\$1.97	\$.25	\$1.72	\$24.00
Northeast Florida	.39	4.30	1.68	.25	1.43	20.00
Central Florida	.47	4.45	2.09	.25	1.84	26.00

Source: Ellis T. Williams, 1966, State guides for assessing forest land and timber, US Dep Agr Misc Publ 1061, p. 23.

The value of the annual net wood production is determined as follows. One, average annual net wood production is calculated

for each forest type in each county . . . from Federal and State timber growth surveys. . . . Survey growth rates are then reduced by 30% to reflect the growth that can be extracted on sustained yield basis [3, p. 164].

Two,

The average stumpage value for each forest type for each county or forest economic region is to be determined at two year intervals. . . . [3, p. 164].

Finally, average stumpage value is multiplied by annual net wood production.

An allowance is made when trees are destroyed by fire, disease, insect infestation or other natural disaster. The assessment of the ". . . land area destroyed is reduced by 75% for the first ten property tax years following the loss" [3, p. 165].

Application of the law is mandatory for tracts of forestland over 500 acres in size and optional for tracts under 500 acres in size. The only requirement necessary for classification is the land be held primarily for the growth of forest products. Determination of the primary use of forest land is the responsibility of the assessor.

A rollback provision applies when a change in classification occurs, unless it ". . . results from an exercise of the power of eminent domain . . ." [3, p. 164].

The penalty (imposed) is the greater of (a) net taxes foregone, based on fair market value on date of withdraws, for the period of classification, not exceeding five tax years, plus interest or (b) a one time tax based upon the amount, if any, by which the fair market value of the real estate at date of withdrawal exceeds the taxable value of the tract under the Act, levied at a rate of 10% from 1973 to 1978, 20% from 1978 to 1983 and 30% thereafter [3, p. 164].

IX. EVALUATION OF THE PRODUCTIVITY CONCEPT

Policy of Society of American Foresters on Property Taxation

Among foresters, the valuation of forestlands for property taxation on the basis of productivity has long had support (59). Valuation on the basis of productivity is often viewed as a means to offset the biases of the ad valorem tax system. Productivity assessments are believed by some to encourage or at least not discourage conservation. The following is the Society of American Foresters' policy on forest taxation:

Taxation of forest land, to be equitable and favorable to conservation, should be based only upon the use and productivity of the land. Private forests provide many public benefits. Forest taxation should encourage forest investments and professional forest management [2, p. 55].

Problems Associated with Implementation

The productivity approach could be in violation of Amendment 14 of the United States Constitution. The

possibility exists that this approach does not provide for equal protection, or treatment, under the law. Should this be determined by the courts, the approach would be invalidated. However, since present-use assessments have been widely used in many states, it seems unlikely that a productivity concept would be ruled invalid.

Additional problems associated with implementation concern the availability of necessary information. To implement the indirect approach the following information is needed: good comparable sales data, an estimate of non-timber associated values, and an estimate of standing timber value. Implementation of the direct approach requires the following information: net value of the expected yield, timing of the yields, and a capitalization rate.

Problems also occur in the administration of these approaches, particularly the direct approach. Decisions must be made concerning the actual figures used to determine the net value of the expected yield. Even when taxable value figures are derived by site, the site must be determined.

Though assessors normally are familiar with the market data approach to valuation, problems may occur when the indirect approach is used. The main problem is with timberlands having conjunctive values associated with uses other than timber growing. Sales that are comparable to a subject property should reflect approximately the same amount of

these values. Due to this fact, the nontimber growing values can become difficult to determine accurately.



CHAPTER IV

THE "BARE-LAND" PRODUCTIVITY AND MARKET VALUE ADJUSTMENT APPROACHES AS ALTERNATIVES FOR TENNESSEE

I. INTRODUCTION

Legal authorization for the implementation of the productivity approach to forestland taxation has been made in Tennessee. It was provided by the Property Tax Assessment and Classification Act of 1973. However, as of July, 1973, no public announcement had been made concerning a revision in the assessment process, to reflect the provisions of The Act.

The possibility of implementing two variations of the productivity approach, one direct and one indirect, in Tennessee, is explored in this chapter. The variations are: the market value adjustment approach and the "bare-land" productivity approach.

II. MARKET VALUE ADJUSTMENT APPROACH

The market value adjustment approach is a modification of the standard market data approach. The term, market value adjustment, is used because the fair market value of

the property, being appraised, is adjusted. It is adjusted to exclude the value of standing timber, and moreover values not related to timber growing.

Implementation

The adjustment process is the key to implementation of the market value adjustment approach. This process differentiates it from the market data approach, which assessors have been applying in Tennessee on a mass scale for several years. Accepting the assumption that this application has been acceptable in recent years, though not necessarily laudable, requires that this approach only be modified to adjust for standing timber value and nontimber growing associated values. Problems anticipated in accomplishing this adjustment will now be discussed.

Timber Value

Adjustment must be made for timber value. One way to accomplish this is to subtract the timber value from the total property value. Accurate determination of timber value requires a timber cruise. Timber cruising is not suited to mass appraisal practices, because it requires considerable time, and must be done by experienced personnel. Deduction of standing timber value must be accomplished in a manner consistent with mass appraisal techniques.

One method of making the adjustment for timber value is through the development of average timber values for each county or group of counties. To make this adjustment value as accurate as possible, but still useful for mass appraisal purposes, average value could be determined for several stand size classes.

A logical grouping of counties for the purpose of developing an average timber value, is according to the five forest resource regions that have been developed by the Forest Service. Figure 1 illustrates the boundaries of these regions. Though there is a great deal of dissimilarity in each region, this method should prove more accurate for each individual county than a statewide average. Development of a value by county would require estimation of 95 different values. Also considerable variation exists within each county, so the overall accuracy gained over that obtainable using the regional breakdown, would be small.

Some consideration should be given to the value, if any, of standing timber on each individual property. The size classes are: (1) reproduction, (2) pole and pulp, (3) small sawlog, and (4) large sawlog. These are the same classifications recommended in the assessment guidelines developed to value timber, before it was exempted from assessment (51).

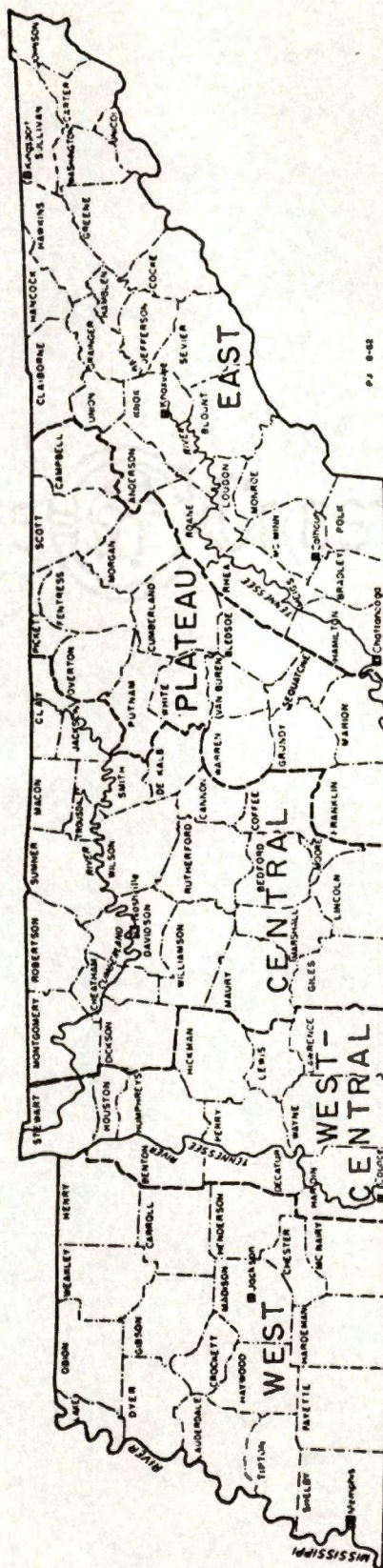


Figure 1. Forest resource regions in Tennessee.

Source: Paul A. Murphy, 1972, Forest resources of Tennessee, US Dep Agr Forest Serv Resource Bull SO-35, 33 p.

Adjustment for timber value could be accomplished in the following manner. First, the assessor determines the value of property in the usual manner. Second, through an examination of the property, or on the basis of secondhand information, he determines stand size class for the property. Third, he subtracts the appropriate timber value from total value. Finally, he takes 25 percent of this adjusted value, which gives the property differential assessed value of the property with timber exempt.

Nontimber Growing Values

Adjustment must be made for values not related to growing crops of timber. The value considered here is speculation. Speculation is defined as the act of buying land for the purpose of taking advantage of expected future price increases. Speculation may play a very large part in determining property value, or only an insignificant part.

The primary hypothesized factor affecting the influence of speculation on property value is location with respect to anticipated future land use changes. Speculation should be easily identifiable in many cases. For example, when immediate potential exists for converting forestland into a subdivision, speculation would surely be reflected in the market price. Speculation may be more difficult to discern in less extreme cases. For example, it could have some

effect on the value of forestland, where land use changes were not expected in the near future, but in the more distant future. For example, forestland in a predominantly rural area may be affected to the extent that buyers and sellers expect the land to shift to a higher use 20 or more years in the future.

Adjusting market value for speculation clearly presents a problem. Namely, identification of that part of market value, if any, attributable to speculation. When appraisal of a subject property is made using the market data approach, comparable sales must be used from the same general area. All sales from one general area would be expected to contain approximately the same amount of speculative value. This suggests an intercounty or statewide approach to assessment be implemented if possible.

It would be possible to implement a statewide approach, if adequate consideration could be given to factors that would make properties not from the same "neighborhood" dissimilar.

In making comparisons between properties, the similarity, or lack of similarity of these factors is considered: (1) size of tract, (2) volume of merchantable products, (3) timber grade, (4) species, (5) accessibility, (6) logging conditions, (7) proximity to market, (8) natural reproduction, (9) scrub (cull) incidence, (10) timber growing hazards, (11) site index, and (13) growth rate [43, p. 26].

The following factors can be disregarded, since standing timber is exempt from taxation: (1) volume of merchantable products, (2) timber grade, (3) species, (4) natural reproduction, (5) scrub (cull) incidence, and (6) growth rate. An assumption is made that timber growing hazards are similar throughout the state and can also be disregarded. Adjustment for, size of tract, accessibility, logging conditions, and site index would have to be made even between properties within the same "neighborhood".

It follows, then, that the only factor that would prevent comparison of properties at considerable distance from each other is proximity to markets. Analysis of market locations could be undertaken to provide adjustment factors for differences in value attributable to this factor.

A problem is created, however, when intercounty comparisons are made. Namely this is not common practice for the county assessor. For example, an assessor in Shelby County would probably not be familiar with forestland values in Claiborne County or vice versa.

This problem does not exist when only intracounty adjustments are made. However another problem is created. That is equalization between counties. In urban counties, some amount of speculation would probably be prevalent, even in the value of the most isolated properties.

Adjustment could be made by first making intracounty adjustments. Assessors in each county could throw out sales that were clearly influenced by speculation, and proceed with assessment as usual. Then, giving consideration to wood market locations an adjustment factor could be developed to apply to each county.

Delineating broad forest regions in the state would make comparisons between counties more relevant. The five forest survey regions would be a logical breakdown.

Application of the Adjustment Process

The adjustment process could be accomplished in the following manner: (1) The property is assessed in the normal manner, (2) Size class of the timber is determined, (3) The appropriate value of this timber is determined, (4) Timber value is subtracted from land value, (5) Land value is then adjusted, if necessary to reflect intracounty speculation, (6) The resulting value is adjusted to conform to regional forestland values.

Adjustment is primarily a mechanical process that can be applied in the office. The value of timber by stand size class will already be determined. Intercounty adjustment values will also be available.

Possibility of Implementation

Specific components of a market value adjustment approach have been discussed to illustrate the possibility

of implementing the approach. Other specifics could be worked out to implement this approach.

Implementation of the approach alone, however, does not mean it will be better than other approaches, or equitable. This approach is only an attempt to assess forestland on the basis of its present use.

III. "BARE-LAND PRODUCTIVITY" APPROACH

Introduction

The "bare-land" productivity approach is defined here as one in which land value is determined through the capitalization of anticipated net income, under the assumption that the present condition of the land is bare (59). This approach is not the same as the income method of appraisal. Use of the income method results in the same value for forestland of comparable income productivity, regardless of existing stand conditions because the land is assumed bare. When the income method of appraisal is used, each property is valued based on its actual condition.

The "bare-land" productivity approach, as defined here, is recommended because it appears to most nearly fulfill the present provisions of Tennessee law. The approach does not value existing standing timber on a property, so the exemption of timber, as required by law, is achieved. The value derived using this approach is based on the income

from timber production, so speculative value is not considered. Accepting the "bare-land" productivity approach as the most theoretically desirable direct approach to timberland assessment in Tennessee requires an examination of methods of implementation.

Implementation

Separating commercial and noncommercial timberland.

Only commercial forestland can be assessed by the "bare-land" productivity approach. Since the land is assumed bare when this approach is used, the definition of commercial forestland must be restricted to include only that land capable of producing net income when certain assumed management practices are applied.

Commercial timberland, then, is defined as that land capable of producing net income from timber production. The use of this definition creates two problems. The first concerns the actual process of differentiating between commercial and noncommercial timberland. The second is the determination of the method to be used in assessing non-commercial timberland.

Commercial timberland can be differentiated by the same method used to distinguish between productivity classes. Development of specific guidelines for differentiating commercial and noncommercial timberland is beyond the scope

of this study. However, since the application of the "bare-land" productivity approach requires development of productivity classes for land of varying productivity, land not included in the lowest productivity class could be designated noncommercial.

This definition of noncommercial timberland differs from the Forest Service definition of "unproductive" forestland. Their definition is "forest land incapable of yielding crops of industrial wood because of adverse site conditions" [35, p. 18]. The Forest Service definition of commercial forestland is "Forest land that is producing or capable of producing crops of industrial wood and not withdrawn from timber utilization" [35, p. 18]. Their definition does not require commercial forestland to be capable of producing a net return.

Those familiar with forestland in Tennessee should realize that a considerable amount of private noncommercial forestland probably exists in the state at the present time. It will be necessary to develop some method to value this land.

One logical method of assessment would be to assign noncommercial forestland a value below the lowest value assigned to commercial forestland. The assignment of value to noncommercial forestland can only be done by making the assumption that the value of this land is derived

from nontimber growing factors. Making this assumption would allow the land to remain on the tax rolls. The tax would be small and not excessively burdensome to the owner.

Determination of site quality. The determination of site quality is essential to the implementation of the income-capitalization approach. Site quality to a great extent determines the productive capacity of the land. Since this productive capacity is the basis for assessment it must be both known and quantified in some way. Though other factors, such as accessibility, influence the ultimate valuation process, allowance can be made for them once the productive capacity of the site is known.

"The most widely accepted method of evaluating site quality in the United States is the direct estimation of site index" [8, p. 37]. Site index is the height of dominant and codominant trees in a forest stand at some index age, usually 50 years. Site index is also expressed in terms of a given species and forest type.

"Site index is . . . related to yield tables to estimate . . . the yield of forest stands. . . ." [8, p. 37]. Usually these yield tables are expressed in increments. For example site index 70 may include the range 65 to 74.

The productive capacity, or site index of forestland will rarely change over time. Once site index is determined, only factors such as severe erosion, innundation, or

drainage of forestland could cause the need for reclassification. (20).

Direct measurement. Direct measurement refers to the actual determination of site index from field measurements. A sufficient number of field measurements are taken on each property to determine the site index or indices of that property. This method should provide reasonably accurate information on site index. It should be noted that any one property may have more than one site index or different portions or areas of that property. When this is the case a weighted average must be used.

The problem with using this method is the monumental amount of field work required. Measurement of site index on all private forestland in Tennessee, an estimated 11.5 million acres, would require considerable time and manpower.

A possible way to reduce the amount of field work is to determine site index on most areas of most ownerships by ocular estimation. Experienced personnel should be able to estimate site index in this manner on most areas. These estimates could be supplemented with direct measurements and field checks.

Soil series approach. Soil surveys can be used to estimate site index. In some of the later surveys

site-index averages for many of the soil series are listed (8, p. 42). In Tennessee soil surveys have been completed and published for 48 counties.

There are two factors that limit the usefulness of the soil series approach. The most obvious is the fact that surveys are only available for less than one-half the counties in Tennessee.

The other factor is the actual reliability of these surveys for estimating forest site quality. The older surveys gave little attention to nonagricultural land. In the more recent surveys in many cases ". . . interpretations are based on limited data or on the subjective opinions of soil scientists and local foresters" [8, p. 42].

An additional problem concerning reliability has been discovered in the form of ". . . excessive site variation within soil-taxonomic units" [8, p. 42].

Probably much of this site variation is related to certain soil and topographic features that vary widely within soil-taxonomic and soil-mapping units, but may not be well described in the definitions of these units. Such soil and topographic features include surface-soil depth, texture and stone content of the subsoil, slope position and steepness, slope shape, and aspect [8, pp. 42, 43].

Plant indicators. "Plant indicators are widely used in northern Europe and Canada" [8, p. 41]. Finland uses plant indicators to determine site quality for tax purposes. "However this method has received little attention in the United States" [8, p. 41].

Plant indicators may be useful in supplementing other methods of soil determination. The Forest Service has developed plant indicators for good upland hardwood sites (38). Further research may be helpful in determining plant indicators for other sites.

Soil site studies. Information gleaned from forest soil site studies may be useful in determination of site quality. Soil site studies provide ". . . information concerning the relationships between tree growth and features of tree environment including soil, climatic, and topographic features" [8, p. 43].

There are two main limitations in using information from these studies to determine site quality. The first is

. . . site-prediction tables developed from soil-site studies are applicable only to the particular area studied and further, to the particular soil and topographic conditions measured within the study area [8, p. 49].

The second limitation, which actually results from the first, is the dearth of soil site studies applicable to Tennessee. Published studies of hardwoods in Tennessee include, white oak, yellow poplar, cottonwood, willow oak, and cherrybark oak, in West Tennessee. A recent unpublished study has been completed on upland oaks on the Cumberland Plateau (39).

Results of other studies in adjacent states may be applicable to parts of Tennessee. However, additional

research will be needed before these results could be deemed applicable (8).

Classification by major forest types. The forest type that an area supports is an indication of the productivity of that area. It indicates productivity in two ways. One is the quality of the site. The other is the value of the timber produced.

The Forest Service recognizes eight major commercial forest types in Tennessee. They are grouped into three major physiographic site classifications. Table VI gives the estimated acreage in private ownership supporting each of these forest types. Table VII gives the total private and public acreage by type in each of the three broad site classifications.

Classification of forestland by forest type is complicated by the fact that these types can occur over a broad range of sites. The most prevalent type in Tennessee, oak-hickory, occurs on a very wide range of sites. The productivity of these sites vary considerably. The illustration from Chapter III, in which the yield of upland oak sites of 55 and 75 feet were compared demonstrated the effect site has on yields of the same type. Assuming no hardwood pulpwood markets or thinnings site index 55 land can only be expected to produce 900 merchantable board

TABLE VI
AREA OF PRIVATE TIMBERLAND BY FOREST TYPE,
TENNESSEE 1971

Type	Thousand Acres
Oak-hickory	8,348.4
Oak-pine	998.7
Loblolly-shortleaf pine	847.8
Cedar	653.9
Oak-gum-cypress	466.6
Elm-ash-cottonwood	140.4
Maple-beech-birch	60.8
White pine	17.0
All types	11,533.6

Source: Paul A. Murphy, 1972, Forest resources of Tennessee, United States Department of Agriculture Forest Service Resource Bull SO-35, p. 24.

TABLE VII

"COMMERCIAL" FORESTLAND BY FOREST TYPES AND
PHYSIOGRAPHIC SITES IN TENNESSEE, 1971

Forest Type	Site		
	Pine	Upland Hardwood	Bottom-land Hardwood
	Thousand Acres		
Oak-hickory	3,532.3	5,575.7	
Oak-pine	1,164.7		
Loblolly-shortleaf pine	998.8		
Cedar	188.3	483.7	21.8
Oak-gum-cypress			547.2
Elm-ash-cottonwood			150.7
Maple-beech-birch		84.4	
White pine	28.9	10.0	
All types	5,913.0	6,187.1	719.7

Source: Paul A. Murphy, 1972, Forest resources of Tennessee, United States Department of Agriculture Forest Service Resource Bull SO-35, p. 2.

feet per acre in 60 years; while site index 75 land can produce 9,288 board feet in the same time periods (15).

Approach to be implemented. The previous discussion has not produced any one entirely satisfactory method that can be used to determine site quality. Though all five approaches discussed have distinct limitations, at the present, these are probably the best methods available. A combination of methods would appear to be the most desirable approach to site determination at the present time. Carmean points out that ". . . all direct and indirect approaches to site evaluation are useful, and all of these methods are in reality complementary rather than contradictory" [8, p. 53].

The major effort now lies in developing an actual combination that can be used. The exact approach implemented will depend in part on the resources allotted to the task; and the findings of subsequent research in this area.

Employment of trained foresters to implement the site determination would provide some flexibility in the methods used. Sites could be evaluated in part from visual inspection, or in some cases, from soil surveys or aerial photographs. Foresters familiar with forest types, topography, forest site studies, plant indicators, and general site

quality, should be able to make reasonably accurate and rapid determinations of site quality.

Valuation of Site Classes

Williams and Canham recommended that a Forest Valuation Council be formed to affect the implementation and administration of a productivity approach to forestland valuation (8). They recommended broad representation consisting of the following groups: The State Tax Commission, the State Division of Forestry, the Forestry faculty of the State University, forest industry, and small-forest landowners (8).

The Forest Valuation Council could make decisions concerning factors affecting value, and more importantly to determine actual value. This council is also needed to keep valuations up to date as changes in factors affecting value occur.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. THE PROPERTY ASSESSMENT AND CLASSIFICATION

ACT OF 1973

The need to apply a new approach to the assessment and taxation of timberland in Tennessee was created by the passage of The Act. Prior to its passage timber was legally defined as realty which meant that its value was considered in the determination of taxable value. The Act exempted standing timber from the assessment process. It also provided for assessment based upon present use instead of "highest and best use".

II. THE PRODUCTIVITY APPROACHES

Four productivity approaches were examined to determine which, if any, could best be used to implement The Act. The approaches examined were: (a) the "bare-land" approach, (b) "sustained yield" approach, (c) "modified" approach, and (d) the market value adjustment approach.

III. TWO VARIATIONS OF THE PRODUCTIVITY APPROACH EXAMINED FOR APPLICATION IN TENNESSEE

Two variations of the productivity approach were studied for possible implementation in Tennessee. The two approaches were the market value adjustment approach and the "bare-land" productivity approach.

Market Value Adjustment Approach

The market value adjustment approach was developed to assess land productivity indirectly. Adjustment of market value is made by excluding that portion of value attributable to standing timber, and that portion attributable to speculation, if any, from the assessment process. This method can be implemented by adjusting the market data approach within an appraisal.

There are several limitations to the implementation of this approach. Probably the most serious is the actual determination of speculative value. In addition inter-county equalization may be difficult to achieve.

Bare-Land Productivity Approach

The "bare-land" productivity approach is theoretically more acceptable than the other approaches examined. It provides a direct method of determining the value of land in timber production. It also exempts standing timber from

the assessment process. This approach is most nearly like what is known as the income method in appraisal terminology.

Two primary limitations associated with the implementation of this approach are: (a) determination of site quality, and (b) the valuation of site classes once site quality is determined. Several ways these limitations could be overcome were discussed.

It is recommended that site quality determination be made by trained foresters, using a combination of available techniques. These techniques include: (a) direct measurement, (b) soil series, (c) plant indicators, (d) soil site research information, and (d) classification by major forest types. Site quality will rarely change, so determination will, in most instances, only have to be made once (20).

Yield by site class will be an important component in determining value. Yield is particularly important in the valuation of each site class with respect to other site classes. It may be possible to use Forest Service Survey data and available yield tables to determine yield by site class.

Valuation by site classes can be accomplished through a Forestry Valuation Council. Basic decisions such as stumpage price, management intensity and capitalization rate can be made by the Council, and updated as necessary.

IV. CONCLUSIONS

The present study has just touched on the area of valuation of timberland using the productivity approach. The actual valuation process to be implemented on a mass appraisal basis remains to be specified. Additional research is needed in this area of valuation. Determination of site is of particular importance. A rapid method is needed to fit the mass appraisal needs of tax assessment. In addition yield studies are needed to better estimate the expected value yield by site under prevalent management practices in Tennessee.

In conclusion it appears that the "bare-land" productivity approach is theoretically correct and the most desirable of the approaches examined; moreover, this approach can be implemented. Estimated values could be derived by a Forest Valuation Council using Forest Service Survey data and published yield tables. Values can then be changed as conditions dictate and additional information becomes available.

LITERATURE CITED

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LITERATURE CITED

1. Anonymous. 1967. The application of ad valorem taxes to forest land in Tennessee. *Keep Tenn Green J* 7(1):4-5, 12-13.
2. Anonymous. 1973. Society affairs. *J of Forest* 71(1):53-55.
3. Anonymous. 1972. State forest tax changes since 1967. *Timber Tax J* 8(1):139-253.
4. Barlowe, Ralieg. 1973. Use-value assessment: In retrospect. In *Era of Decision, Property Tax Issues in the Seventies--a Conference*. Southern Work Group on Real Property Taxation, Texas A&M University, 15 p.
5. Barlowe, Ralieg, James G. Ahl, and Gorden Bachman. 1973. Use value assessment legislation in the United States. *Land Econ* 49(2):206-212.
6. Boyer, P. B. 1931. Taxation of timber in Tennessee. Unpubl Report, U of Tenn, 30 p.
7. Brannen, Claude O. 1920. Taxation in Tennessee. The Baldwin Law Book Co, Louisville, 262 p.
8. Carmean, Willard H. 1970. Site quality for eastern hardwoods. In *The silviculture of oaks and associated species*: 36-56. US Dep Agr Forest Serv Res Pap NE-144, 66 p.
9. Cooper, Diana S., and Albert C. Worrell. 1971. Forest land as taxable property. *J of Forest* 69(7):400-406.
10. Davis, Kenneth P. 1966. Management: Regulation and valuation. McGraw-Hill Book Co., New York, 519 p.
11. Duerr, William A. 1957. Forest Taxation problems--How serious and for whom? *Proc Society of American foresters*, p 125-128.
12. _____. 1960. Fundamentals of forestry economics. McGraw-Hill Book Co., New York, 579 p.

13. Fairchild, Fred Rogers, and Associates. 1935. Forest taxation in the United States. US Dep Agr, Misc Publ 218, 681 p.
14. Fowler, Oscar S., and Garland R. Wells. 1973. Timberland taxation in Tennessee. Tenn Survey of Business 8(7):3-6.
15. Gingrich, Samuel F. 1971. Management of young and intermediate stands of upland hardwoods. US Dep Agr Forest Serv Res Pap NE-195, 26 p.
16. Hady, Thomas F. 1970. Differential taxation of farmland on the rural-urban fringe. Amer J Agr Econ 52:25-32.
17. Hall, R. Clifford. 1935. The forest tax problem and its solution summarized. US Dep Agr, Cir 358, 11 p.
18. Hagenstein, W. D. 1954. Trees and taxes. J of Forest 52(12):902-904.
19. Hargreaves, Leon A., and Richard W. Jones, 1972. Forest property taxation. Ga Forest Res Council, Rep 29, 27 p.
20. _____, Franklin Hitchcock, T. E. Avery, J. Reid Parker, and C. D. Clement. 1965. The property tax on forest lands in Georgia. Ga Forest Res Council, Rep 12, 64 p.
21. _____, Franklin Hitchcock, T. E. Avery, J. Reid Parker, J. T. May, and J. H. Bamping. 1965. Proposed assessment guide--Forest lands Georgia. Ga Forest Res Council, Rep 11, 24 p.
22. Hedlund, Arnold, and J. M. Earles. 1971. Forest statistics for Tennessee counties. US Dep Agr Forest Serv Resource Bull SO-32, 58 p.
23. Ike, Albert F. 1970. Species-site relationships for southern Appalachian hardwoods. In Proceedings of Symposium on Southern Appalachian Hardwoods. 23-44. US Dep Agr Forest Serv, Atlanta, 136 p.
24. _____, and C. D. Huppuch. 1968. Predicting tree height growth from soil and topographic site factors in the Georgia Blue Ridge Mountains. Ga Forest Res Council, Pap 54, 11 p.

25. King, David A. 1963. Forest land classification for property tax assessment purposes in Wisconsin. Land Econ 39(1):96-99.
26. The Knoxville Journal, April 14, 1973. Amendment could mean higher taxes. p. 1.
27. Lundgren, Allen L. 1971. Tables of compound-discount interest multipliers for evaluating forestry investments. US Dep Agr Forest Serv Res Pap NC-51, 142 p.
28. Manning, Glen H., and Emmet F. Thompson. 1969. Forestry property taxation: Another look. J of Forest 67(8):556-559.
29. Marquis, Ralph W. 1948. The relation of property taxes on forest land to the practice of forestry in Tennessee. Unpubl Rep to The Tax Revision Commission, 6 p.
30. McDonnell, Norman R. 1971. Recent developments in ad valorem timber taxation. Timber Tax J 7(1):12-24.
31. Milliken, William F. 1968. Forest taxation and the urban trend. Forest Farmer 28(2):18-19.
32. Miralles, Floyd. 1971. Effect of various tax systems on forest income. J of Forest 69(7):407-410.
33. Moore, Milton A. 1961. The taxation of timber properties in British Columbia. Proceedings Nat Tax Assoc, p 527-535.
34. Morgan, Cecil. 1956. Property assessment administration in Tennessee, 1955-56. Rep to the County Tax Assessment Subcommittee of the Legislative Council Committee, 135 p.
35. Murphy, Paul A. 1972. Forest resources of Tennessee. US Dep Agr Forest Serv Resource Bull SO-35, 33 p.
36. Porterfield, Richard Lee. 1971. The financial maturity of certain southern mixed hardwood stands. N.C. State U. School of Forest Resources Tech Rept 45, 49 p.
37. Ring, Alfred A., and Nelson L. North. 1967. Real estate principles and practices. Prentice-Hall Inc., Englewood Cliffs, 542 p.

38. Roach, Benjamin A., and Samuel F. Gingrich. 1968. Even-aged silviculture for upland central hardwoods. US Dep Agr, Agr Handbk 355, 39 p.
39. Rodriquez, Luis. 1973. Site evaluation of an upland hardwood forest in Scott County, Tennessee. Unpubl M.S. Thesis, U of Tenn, Knoxville, 70 p.
40. Schnur, Luther G. 1937. Yield stand and volume tables for even-aged upland oak forests. US Dep Agr Tech Bull 560, 85 p.
41. Senate Bill 384. 1973. Senate, State of Tennessee, 87 p.
42. Siegel, William C. 1964. Forest tax law at work. Forest Farmer 24(3):14-16.
43. Sizemore, William R. 1967. Gross income from forest farming as a basis for ad valorem taxation. Forest Farmer 26(13):6-8, 12.
44. Sizemore, William R., Mary H. Sizemore, A. M. Herrick, and L. A. Hargreaves Jr. 1965. Estimating fair market value of southern forest lands. Ga. Forest Res Council, Rep 15, 120 p.
45. Smith, R. C., and R. M. Mischon. 1965. Trends in forest taxes in south Missouri. Mo Agr Exp Stat Res Bull 883, 23 p.
46. Thompson, Emmet F., Glenn H. Manning, and Lawrence S. Davis. 1966. A review of Virginia's forest property tax. Va Agr Exp Stat Res Rep 111, 13 p.
47. Thorogood, James E. 1949. A financial history of Tennessee. Tenn Ind School, Nashville, 245 p.
48. Ticknor, W. D. 1970. Recent changes in Florida ad valorem taxes. Timber Tax J 6(1):121-130.
49. Trestrail, Richard W. 1969. Forest and the property tax-unsound accepted theory. Nat Tax J 22:347-356.
50. US Dep of Agr Soil Con Serv. 1964. Soil survey Williamson County Tennessee. US Govt Printing Off, Washington, 147 p.

51. Van Mol, John. 1972. Assessor's Manual. Correspondence between John Van Mol and officers and directors of Tenn Forest Assoc, 8 p.
52. Wells, Garland Ray. 1967. The comprehension and practice of forestry by private, nonindustrial forest owners in North Carolina. Unpubl Ph.D. Thesis. Duke U, Durham, 235 p.
53. Williams, Ellis T. 1957. Forest taxation: What can be accomplished by improving and modifying the property tax? Proc Society of American Foresters, p 130-133.
54. _____. 1961. Has the time come for a fresh look at forest taxation. Proc Nat Tax Assoc. p 516-527.
55. _____. 1970. Recent trends in property taxation. Timber Tax J 6(1):111-120.
56. _____. 1970. State guides for assessing forest land and timber. US Dep Agr Misc Publ 1061, 91 p.
57. _____. 1956. Tax assessment of forest land and timber shows improvement. J of Forest 54(3):172-176.
58. _____. 1961. Trends in forest taxation. Nat Tax J 14:113-143.
59. _____, and Hugh O. Canham. 1972. The productivity concept in forest taxation. Forest Science 18(1):3-20.
60. Winters, Robert K., and James G. Osborn. 1935. Growth and yield of second-growth red gum in fully stocked alluvial land in the South. US Dep Agr Forest Serv Occ Pap SO-54, 12 p.

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