The economics of hardwood management in the United States: 1950-1995, an annotated bibliography

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An Annotated Bibliography

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Introduction

This bibliography includes journal articles, published reports, conference proceedings articles, and academic theses and dissertations dated between 1950 and 1995 that concern economic aspects of managing hardwood tree species for timber production in the United States. The articles and reports were identified through keyword searches of computer databases available through the Mississippi State University computer system. Keywords used included individual species names as well as economic terms such as costs, returns, investment, and profit. The specific databases included the 1) USDA Agricultural Library - AGRICOLA CD-ROMs, 2) Colorado Alliance of Research Libraries System, 3) EBSCO Dissertation Abstracts, and 4) the Social Sciences in Forestry Bibliography maintained at the University of Minnesota Library. Additional references were acquired by examining the “literature cited” pages of the articles found through computer search.

The article summaries concentrate on study methods, silvicultural practices, financial evaluation criteria, geographic area, and other information to help readers evaluate an article’s potential usefulness. Study results are not summarized unless they would be a determining factor in judging an article’s potential usefulness. Articles that are not annotated were not available for review at the time of publication, but were included based upon keywords in the title or references from other papers. Also, some articles that do not specifically reference hardwoods or economics were included due to their usefulness in economic evaluation – examples include cost-shares and assistance, and economic analysis criteria.

A keyword index is included. The index is formatted by author, year, and reference number for a variety of topics.

This is not a comprehensive listing of all the articles dealing with the economics of hardwood management since 1950. The bibliography will be updated in the future, however. Suggestions for articles that were not included or articles published after 1995 may be directed to:

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KEYWORD INDEX

ALLEGHENY REGION
[Grisez, 1972 #172; McCauley, 1972 #299; Miller, 1984 #313; Miller, 1986 #322; Risbrudt, 1986 #360; Risbrudt, 1987 #359; Sarles, 1985 #368]

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[Baumgras, 1990 #18; Baumgras, 1992 #20; Burkle, 1952 #63; Campbell, 1987 #70; Campbell, 1987 #75; Countryman, 1989 #89; Dale, 1986 #96; Duerr, 1956 #113; Lancaster, 1975 #250; LeDoux, 1995 #266; May, 1992 #294; McGee, 1982 #303; Mills, 1988 #326; Risbrudt, 1986 #360; Risbrudt, 1987 #359; Starkey, 1989 #391; Utz, 1970 #420; Utz, 1981 #422; Webster, 1963 #434; White, 1988 #440; Worley, 1970 #447; Zahner, 1982 #451]
Article Summaries


Reviews the hardwood resource supply/demand situation in the United States using data from the latest Forest Service surveys. Discusses availability of and relative price changes for hardwood stumpage and uses the Southeastern Regional Timber Supply model to examine harvest increases of 1.5% per year for the next twenty years.


Details a procedure for determining optimal diameter distribution and optimal cutting schedule for an uneven-aged forest by using non-linear programming models that consider the interdependence of size classes in the stand table projections. An example is given for northern hardwood stands in Wisconsin where optimal stand structures are found that maximize value growth for a given basal area range, and a conversion cutting schedule that maximizes present net worth is determined.


Discusses optimal diameter distributions in selection forests as derived from the relationship of value growth and value of growing stock, and as derived from physical stocking. Gives an example of the differences between investment efficient and basal area efficient diameter distributions using northern hardwoods.


Discusses the major cost-share programs and technical assistance available for black walnut management. Considers the ACP, FIP, CRP, and Illinois and Nebraska state programs relative to black walnut management.


Discusses using a northern hardwood growth model and mathematical programming to determine optimal diameter distributions for uneven-age management. Gives optimal distributions, growth, and stocking data for northern hardwood uneven-age stand value maximization subject to different initial basal area constraints.


Discusses the application of non-linear programming with diameter-class and individual-tree northern hardwood growth models to derive diameter distributions and stocking that maximize net present value.


Discusses the role of economics in the management of hardwood land owned by Hammermill Paper Company.


Includes a discussion of marketing low value hardwoods in site conversion to pure pine.

Examine internal rate of return for cottonwood sawtimber plantations on three site classes at three stumpage price levels, six spacing intervals, and various establishment costs with all stands being thinned at least once.


Uses USDA Forest Service inventory data and the Automatic Interaction Detection technique to examine the influence of tree and stand characteristics on rates of value change in New England states timber stands. Stands were partitioned into 14 value change groups based on predictor variables of species composition, tree size, and stocking.


Uses linear programming to solve for aspen harvest scheduling for joint production of timber and ruffed grouse habitat. Grouse habitat was analyzed using habitat suitability indices and timber value was analyzed as soil expectation value.


Gives costs of pruning as a control for dutch elm disease in two Minnesota municipalities and compares pruning costs with those of removal.


Gives optimal investment efficient diameter distribution and land expectation value for northern hardwoods obtained using a northern hardwood mixed-species growth model and a Weibull distribution function. Assumes 5% interest rate, 5 year cutting cycle, and max dbh = 23 inches. Compares results with those of other studies.


Compares net present worth of three sanitation levels for controlling Dutch Elm Disease in Minneapolis, Minnesota over a ten year planning period. Includes calculations of cost per extra tree saved and sensitivity analysis for changes in tree loss rates, removal costs, and discount rate.


Discusses how and why Westvaco Corporation manages its hardwood forest lands, and also discusses some supply and demand issues in hardwood forest management.


Net present value was calculated for six simulated management options in even-aged upland oak stands (SI 70, 90-year rotation). OAKSIM was used to project growth and yield. Management options included no thinning and one to three thinnings at ages 30-70. Net revenue was estimated for 14 different marketing/utilization options with road costs, variable product prices, and landowner cash flow constraints considered.

Describes the programming and use of APTHIN, a computer program that calculates optimal product mix and maximum harvest revenues from Appalachian hardwood thinnings.


thinnings (SI 75 and 80) in central Appalachian hardwoods in terms of net revenue from a single harvest utilizing either a rubber tired skidder or skyline yarding system in which chain saw felling was used. Revenues are given for three price levels. Includes production rates, and basal area and volume harvested for each type of harvest.


The 18 H.P. Bitterroot Miniyarder was analyzed by time-study for production and cost in a clearcut operation in small (90% less than 10 inches dbh) Appalachian hardwoods. Costs are given in dollars per unit for 10% and 5% down-time (as a percent of scheduled time). Sensitivity analysis is done for volume per piece and volume per acre. The effect of a smaller crew size is also discussed.


The author suggests selection thinning as an alternative to diameter limit harvest to relieve the problem of low or negative returns from harvesting small trees. Compares yields from selection harvest in a yellow-poplar stand to those of a normal thinning from below.


Describes a slide rule with which interest rate earned and growth required to earn a certain interest rate can be determined for various size individual yellow-poplar trees in West Virginia.


Five thinning treatments for northern hardwood pole stands were evaluated in terms of productivity and cost. The treatments analyzed were strip, selection, strip-selection, and shelterwood thinnings with mechanical felling and skidding along with a selection thinning with chain saw felling, with all output chipped in-woods. Costs were estimated by treatment for the individual machines, and labor costs were included. Also included is a 'break-even' analysis considering two production output rates and profit based on the average output rate.


Describes the use of an econometric model, the Hardwood Assessment Market Model (HAMM), in projecting consumption, production, and prices of hardwood lumber and sawtimber stumpage under differing market conditions. Demand is derived for three grades of sawtimber in the model. Three simulations of the model are included.


Discusses the needs and challenges involved with the development of a hardwood stumpage sector supply/demand market model. Specifically, discusses general trends in outputs and prices of the final product industry sector, trends in hardwood ownership patterns, log quality and lumber price trends, and timber removal trends.

34. Blinn, C. R. 1983. The economics of integrating the harvesting and marketing of hardwood timber to achieve increased profitability. Ph.D. Dissertation, Virginia Polytechnic Institute and State University,
Technical Report


Analyzes profitability of five northern hardwood harvesting systems (described under Blinn et al., 1986) under three product sorting intensities (pulpwood only, upgraded, and fully integrated) and a whole tree chipping system with pulpwood-only harvest in terms of a profitability index. The profitability index was defined to be after-tax present value of net cash flows (35% tax rate, 15% discount rate) divided by initial capital investment. Also discusses stand characteristics affecting after-tax net present values.


Discusses investment analysis using the Central/Lake States versions of the TWIGS microcomputer growth program. Reviews investment analysis criteria (cash flows, present worth, equivalent annual income, soil expectation value, benefit cost ratio, internal rate of return, real vs. nominal analyses, risk) and gives an example of inputs, outputs, and sensitivity analysis using a mixed pine stand.


Discusses a study that examines (1) the profitability (as an index of present value of net cash flows divided by the initial capital investment) of multiproduct harvesting for five timber harvesting systems under three product sorting intensities, and (2) the impact of product sorting and various stand parameters on harvesting system profitability (as measured by after-tax net present value).


Uses the Harvesting Analysis Technique program to analyze profitability of simulated forwarding, manual fell-chain saw buck, manual fell-mechanized slash, mechanical fell-mechanized slash, and whole-tree chip clearcut harvesting systems under three product sorting intensities (pulpwood only; pulpwood, firewood, sawbolts, and pulpwood, firewood, sawbolts, sawlogs) in 13 aspen/mixed-hardwood stands in Virginia. A profitability index (after-tax present value divided by initial investment) was determined for each system/product sorting intensity (assuming a 5-year period, 35% tax rate, and 15% discount rate). Spearman correlation coefficients were calculated to determine the relationship of net present value of each system/intensity to various stand characteristics.


Details a methodology for appraising the multi-product value of hardwood timber stands. Gives estimated delivered product value per acre and per cord for six Lake States northern hardwood stands under four product sorting intensities (pulpwood, pulpwood and sawbolts, roundwood multi-product, and fully-integrated multi-product) assuming a market for all products.


Uses the Harvesting System Simulator computer program to estimate productivity and after-tax net present value per $100,000 initial investment and annual payroll for five harvesting systems and two product sorting intensities in 13 northern hardwood stands. The five systems are: 1) fell, limb, and buck with chain saw, load with attached loader and forward to landing; 2) fell and limb with saw, cable skid to landing, buck with saw; 3) fell and limb with saw, cable skid to landing, buck sawlogs with saw and other material with slasher; 4) fell and bunch with track type feller/buncher, limb with saw, grapple skid to landing, buck sawlogs with saw and other material with slasher; 5) fell and bunch with track type feller/buncher, grapple skid to landing, chip with whole tree chipper and blow chips into van.


Discusses the existing research on black walnut plantation economics and identifies what is needed to improve future studies.

General discussion of the economic considerations of managing and marketing hardwood timber for the nonindustrial forest owner.


Describes a methodology for designing economical group selection harvests in Appalachian hardwoods. The system uses a field computer to incorporate value growth percent, value, volume, and basal area of the group/plot with regeneration, wildlife, land class, and road location variables to determine the most profitable operation that accomplishes landowner objectives.


Uses corn silage production data to estimate production and harvest cost per acre for three different hybrid poplar clone plantations in central Pennsylvania under three planting densities, first rotation ages 2-4, and second rotation ages 1-4. Also gives costs and yields for four fertilization regimes applied to the least cost clone-rotation-spacing system. Assumes 6% interest rate, and all pertinent cost and production assumptions are given.


Reports on a study of eastern Oklahoma bottomland hardwoods to identify their ecological, wildlife, and economic values and importance; determine past, present, and future trends in area and management; identify areas needing special management; and analyze management alternatives. Includes a section on the economic value of game and furbearer harvest, timber products, and pecan production; and a section on the tax/economic incentives for bottomland hardwood management.


Computes and compares felling and skidding costs associated with three thinning levels (75%, 60%, and 45% residual stocking) in an immature central Appalachian mixed oak stand in West Virginia.


Presents stand-level value losses from delaying regeneration for five years in terms of soil expectation value, annual income, and present net worth for two sites at two interest rates. The species regenerated are not mentioned, nor are hardwoods. Also discusses value loss at the forest level for non-declining even-flow and declining-flow planning.


Discusses and suggests a plan for management of
Appalachian hardwoods for firewood and wildlife production. Compares this plan with clearcutting for fiber production in terms of present value (16% interest, 1982 prices, 60-year period, clearcutting revenue discounted back 60 years, before taxes).


Brief general discussion of hardwood supply and demand issues, with concentration on the lumber industry.


Develops a procedure for estimating economically optimal thinning regimes in even-aged mixed-species hardwoods using a stand table projection growth model and a non-linear programming optimization model. A non-linear programming method and heuristic random search methods were evaluated as solution techniques.


Costs are estimated for establishing oaks on old field sites in the South using direct seeding and planting. After-tax present values are then determined both with and without cost share assistance. These values are then compared in terms of marginal benefits versus marginal costs of planting. Estimates of rates of return for oak planting and seeding on CRP lands are also given.


Describes a non-linear programming model for determining optimal thinning and harvest for mixed-species stands. The model projects diameter class upgrowth and mortality as a function of site quality and stand density, and maximizes present value as the objective function.


Describes a non-linear integer programming approach that applies simple random and multistage random searches to estimate optimal thinning and rotation for even-aged, mixed-species hardwood stands.


Identifies and briefly summarizes state provided forestry cost-share programs. Discusses the general structure and funding of the programs.


Uses linear and non-linear programming techniques to examine the effect of selection management on tree-diameter diversity (measured by Shannon-Wiener index) and economic returns (measured by soil expectation value). Presents a case study utilizing northern hardwood data to determine the effect of cutting cycle and intensity on diversity and soil rent at a 3% real interest rate. Also details a method to compute the highest soil rent achievable for a specified level of tree-size diversity at 2%, 3%, and 4% real interest rates.


Details a matrix model of selection-managed forest growth using northern hardwood stand data. Uses linear programming to determine optimal (maximum net
present value) diameter class distributions for 5, 15, 25, and 35 year cutting cycles. Presents net present value for each cycle length for several levels of fixed-cost.


Uses Forest Service inventory data (1966 and 1984) and historical delivered log prices to determine volume growth rates of single hardwood trees by species, size, and grade for the maple-birch forest type in Wisconsin.


Uses factory lumber conversion surplus values to determine financial maturity of upland red oak, white oak, and yellow-poplar. Gives tables of rate of return by diameter, grade, log height, and vigor class. Discusses and gives examples of the effects of grade and merchantable height increases as well as the effect of competition on rate of return. Also gives rates of return for trees utilized as cross-ties and mine props using a lumber value index.

64. Callahan, J. C. 1966. Economic returns associated with fifty nonindustrial-private woodlands in Indiana. West Lafayette, Indiana, Purdue University, Agricultural Experiment Station, Research Bulletin 815. 16 pp.

Gives rate of return on investment and net per-year returns for 50 non-industrial private woodlands in Indiana with costs/returns/inventory studied over a 5 to 17-year period. Includes regression analysis of variables affecting returns.


Gives present net worth and internal rate of return of black walnut plantations for several tree spacing alternatives, land costs, weed control methods, pruning schedules, and interest rates. Includes sensitivity analysis for cost/return estimates and financial evaluation of several multi-cropping alternatives.


Discusses the effect of interplantings of black alder and autumn olive on black walnut growth, volume, and value in southern Illinois. Gives present values at 4%, 6%, and 8% real interest rates of both plantings for a range of rotation ages. The 18-year-old stands were projected to rotation age and values were derived as a function of diameter, grade, product, and volume.


Determines Land Expectation Value (LEV) for an even-aged management system for upland oak sites in southern Illinois. Comparisons were made for variations of the system including five or six thinnings and rotation ages from 60 to 100 years for three stands of varying site quality. LEVs were determined on a before- and after-tax basis. A sensitivity analysis is also included.


Examines 1960-1985 stumpage prices for Illinois hardwoods and assesses their usefulness as guides to future prices in terms of trends, levels, ranges, volatility, market timing, and species comparisons.

72. Campbell, R. A. 1951. Tree grades, yields and
Values for some Appalachian hardwoods. USDA Forest Service, Southeastern Forest Experiment Station, Station Paper 9. 26 pp.

Presents an individual tree grading system and incorporates it with derived factory lumber quality index values to determine tree values for 10 Appalachian hardwood species. The grading system is based on butt-log quality and the Bent Creek Experimental Forest grading system. Tree values (derived using 1950 price data) are presented graphically by dbh as lumber values per MBF. Tables of quality index values and lumber yields are presented by tree grade and diameter/merchantable height.


Uses 1947-1952 North Carolina data to determine logging costs for pine/hardwood harvesting in Appalachia. Costs are separated by felling/limbing/bucking, skidding, loading, and hauling. Total cost per MBF by tree size and method is reported.


Summarizes the results of four log and tree grading studies in second-growth yellow-poplar in North Carolina. Presents quality index tables and derives stumpage values by site class, tree size, and grade.


Determines before and after-tax land expectation values for regenerated upland hardwood stands in Illinois managed under an even-aged harvest system with two pre-commercial and two commercial thinnings. LEVs are given for a range of site classes, discount rates, and real rates of stumpage price appreciation. Takes into account state forestry incentives cost share and federal income tax adjustments. Sensitivity analysis is done for changes in site, discount rate, grade distribution, price assumptions, and species composition.


Gives individual tree economic maturity dbh values at a 3% desired interest rate for 13 Appalachian hardwood species by vigor class and number of logs in tree. Explains how to adjust the values for different desired interest rates and explains tree grades. Stumpage values were derived from the worth of #1 common lumber in the tree.


Uses the TWIGS growth model to calculate present net worth of a 47 year-old second growth northern hardwood stand at 4% and 8% interest rates and four price/product combinations with two thinning levels, 10 or 15 year thinning interval, and thinning from below or above with a clearcut in 30 years.


Briefly summarizes the Agricultural Conservation Program, Forestry Incentives Program, Conservation Reserve Program, Stewardship Incentive Program, and federal income tax incentives.


Opportunity costs, expressed as differences in before-tax Land Expectation Value, were estimated for establishing Streamside Management Zones (SMZs) on land that included 12,126 acres of hardwood forest in the Georgia Piedmont. These opportunity costs were estimated for five scenarios that included one in which hardwoods were kept on the site and sold for pulpwood on a 30-year rotation. This scenario was carried out for two cases - one where the SMZs were thinned every 30 years and one where the SMZs were not thinned.

Discusses a micro-computer program, YIELD-MS, that can be used to aid in hardwood stand management prescription decisions. The program incorporates several growth and yield models; can estimate stand value according to tree species, size, product, and grade; can estimate future cash flows; can calculate various financial criteria for investment analysis; and incorporates changes in tree grade as part of its projections. A demonstration trial of the program is given. The author also briefly discusses marketing opportunities for hardwoods.


Presents the value of a growth and yield model for New England oaks (Hibbs, D.E. and W.R. Bentley 1984) in terms of the difference in revenue from managing a stand under the guidelines produced from this model as opposed to managing the same stand under previously accepted guidelines.


Gives cost per MBF of grading and scaling/grading sawlogs for most major northern and Appalachian hardwood species. The time study experiment was done in the Appalachian mountain region, and costs are given by scaling and grading location (i.e. in the woods or at the mill), log size, crew size, and species.


Discusses future demand and supply of hardwood timber and some factors that may affect the supply and demand relationships.


Compares wide spaced (no competition) and narrow spaced (competing) even-aged cherrybark oak in terms of discounted lumber values at different real interest rates and rotation ages. Further analysis is done for potential cherrybark oak price increases and alternative land uses with known soil expectation values.


Discusses the factors motivating small landowners to invest in timber management and builds a case for using rate of return as an indicator of investment success.


Computes combined timber and land expectation value assuming a 60-year rotation and 4% real discount rate for oak clearcutting, underplanting, and shelterwood management and selection management of sugar maple in Iowa and Missouri as governed by a myriad of combinations of initial stand values, silvicultural costs, and harvest revenues.


Discusses utilization of the hardwood resources of the Georgia mountains for firewood. Presents costs of harvesting small hardwoods with a small skidder and skyline-yarder from time-study data.


Evaluates typical southern pine and hardwood harvesting systems in terms of logging cost as a function of tract size, tree diameter, species composition, and volume per acre.


Discusses biological and financial rotation age of aspen in Michigan. Explains in detail how to determine financial rotation using growth rates and an alternative interest rate.


Details the valuation of oak species, hickory, and yellow-poplar in the Tennessee Valley through the use of butt log tree grades and tree vigor classes. Explains stumpage value derivation through lumber value and conversion costs and discusses stumpage value differentials for rate of value change comparisons. Gives example applications of stand inventory and cut/leave appraisal, and discusses hardwood stand management through volume regulation.


Uses the OAKSIM growth and yield simulator to project the effects of thinning upland oak stands in the Appalachians. Base stands were 30 years old with a black oak site index of 60 and 80. Gives volume and dollar value yields for various combinations of thinning to 40%, 60%, or 75% stocking at ages 30-70 on 80- and 120-year rotations. Dollar values were adjusted with thinning intensity, and thinning revenues were compounded at 4% interest.


Evaluates the FORET community dynamics model in terms of its accuracy of predicting ecological parameters to be input into an economic prediction model for evaluating eastern hardwood management. Data were from Vermont for a 300-year simulation of 30.5 centimeter diameter-limit cuts on a 60-year rotation.


Discusses value growth rates of western Massachusetts hardwoods in relation to volume, grade, and market value changes. Provides a table of theoretical real annual value growth rates for major species during the 1979-1989 period that accounts for risk and carrying/operating expenses.


Provides updated (from 1976) tree value conversion standards for twelve major hardwood species of the oak-hickory forest type, that were derived using updated conversion cost and price values. The tree value...
conversion standard is the dollar value of a tree based on the quantity and quality of 4/4 lumber that can be extracted from the tree. Value tables are given for each species by butt-log grade, merchantable height, and diameter. Also discusses changes/differences from the 1976 values.


Details a stand valuation technique that uses individual tree values to determine hardwood stand value. An example is given for a second growth oak-hickory sawtimber stand. Individual tree value is determined (through "tree value conversion standards for hardwood sawtimber" and "composite volume and value tables for hardwood pulpwood") by species, dbh, merchantable height, and butt-log grade and added together to get stand value. Ten-year projected stand values are determined in the same way by utilizing vigor class to project individual tree values. Comparisons are made in terms of basal area, volume, value, and rate of value increase for cutting alternatives of harvest now, let grow, thinning, selection, high-grade, and low-grade.


Gives volume and value tables for hardwood pulpwood in standing trees by dbh and merchantable height. Values are given for various stumpage prices of $1 to $25 per cord. Examples are included of using the tables for valuation of pulpwood size trees and the pulpwood portion of sawtimber trees.


Explains the derivation of and gives rates of value increase and financial maturity diameters for ten species common to the oak-hickory forest type. The economic principles involved are explained for individual trees as well as stands.


Gives nominal and real rates of value change from 1973-1983 for unmanaged oak/hickory, maple/beech/birch, and aspen/birch forest types and two unmanaged softwood forest types in New Hampshire. Also, regression analysis was used to try to determine relationships between real value change and stand characteristics.


Discusses the effect of long-term real stumpage price changes on the optimal rotation age and land expectation value of forest stands. Gives real and nominal annual rates of stumpage price change for several hardwood species in New Hampshire over the period 1964-1983. Also briefly discusses the effect of time value of money and short term price changes on harvest decisions.


Describes Vermont's Use Value Appraisal property tax program with respect to tax relief for forest landowners. Also discusses an econometric model used to determine probability of enrollment in the program.


Gives ten to twenty year trends for volume harvested from private and public lands, stumpage prices, and factors that influenced demand and supply for hardwood stumpage in the southern Appalachian region.


Describes the economic forces affecting California's hardwood resource. These forces include demand for hardwood products, land management activities, and land-use conversion.


Gives volumes and values of dead oak for 23 salvage sale areas on the Tuscarora State Forest and 16 salvage sale areas on adjacent public and private holdings in Pennsylvania. A chart shows the comparison of dead oak values to live oak values.


Compares present net worth for three real discount rates (4.0, 7.125, and 10.0) of light, moderate, and no thinning practices for two rotation ages (60 and 80 years) and two thinning initiation ages (20 and 40 years) for black oak stands in the Missouri Ozarks. Stand data was from 72 one-half acre experimental plots with future growth estimates from derived predictive equations. Includes sensitivity analysis for changes in thinning costs and stumpage prices.


Discusses factors affecting historical and future supply/demand of hardwoods and gives a brief commentary on world, eastern U.S., and northeastern U.S. hardwood production and importance.


Uses the premise of marginal cost equal to marginal revenue to determine the optimal stocking of a forest managed under the selection system. Optimal stocking is defined as that which yields the greatest net return and is determined at the point where marginal value growth equals the alternative rate of return. This point is then derived for a simulated loblolly/shortleaf pine stand by plotting current value growth over value of growing stock to determine marginal value growth. Does not directly refer to hardwoods, but the article is one of the pioneer references on financial maturity.


Comprehensive coverage of financial maturity of timber with financial maturity guides included. The method is based on loblolly pine, but is also carried out for bottomland red oaks and sweetgum, upland oaks, and yellow-poplar. Also compares financial maturity and soil rent concepts.


General discussion of the biological/economic advantages/disadvantages and growth/costs/returns of cottonwood plantations.


Estimates rate of return of both pulpwood and sawtimber rotation cottonwood plantations under
The author identifies cost assumptions and also discusses the inclusion of revenue from combined cottonwood/agricultural crop production.

Present net worth, equivalent annual income, benefit/cost ratio, and internal rate of return were calculated using an 8% discount rate for each of five rotation ages and four spacing arrangements for short rotation sycamore. The author discusses profitability for non-industrial and industrial landowners, sensitivity of profits to stumpage prices, optimal number of coppice crops, profit from genetic improvement, and profit as compared to agricultural crops.

Evaluates five thinning and pruning treatments in 30-year-old scarlet/black oak stands in terms of net present value. The STUMP model was used to predict value changes over time and TWIGS was used for growth projection. Linear programming was used to determine management regimes that maximize net present value of four hypothetical stands.


Compares thinning treatments in 5-year-old oak stands in Missouri in terms of present net worth. Treatments were no thin, thin all clumps, and thin 100, 150, 200, or 250 clumps per acre to a single stem. Computer growth simulation was used to project stands to harvest age (from age 21). Present net worth was computed for rotation ages of 60 and 70 years, 3% and 5% interest rates, and medium and high stumpage prices.

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Discusses the eastern hardwood resource and programs that are or could be directed at the promotion of management and use of this resource.


Presents 15-year basal area, diameter, and cubic, cord, and board foot volume growth along with stocking, mortality, ingrowth, and stand structure changes in second growth northern hardwoods that were cut under one of three selection levels, a croptree release, or an 8-inch diameter limit. Briefly discusses stumpage returns, but has no other economic information.


Provides a financial analysis of eight cutting methods for northern hardwoods in terms of lumber grade yields. Cutting methods included diameter limit, single tree selection, and light improvement cuts. The analysis included total discounted returns, managed forest value, and present worth for each of the harvest types.


Gives total revenues, discounted revenues, managed forest value, and present worth at 2%, 4%, and 6% interest rates using both historical regional and constant prices for 32 years of light improvement cuts, four diameter-limit intensities (22, 16, 12, and 5 in.), and three selection intensities (90, 70, and 50 ft²) in Michigan hardwoods.


Describes the use of and presents the advantages and disadvantages of linear programming as a tool for forest management planning. Gives an example of LP usage in harvest scheduling.


Gives net present worth and internal rate of return at 3%, 5%, 8%, and 10% interest rates of pruning 33 year-old oak stands in Butler County, Missouri under 60, 70, 80, and 90 year rotations. Three pruning regimes were used: A - all costs included, all trees pruned; B - labor costs excluded, all trees pruned; and C - all costs included, 100 trees/acre pruned. Computer simulation was used to calculate rotation age volumes, and an annual real stumpage appreciation of 1% was assumed.
Also includes an estimate of stumpage price per MBF needed to cover the cost of pruning.


Discusses the forest resource in the Missouri Ozarks and its management, timber yields, available product markets, and potential costs/returns. Gives future net value (at 3% interest) of managed and unmanaged stands of oak and pine for various levels of cost, site quality, stocking, stumpage price, and years to harvest. Includes a section that explains practical application to a specific tract.


Gives treatment cost of and stand value increase/decrease resulting from red oak borer control in six stands in the Hoosier National Forest of Indiana.


Derives internal rate of return and net present value (10%) of four hybrid poplar intensive culture systems (4x4 and 8x8 spacing, with/without irrigation-fertilization) from research data. Discusses risks and uncertainties, irrigation and fertilization, short and long rotations, and economics of scale as they affect the investment.


Gives net present value of 72 management variations for black walnut plantations in the Central hardwood region. Variations are hand/machine planting of nuts at 10x10/7x7/4x4 spacing with/without a thinning/pruning regime where harvest age maximizes net present value on 40/60/80 site index lands.


Discusses the types of property taxation and their individual effects on the management and profitability of hardwoods. Gives an example of the effect of the different types of taxes on internal rate of return for a 40-acre hardwood parcel in Maine.


Costs and returns per cunit of output are estimated from time study data for four cutting methods — selection, patch, diameter-limit, and clearcut — in beech-birch-maple stands in New England. All harvests utilized chain saw felling, crawler tractor skidding, and multiproduct bucking. Average local costs and prices were used, and the cost of marking in selection and patch cuts was not included in the analysis.


Gives costs and returns (in dollars per cord) from four selection harvests spaced at 2-year intervals (1952-58) in a 37-acre second-growth and a 43-acre old-growth stand on the Bartlett Experimental Forest. Gives costs/returns for 1) owner doing all work, 2) harvesting labor hired, owner marking, and 3) owner marks and sells stumpage.


Explains and diagrams felling and bucking recommendations for maximizing volume and value in hardwood timber harvests.


Natural, direct seeded, and plantation stands of pure pine and hardwood and mixed pine-hardwood are compared in terms of internal rate of return and annual equivalent value. Yields were derived from microcomputer simulation using five different stand establishment scenarios with and without thinning. Economic analysis was accomplished using the Quicksilver program and average values for the Piedmont and Coastal Plain.


Describes the bucking decision simulator program HW-BUCK, that can be used as a training tool for increased value recovery from northern hardwood sawlogs and veneer logs. Discusses approaches to improve bucking value recovery from hardwoods.


Discusses supply/demand issues in black walnut management, with special emphasis on log quality.


Uses Forest Service inventory data and tree-value conversion standards to determine average rates of value change for New England trees by species, diameter class, Forest Service tree class, and stand stocking level. Uses automatic interaction detection analysis to determine tree and stand variables that influence value change rates. A guide is developed from this information for predicting individual tree value change by the four above mentioned variables.


Uses data collected from 600 plots in central Pennsylvania from 1978 to 1985 and tree-value conversion standards to determine loss in timber value and compound annual rate of value change of species susceptible to gypsy moth defoliation. Gives a table of value loss and rate of value change by percentage tree defoliation (average for 1980-1982) as well as the average values for all trees in the study. Approximates the benefits of control measures by estimating net loss attributable to the gypsy moth by subtracting the values for the least impacted trees from the average.

154. Gansner, D. A. and O. W. Herrick. 1987. Using timber stand and tree characteristics to estimate rates...

Explains the process of determining rates of value change in hardwood timber from Forest Service inventory data and gives rates of value change for hardwood timber in Pennsylvania by species, stocking density, initial value, and tree and site quality for the period 1965-78. Also explains how to use basal area growth to determine very short run rates of value change.


Gives hardwood timber value growth rates in Maine, by species, for the period 1971-82. Valuers for hardwood sawtimber were based on tree-value conversion standards, and cordwood values were based on local stumpage price levels.


Compares rate of return on investment from hardwood stands managed for pulpwood production in southeastern Ohio for a range of stumpage price levels, management cost levels, and site indices.


Gives a brief discussion of investment analysis components (costs, returns, compound interest) and gives a general discussion of the effect of species composition, stand structure, site quality, products, product value, and non-timber benefits on hardwood management decisions.


Gives costs/returns and derives internal rate of return and present net worth for four black walnut multicropping options (timber/grazing to timber/grazing/soybeans/wheat/fescue) – each under various site quality, growth, thinning, and rotation assumptions.


Financially examines four black walnut multicropping management options in Missouri involving wood and nut production, soybeans and winter wheat, fescue seed and hay, and grazing. Least intensive is wood/nut production with grazing; most intensive includes all. Timber evaluation is for two site index values, three rotation lengths, two growth rates, and precommercial or precommercial and commercial thinning. Financial evaluation involves internal rate of return and present net worth.


Details a linear complementarity (linear programming) model to determine long-run optimal harvesting of short-rotation intensive culture plantations. The model is then applied to a hypothetical mixed poplar/alder plantation under a nitrogen depletion constraint to determine optimal rotations holding either discount rate or biomass market value constant. Extending the model for fertilization, mortality, and other factors and their interactions is discussed.


Gives a table of financial maturity diameters at 2%, 4%, and 6% interest considering butt log grade, diameter
growth, height increase, and grade increase.


Current and expected (10 year) tree values for sawtimber-size sugar maple in the Lake States were determined for three different 10 year growth rates and are presented in tabular form. These values were determined from the amount and quality of lumber that can be sawn from the tree.


Provides a model that uses a Weibull probability function and bootstrap sampling to avoid stochastic growth equation problems in the determination of optimal stand structure in uneven-aged northern hardwoods.


Discusses prior work developed to model optimal uneven-aged diameter distributions in northern hardwoods. Examines the non-linear optimization model developed by Martin (1982) by a method utilizing nonparametric bootstrap and multivariate normal theory methods to determine approximate 95% confidence statements on the decision variables and their functions.


Uses RMYLD (computer program) aspen yield tables combined with a forage production model to perform economic analysis of timber/forage production in Rocky Mountain aspen stands. Has an example of a model run for cattle/timber and sheep/timber that gives present net worth and rate of return for harvest ages of 30-120 years. Includes a sensitivity analysis for the inclusion of thinning, increased animal month revenues, discount rate change, and site productivity change.


Discusses the application of financial maturity and details the steps for determining it for Allegheny Plateau black cherry, red maple, and white ash. Gives expected rates of value increase by species due to growth only and growth/quality increase. Provides tables with ten-year value increase by diameter, grade, height, and vigor class.


Discusses the components of an interest rate and defines and discusses the use of net present value and internal rate of return. Has examples of marginal analysis for TSI in northern hardwoods and thinning in red pine. After-tax analysis is explained in the red pine example.


Presents and describes a numerical example of the calculation of after-tax real rate of return for hardwood timberland. Also explains how to compare the results.
with other investments, such as certificates of deposit.


Identifies the steps involved in financial analysis of hardwood timberland, and discusses the investment criteria of net present value, rate of return, benefit/cost ratio, and annual equivalent income. Financial analysis is applied to an example tract.


Describes a computer program that estimates the growth and present value of individual black walnut trees from field data for projection periods of up to 20 years. Consideration is given to present diameter and height, competition, site quality, and sawlog/veneer log specifications in the growth/value determinations and present value is determined for a user-defined interest rate. Use requires knowledge of point sampling, tree measurements, and site index determination.


Explains the determination of financial maturity of a single tree in terms of rates of value increase by vigor class with value determined by lumber conversion surplus. The system considers changes in grade and the effect of adjacent trees. Includes a simplified financial maturity marking guide for bottomland red oaks and sweetgum under three vigor classes and three common alternative rates of return.


Presents and compares optimality conditions for solutions (diameter distributions that maximize net present value) to dynamic and static programming models of uneven-aged forest management. Compares dynamically and statically derived harvest regimes for northern hardwoods managed on a five year cutting cycle in terms of land expectation value.


Rates Douglas-fir/red alder management regimes in terms of expected present value on a range of Douglas-fir site indices. Management options include site prepare/plant Douglas-fir/herbicide/animal control, planting only, and natural regeneration – leaving or removing red alder at year 15 - no commercial Douglas fir thinning or thinning in increments of 50 trees/acre – and a range of rotation ages. Expected present values are given for several Douglas-fir regeneration success rates and varying Douglas-fir/red alder prices.


Presents a gradient-based non-linear programming technique for estimating the optimal sequence of diameter distributions and selection harvests in uneven-aged stands. The technique is illustrated using a northern hardwood diameter-class simulation model (Adams and Ek, 1974) and maximum present net worth is found assuming 5-year harvest interval, 150-year planning period, 4% interest rate, and three diameter/stumpage relationships. These are 1) increasing value from 12-20 inches, 2) increasing value in all sizes, and 3) value constant in all sizes.


Describes a rule-based expert system for personal computers for determining stumpage value of individual trees in Appalachian hardwood stands. Incorporates quality, market location, logging costs, and harvest intensity into the value determination. The program includes a logging cost estimator that uses felling, skidding, bucking, loading, hauling, and road variable inputs to determine costs.


Describes and reviews, in terms of advantages and limitations, published work on diameter distribution guides, uneven-aged stand simulation models, and models combined with optimization techniques – with emphasis on the author's own work. Includes some discussion of financial maturity and other economic considerations.


Presents net present value of 20-year rotation paulownia plantations under fixed prices and costs for two yield levels and 5% and 10% discount rates. Includes tables of practices and associated costs. Also discusses future demand for paulownia and gives prices and total U.S. acreage at which plantations would become uneconomical.


Presents volume and value loss in black walnut due to decay for 920 trees in 37 separate sale units in Nebraska, Iowa, Kansas, Minnesota, and Wisconsin. Also gives probable causes of decay and guidelines for reducing decay.


Evaluates two short rotation poplar harvesting systems for pulp chip production in Oregon – a skidder system and a cable yarder system. Gives cost estimates for skidding, yarding, and flailing/chipping.


Calculates before-tax and after-tax net present value, internal rate of return, composite rate of return, annual equivalent value, benefit/cost ratio, and soil expectation value for growing black walnut timber on a site index 75 plantation in the South using several different interest rates. Includes yield and cost/return information.


Discusses trends in demand, supply, and price of hardwoods in the U.S. projected to the year 2030.


Gives production data and cost per cunit for eight pulpwood/chip harvesting systems in Lake States hardwoods using both new and used equipment. Systems were variations of whole-tree chipping, tree-length logging, and mechanized fell/manual buck harvesting.


Analyzes the effect of service forester assistance on physical harvest conditions and harvest returns in aspen timber sales in Minnesota. Compares returns with those of no assistance and consulting forester assistance. Also discusses the economic worth of the program to the state.


Describes the use of YIELD-MS, a micro-computer growth and yield model for mixed-species forests. The program can calculate before- and after-tax net present worth, internal rate of return, composite rate of return, annual equivalent value, benefit/cost ratio, and soil expectation value using both real and inflated interest rates. The program can also produce before- and after-tax cash flow streams.


Reports on a study that compares soil expectation values for one hardwood and three pine regeneration options for a Cumberland Plateau site. Computer simulation was used to estimate growth of existing stands in which no thinning takes place, and financial evaluation was done using the YIELDplus program.


Shows how price relatives are used in place of dollar values to determine a quality index, that expresses the value of the lumber in a log or a tree as a percentage of the value of an equal volume of lumber of the reference grade. Explains the use of the quality index in determining lumber grade yields from sawlogs, and the use of tree grades and their corresponding quality indexes to determine conversion surplus for stumpage appraisal. Gives applications of hardwood timber appraisal using the quality index and conversion surplus with Indiana stand data. Also gives an economic marking guide that uses conversion surplus as a base, and gives an example of the guide using different growth rates and species.


Estimates the value of whole-tree chipping in northern U.S. hardwoods as the difference between supply schedules for hardwood pulpwood harvested in 1979 on a post- and pre-whole-tree chipping basis.


Ranks investment options for thinning/timber stand improvement and site conversion to pine in Virginia/West Virginia oak forests by internal rate of return. Treatments were assigned by "common practice, management guides, and research" to stands by the modal conditions of three site quality levels, four average dbh classes, ten 20-year age classes, nine 20 ft² basal area classes, and growing stock level. Internal rates of return are given by stand-site class as well as market availability (sawtimber only or sawtimber and pulpwood) and cost-return options (avg. cost-avg. return, low cost-high return, and high cost-low return). Discusses the interaction of stand characteristics with investment, the effect of opportunity costs, and the limitations of the rate of return estimates. Describes the procedures used in the analysis as well as an appendix of stand characteristics and cost/returns associated with each treatment/stand-site class combination.


Uses Forest Service inventory data (1965 and 1978) to determine rate of value change for hardwood timber stands in Pennsylvania. Has a simplified guide for estimating rate of value change.


Estimates hardwood tree value growth rates in Pennsylvania for the period 1965-78. Based on tree-value conversion standards and values of diameter, merchantable height, and quality changes from the 1965 and 1978 Forest Service surveys.


Benefit/cost analysis of chemical control of the gypsy moth in West Virginia and Maryland for several
hardwood species composition scenarios. Gives break-even spray cost for each scenario.


Briefly describes the OAKSIM program for mainframe and Data General computers. Uses OAKSIM output and average delivered log prices in Ohio to determine the rates of return of four thinning intensities (100, 75, 60, and 40% residual BA) in a 30-year-old, site index 70 stand. Gives management guidelines derived from the study.


Describes wood procurement procedures and criteria for Proctor and Gamble's Mehoopany, Pennsylvania Division - a hardwood only pulp and paper operation.


Uses various southern yield data for financial comparison of plantation and natural stands of hardwoods on high and medium quality sites. The soil rent formula is used to compare natural hardwood stand management to plantation management of sycamore and yellow-poplar, before and after taxes. The author uses compound interest methodology to compare the cost per unit volume of natural stands vs. sycamore plantations, and then determines the precommercial treatment cost allowed in natural stands to equate after-tax cost of wood with that of plantations.


Compares the concepts of financial maturity and maximization of present value as they apply to the "average" white oak crop tree and veneer tree in Indiana.


Discusses supply, demand, and price interactions for oaks in the eastern U.S. Gives tables of average real annual compound rate of price change for hardwood lumber and delivered logs in Indiana from 1948-1983. Discusses relative scarcity of different hardwood species, oak market trends, and the supply/demand outlook for oak to the year 2020.


Briefly discusses industrial and non-industrial timberland financial decision making environments, alternative investment criteria, and reasons for using financial criteria in the decision process. Explains and gives formulas for net present value, internal rate of return, and soil expectation value. Gives very brief
discussion of portfolio analysis, inflation adjusted financial evaluation, and after tax financial evaluation. Includes an extensive appendix of compound interest formulas with numerical examples that involve hardwood timberland.


Brief discussion of black walnut investment characteristics and opportunities. Gives a good summary of federal income tax treatment of timber investments.


General discussion of investments in hardwood timber. Briefly discusses timber investment attributes such as cost minimization and tax considerations.


Discusses increasing profitability of hardwood forest management through proper inventory, utilization, and marketing; protection from abusive cutting, fire, and grazing; and setting volume and product production goals based on site quality.


Uses time-series data as a basis for productivity and operating cost estimation for five small tractors for thinning hardwoods under varying stand conditions and production variables (volume per turn, number of logs per turn, volume per log, slope yarding distance). Tractors studied were from Pasquali, Forest Ant, Massey-Ferguson, Holder, and Same.


Gives cost of thinning pole-size northern hardwoods with a whole-tree chip system incorporating a feller buncher, two grapple skidders, and a 22-inch chipper. Costs are given as dollars per green ton for production and transportation.


Provides an argument for growing high-quality hardwoods in the eastern region. Gives legitimacy to the argument through the discussion of broad perspective economic, biological, and social factors affecting hardwood forestry.


Discusses the factors affecting demand for and supply of hardwoods in the northern United States.


Presents the results of a mail questionnaire of forest product industries and logging contractors in the South Delta region of Louisiana. The questionnaire contained 55 factors related to harvesting costs for hardwood in the region. A table is given showing the relative importance of each factor.


Gives costs of strip-selection thinning in pole-size northern hardwoods in Michigan with a long-reach feller buncher. Also discusses whole-tree chip production, stand damage, and soil compaction.


Discusses the economic potential of short rotation intensive culture hybrid poplar production in Minnesota. Focuses on production for energy, but includes a section on wood products.


Discusses a model that determines optimal economic harvest decisions from the state of the stand and the price of products at the time of stand examination. Also briefly discusses the economic effects of applying the model, and compares the model to previous harvesting guides. Lastly, the authors examine the effects of changing the economic and biological assumptions of the guide.


Derives and presents economically optimal harvesting policies and expected stand values for northern hardwood stands in Wisconsin using 3% and 5% interest rates. A transition matrix was used to predict future stand and market conditions from existing basal area and price data; a method of successive approximations was then used to find a harvest strategy that would maximize net discounted value of returns. Includes sensitivity analysis for effects of changes in discount rate, fixed costs, and transition probabilities.


Describes a computer program that determines net present value of various thinning-from-below regimes in existing pole or sawtimber size bottomland hardwood stands. Data needed for analysis are stand structure, growth factors, and current and expected future prices.


Discusses hardwood plantation and natural stand establishment and management practices. Gives average costs of establishment for plantations and natural stands and briefly discusses the relative merits of each.


Discusses factors affecting supply and demand for hardwoods. Specifically discusses past resource trends, technological advances, and plantation and natural stand management.


Compares three natural stand management alternatives to plantation management of sweetgum in terms of after-tax present value and internal rate of return. Residual control after harvest was also considered in the analysis.

Outlines general management techniques for improved quality of bottomland hardwood stands. No direct discussion of economics.


A computer model was developed that uses regression models and volume formulas to determine present and future volumes, growth, and economic values of natural timber stands in Mississippi based on sample tree and stand measurements.


Evaluates the effects of transportation costs and price differences between hardwood pulpwood and sawlogs on merchandising and hauling decisions for hardwoods in the Alabama-Mississippi-Tennessee region. A model is developed to help in merchandising and transportation decisions based on cost, price, and haul distance and payload variables.


Introduces a model developed to assist in evaluating the effect of transportation costs and price differences between hardwood sawlogs and pulpwood on merchandising and hauling decisions. The break-even model is designed for individual loads of hardwood sawlog/pulpwood material in the Mississippi-Alabama-Tennessee region.


Presents internal rate of return and present net worth of four different multicropping options and a timber-only option for black walnut plantations on medium and high quality sites. Includes a table of management activities with associated costs and revenues.


Identifies inhibitors to the economical management of non-industrial, privately owned hardwood forests and gives suggestions for encouraging management on these lands.


Discusses market and deflated lumber and stumpage price trends in Appalachian and Northern markets for eight eastern hardwood species for the period 1964-1985.


Describes a marketing center designed to provide selling opportunities for low-quality hardwoods. A spreadsheet template is developed to aid in feasibility analysis and business planning. The template provides income statements, cash flows, balance sheets, sales projections, and direct/indirect cost statements.

Identities and briefly discusses private and public technical assistance, federal and state financial incentive programs, and property tax incentives available for hardwood management in Iowa, Wisconsin, and Minnesota.


Gives the results of a survey of buyers and users of red and white oak in the Mountain and Piedmont regions of North and South Carolina and Virginia. Information gathered by the survey includes the price paid for various log grades, demand for prime grades, and interest in establishing landowner assistance programs to ensure better grades of oak.


Gives the results of a survey of buyers and users of red and white oak in the Mountain and Piedmont regions of North and South Carolina and Virginia. Information gathered by the survey includes the price paid for various log grades, demand for prime grades, and interest in establishing landowner assistance programs to ensure better grades of oak.


Gives results of a telephone survey of 15 veneer mills and 6 sawmills that use yellow-poplar from the Piedmont area of North Carolina. Information gathered included (1) definition and cost of each grade, (2) log hauling distances, (3) payment method to landowners, (4) the desirability of a uniform, industry-wide grading system, and (5) amount of interest in establishing a landowner assistance program. Presents conclusions based on the survey information.


Discusses factors involved in the economic analysis of alternative black walnut management regimes. Silvicultural options are discussed in terms of published results. Available growth models are discussed, and past economic research is described in terms of design and pertinent findings.


Internal rate of return and present net worth were calculated and compared for black walnut timber management, as well as several multicropping alternatives, for a 60-year rotation with two pre-commercial and two commercial thinnings for medium and high quality sites in Missouri. A table of practices and associated costs and returns is included.


Uses growth and stand data from 30-year-old thinned/unthinned scarlet oak stands (SI 65) in the Missouri Ozarks to analyze financial returns from no thinning, precommercial thinning, and precommercial followed by commercial thinning at 10-year intervals. Includes rotation ages of 60 and 80 years. Present net worth (at 5% interest) and rate of return are presented for three different stumpage values ($20, $35, and $50/MBF). Sensitivity analysis is done for precommercial thinning costs, resulting in a table of percent change in costs needed to decrease the internal rate of return by 1%.

Provides soil expectation value and present net worth of several agroforestry enterprises— including black walnut timber production — used to control erosion on farms in the Corn Belt.


Presents and describes guidelines for pre-commercial cleaning, basal area thinning, and crop-tree release in young northern hardwood stands, with concentration on crop-tree release. Includes a brief discussion of the economic feasibility of such operations.


Discusses and gives general guidelines for cleaning, thinning, cull tree removal, and post-harvest treatments to improve upland central and northern hardwood stands. Includes an economics section that gives a table of priority ratings for each treatment type, potential rate of return (low-high), and when returns can be realized.


Discusses fertilization of northern hardwoods. Includes a small section on economics that gives an equation (rate of return) that can be used to determine the profitability of fertilization.


Discusses the results of a study of rates of value change in yellow birch sawtimber and veneer trees. Gives a table of 10-year value change rates by dbh class for 2-log, medium-low vigor trees with improvement in grade.


Tables and methodology are presented for projecting basal area, diameter, volume, and value by product for northern hardwood stands. Also given is information for determining and comparing rate of return on stand improvement investment options.


Uses quality data collected on the White Mountain National Forest to determine rate of value change (10-
Uses computer simulation to predict costs of cable yarding in eastern hardwoods. Presents estimated yarding cost by average tree dbh for six yoders (Bitterroot, Kolier K-300, Appalachian Thinner, Skylok 78, Urus 1000-3, and Ecologger 1) for 200 and 400 foot average yarding distances (based on 2,000 cubic foot removals). Also gives a breakdown of costs by component (labor, equipment, etc.). Discusses the effects of tree size, product volume, species market values, and harvest type on cable logging costs and revenues.

Describes MANAGE, a Fortran V computer program that integrates harvesting, silviculture, market, and economic concerns to aid in the management of eastern hardwood stands. Output includes present net worth, soil expectation value, cash flow, and product yield by grade as well as other yield and volume information. An example application is given for a 40-year-old Appalachian red/white oak stand (avg. dbh = 8.6, trees/acre = 201, basal area = 81.3, site index 70) for light, medium, and heavy thinning. Evaluations were for 80-150 year rotations using a 4% real interest rate.

Provides a general description of ECOST, a computer program to estimate stump-to-mill costs by component (felling, yarding, etc.) for cable-logging of steep-slope hardwood sites in the eastern United States. Includes required inputs and possible tabular outputs, and gives an example of typical program output.

Includes a program outline and an example run of PROFIT-PC, including required inputs and possible outputs. PROFIT-PC is a menu-driven, interactive computer program for estimating product volume, optimal product mix, and maximum net revenue for multi-product harvesting of central Appalachian hardwood stands. Output includes revenue/cost sheet

Uses the ECOST computer model to determine stump-to-mill costs for six different cable yoders logging Appalachian hardwoods for average stand diameters of 7-12 inches. The APTHIN computer model was then used to determine revenue for the optimum product mix by average diameter for high, medium, and low price levels and haul distances of 20, 40, and 60 miles. Includes an economic feasibility matrix with variables of volume harvested, haul distance, average tree DBH, and price level.

Presents stump-to-landing costs for selected cable, ground-based, and portable winching systems for harvesting/thinning young hardwood stands. Discusses the effect of yarding/skidding distance on costs.

Describes a methodology to determine stump-to-mill logging costs using time and motion data, simulation techniques, non-linear regression, and feedback loops. Gives examples of application of the model for comparison of different harvesting machines/methods, determining hardwood thinning feasibility, and determination of oak salvage feasibility following gypsy moth attack.

Includes a program outline and an example run of PROFIT-PC, including required inputs and possible outputs. PROFIT-PC is a menu-driven, interactive computer program for estimating product volume, optimal product mix, and maximum net revenue for multi-product harvesting of central Appalachian hardwood stands. Output includes revenue/cost sheet.

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Uses time-study data to analyze the effects of slope distance, lateral yarding distance, turn volume, logs per turn, crew size, and move costs on the production rates and yarding costs of group selection cable logging harvests in North Carolina hardwoods. The results may be used to determine group selection harvesting costs.


Uses time-study data to estimate cable skidding production rates and costs in Appalachian hardwoods for group selection units of 0.5, 1.0, 1.5, and 2.0 acres. Cost analysis includes the effects of unit area, move time, skid distance, volume and number of logs per turn, log size, and number of winching pulls on total skidding cost.


Uses Forest Service Forest Inventory and Analysis data, the ECOST harvesting cost model, and wood price reports to determine the feasibility and profitability of cable logging southern upland hardwoods (14 states) on slopes greater than 30%. Three yarder sizes and three yarding distances were evaluated. Estimated area of profitable-to-log inventory is given by state, cable system, and yarding distance. Estimated profitable-to-log volume is given by state, profit attained, and yarding system. Discusses average conditions where cable logging is a profitable venture.


Presents derived cost equations associated with felling, limbing and bucking, yarding, loading, and hauling in skyline cable logging of eastern hardwoods for two small and four medium size cable yarders.


Gives an equation to predict and compare yarding costs of the Clearwater cable yarder to six other yarding systems for eastern hardwood thinning and harvest.


Gives economic feasibility matrices for salvage of gypsy moth-killed red, white, chestnut, scarlet, and black oaks for four expected salvage volumes, three haul distances, and three price levels. ECOST and EASTCOST computer programs were used to estimate logging costs; price data were from Ohio, Pennsylvania, and Tennessee.


Describes and compares a micro-computer model for optimum bucking of northern hardwoods to current bucking techniques. Lists the total value of trees treated with current and optimal techniques and suggests uses of the computer model in increasing tree value.


An essay discussing the virtues of natural versus plantation management of temperate hardwoods. Specifically, discusses the economic case against natural management systems, the weaknesses associated with this argument, the inclusion of non-financial values in appraisal, and alternative interest rate determination. Discusses the effect of interest rate on the extensive/intensive decision and illustrates the discussion with benefit cost ratios over a range of discount rates for natural and plantation management of hardwoods.

Uses data from 105 small farm woodlands to determine stand treatments and associated costs/revenues available to Virginia Piedmont landowners. Determines present worth and equivalent annual income of several pine and hardwood investments.

Gives annual dollar value of deer hunting as related to the retention level of oak basal area in the Shasta-Trinity National Forest. The study uses contingent valuation techniques and gives values for 5, 10, 17, and 30 ft² of retained basal area.

Summarizes the results of intensive culture economic research that was sponsored by the North Central Experiment Station. Discusses hybrid poplar break-even and cash-flow analyses as well as the inclusion of risk analysis in financial evaluation.

Compares a standard discounted cash flow and a stochastic simulation model in terms of net present value and internal rate of return for a short-rotation hybrid poplar plantation investment (8x8, two 15-year rotations) in the Lake states. The stochastic model examined varied product prices, harvest yields, and harvest/transport costs in terms of individual and combined effect.

A mixed-species growth model is developed for Wisconsin hardwoods and an economic management guide is developed that maximizes land expectation value. The guide is compared to other guides in terms of returns, stand structure, and species composition. A Markov decision process guide is then developed to take uncertainty into account and is compared to the economic and other guides in a stochastic environment.

Using Wisconsin growth data, a growth model was developed and validated for uneven-aged stands. Linear programming was used to solve for an economic management guide that maximized soil rent at a steady state. This guide was compared to 5 other guides (Arbogast 1957, selection with q=1.44 and ba=20.7 m², 12 and 16 inch diameter limit, and high-grading) at steady state in terms of soil rent and ecological diversity as measured by Shannon's index. Forest value (land+timber) is also compared by cutting guide for several initial stand conditions.

“continuous” grading system that eliminates grouping errors in lumber volume prediction and valuation of yellow-poplar. The model predicts volume by lumber grade using field measurements of dbh, merchantable height, and number of 5-foot clear cuttings on the first log.


Discusses supply and demand in the hardwood market, and the effect of market interactions on stumpage prices. Uses a simplified market model to discuss factors influencing supply of and demand for stumpage, sawlogs, lumber, and furniture, and how these market interactions affect stumpage prices.


Gives a brief discussion of relative northern hardwood price trends for different log grades. Uses the PROQUAL computer program (that incorporates tree grade) to simulate and determine rate of return on growing stock, net present value (at 5%), and bare land value (calculated as the present value of land/timber minus the residual timber liquidation value) for seven harvest alternatives in sugar maple stands. These alternatives are 13, 15, 17, and 19 inch diameter limit cuts and Arbogast's 1957 selection cutting guidelines for 80 ft² residual basal area under the limitations of 1) removing poorer grades first, 2) removing higher grades first, and 3) removing grades proportionally - all for 5-, 10-, and 15-year cycles. Stands were projected until a constant residual stand structure/harvest was achieved.


Discusses hardwood plantation management by Union Camp Corporation. Describes the silvicultural research and management strategies of the company and gives reasons for selecting plantations over natural regeneration. Includes an "economics" section that compares the yields and costs of plantations versus natural stands.


Describes and discusses the accomplishments and public/private costs/returns of Cooperative Forest Management Program (CFM) and the Agricultural Conservation Program (ACP) assisted forest management practices in Pennsylvania in 1965 from a study of 13 counties. Includes a section that gives rate of return on investments in cleaning/cull-tree removal and precommercial thinning in northern hardwoods, oak stands, and cove hardwoods - separated by public and private investment and by ACP/CFM and CFM-supported operations.


Gives a model to help in the decision to regenerate or manage southern bottomland hardwood stands. The model does not directly take economics into account, but it is based on quality, vigor, and stocking of trees. Includes comparison of the model's vs. expert hardwood foresters' decisions.


Gives generalized charts for determining present value, future value, and expected rate of return for hardwood trees using a given stumpage price.


Presents profit-maximizing stocking guides for selection management of northern hardwoods for three site classes, 5- and 10-year cutting cycles, and 1-9% alternative rates of return. Guides were derived using existing data and the Weibull distribution function to maximize value growth minus holding costs. Also compares the derived guides to existing guides.


Gives production rates and costs for thinning northern hardwoods (8.7 inch average dbh) under manual and semi-mechanized Swedish "tree-section" (no limbing) harvesting systems for fuelwood production.


Uses USDA Southern Forest Inventory and Analysis (SOFIA) data, a stump-to-mill cost prediction model, and stumpage/delivered wood prices to assess percentage upland hardwood timber availability from non-industrial private owners in Tennessee. SOFIA plots were determined to be viable harvest plots as a function of logging profitability/feasibility and landowner attitudes. A procedure is also described for defining a wood procurement zone for a hypothetical mill.


Presents a method of adjusting 4/4 lumber quality index values for hardwood logs. Quality index values were compared to values obtained from a study of seven sawmills in Ohio and Kentucky in which products other than 4/4 lumber were produced. Gives tables of quality index values and adjustment ratios obtained from the study for yellow-poplar and red, black, scarlet, white, and chestnut oaks.


Details the biological and economic characteristics of two Appalachian hardwood stands (oak SI 62 & 75) as related to single-tree selection management over a 12-year period with two cuts and two inventories. Discussion of biological results includes species composition, growth, quality, reproduction, and stand structure. Economic evaluation is done for each stand as 1) percent of sawlog value by grade, 2) internal rate of return on initial stand value, 3) net future value including only initial stand value, 4) NFV with land costs added, 5) NFV with annual management/tax expense added, and 6) NFV with land and management/tax costs added.


Data from thinning studies on the Bartlett Experimental Forest in 25-year-old northern hardwoods was used to economically evaluate 1) no thinning, 2) one crop tree competitor removed, 3) removal of low value competitors, and 4) removal of all trees competing directly with predominately paper birch crop trees. Stand table projection was used to determine stand structure at 10, 15, and 20 years after thinning. Economic analysis for each projection period was in the form of achievement of four production goals, ability to provide an intermediate commercial thinning, and percentage of treatment plots that met various desired rates of return on the precommercial thin with pulpwood only and pulpwood/boltwood markets.


Reports on a study of three pre-commercial thinning techniques in New Hampshire hardwoods. Compares
rate of return and expected gross per-acre income of the thinning investments to a control.


Reports rate of value growth, internal rate of return, net present worth, and net future worth of two West Virginia Allegheny hardwood stands based on 20 years of individual-tree-selection harvest. Also discusses land, management, tax, and timber holding cost considerations.


Calculates present net worth (6%) of 17-inch diameter-limit cuts with 15-year and 20-year respective cutting cycles in site index 60 and 80 stands and single-tree selection (>11" dbh) with a “q” of 1.3 and 10-year cutting cycle on both sites in Appalachian hardwoods. Data used are from 20-30 years of management on the Fernow Experimental Forest in West Virginia.


Uses data from 400 plots in Ohio to determine probabilities of diameter, merchantable height, and tree quality changes of sawtimber trees over a 10-year period. Details a procedure for using combined DBH, height, and quality probabilities to project future tree characteristics and rate of value change over the period. Includes an example of the process for an 18-inch, grade 2 red oak.


Uses sample tree data and mortality estimates based on defoliation histories and tree characteristics to determine immediate and future stand value changes resulting from gypsy moth defoliation in a pulpwood stand and a sawtimber stand in the northeast.


Discusses the causes of low-quality hardwood stands in the Cumberland Plateau and Highland Rim area, offers management options for improving or regenerating the stands, and gives methods for evaluating stand and site potential. No direct discussion of economics.


The most recent USDA Forest Service Forest Inventory and Analysis results for each state in the region are used to describe the bottomland hardwood timber resource, and for comparisons with results from previous inventories.


Discusses the economic importance of epicormic branching of hardwoods and gives lumber value loss attributed to epicormic branching for a southern bottomland hardwood stand. Discusses the factors influencing epicormic branching of bottomland hardwoods and how to reduce future problems.


Discusses financial maturity of paper birch sawtimber and sawbolt trees. Has tables of the range of expected sawtimber value increase by dbh and vigor class for stable and increasing/decreasing conversion costs/lumber values. Gives boltwood value increase by dbh and expected increase in number of 5-foot bolts.

Lumber quality index values based on 1964-1968 prices are used to determine tree value conversion standards (conversion surplus) for 12 hardwoods species of the oak-hickory forest type. Gives tables of quality index and conversion surplus values for each species by grade, merchantable height, and dbh.


Briefly discusses the quality index concept and gives log quality index values by diameter and grade for white ash, beech, black cherry, hard and soft maple, red and white oak, and yellow-poplar for the Appalachian and Northeastern areas.


Gives expected rate of value and dollar value increases for sugar maple in Pennsylvania and West Virginia for a ten-year period. Also gives a financial maturity diameter marking guide for several vigor classes, return percentages, lumber prices, and conversion costs.


Presents expected rates of value increase for yellow-poplar and beech for a 10-year period. Rates are based on tree growth and quality data from West Virginia. Includes financial maturity marking guides.


Uses data collected over a 30-40 year period on the Fernow Experimental Forest in West Virginia to evaluate single-tree selection and diameter-limit harvesting practices in terms of product yields, income, species composition, quality, volume growth, and returns on stand value. Also discusses the economic considerations of logging damage, poletimber management, higher diameter limits, and residual stand goals.


Describes a dynamic forest management model for prescribing treatments in a multi-stand management unit containing even and uneven-aged stands. Results of an application of the model to an Appalachian hardwood forest are given. Stand- and forest-level optimal solutions are compared and the efficiency of the solution algorithm is discussed.


Time-study data is used to give cost per tree/hour/acre for reducing basal area (to less than 10 ft^2) of non-merchantable (<"d" dbh) stems in commercial thinning to 45, 60, and 75% stocking in 60-year-old black cherry-maple stands in West Virginia. Also gives additional volume and after-tax value yields needed to earn 5.25%, 7.5%, or 9.0% return on sapling removal for investment periods of 10, 20, and 30 years.


Compares costs of releasing 80 crop trees/acre by the crown-touching method in a 12-year-old Appalachian hardwood stand (2700 trees/acre, 77 ft^2 basal area) using stem injection, basal spraying, and chain saw felling. Costs were given on a per tree and per acre basis. Presents per acre costs for releasing 50, 60, and 70 crop trees using production data obtained from the study.


Discusses the profitability of precommercial treatments
in even-aged Appalachian hardwoods as affected by treatment cost, required rate of return, investment period, and stand response to treatment. Provides tables of stand value increase needed and maximum precommercial thinning cost allowable to earn a 4% real rate of return. Also includes a nomogram that allows the prediction of volume and diameter increase needed for a particular investment amount and period to be economically.


General discussion of the economic impact of management goals, markets, products, roads, price fluctuations, and even-aged vs. uneven-aged management in central hardwood stands.


A method for defining the most profitable residual stand structure for single-tree selection is presented. The method uses linear programming to solve for cutting cycle length and residual number of trees in each dbh class that maximizes net present value. Discusses the effect of constraints to residual basal area, largest residual diameter, and diameter distribution, and compares economic to existing residual stand guidelines.


Uses data obtained over a 34-year period from the Fernow Experimental Forest in West Virginia to discuss the effects of periodic volume and product yields, species composition and volume, and changes in residual stand quality on financial returns from single-tree selection management in central Appalachian hardwoods (site index 50 of 60-80 feet for northern red oak). Also discusses the effects of logging damage, poletimber management, increased diameter limits, and residual stand goals on returns in selection and diameter-limit management. Provides tables that 1) compare returns from commercial clearcut, diameter-limit, sawtimber selection, and pole-sawtimber selection management, and 2) give optimal residual basal area and maximum net present value (at 4% real interest) for several "q"/largest diameter tree combinations for single-tree selection on a 10-year cutting cycle.


Evaluates single-tree selection, group selection, two-aged, and even-aged management of eastern hardwoods in terms of economic feasibility. The GB-SIM harvesting simulation model was used to supply the data for calculating the revenue associated with each practice in current and future harvests under three merchantability options (8" dbh, 4" top; 12" dbh, 4" top; and 12" dbh, 10" top). An after-tax cash flow analysis was done for each of three price levels for sawlogs, sawbolts, and pulpwood-fuelwood.


Compares diameter-limit and selection harvesting systems with respect to rate of return on residual stand value. Data were from stands managed under a given practice for 30-40 years. Briefly discusses the economic considerations for application of the respective harvesting systems.


Details a partial harvest method that combines rate of return (Trimble et al, 1969) controlled diameter-limit cutting with improvement cutting in the below-limit tree sizes. Minimum residual basal area guidelines are used to adjust diameter limits to provide sustained yield. Gives results of the application of this method on the Fernow Experimental Forest in West Virginia, including rate of return on residual stand value for two cutting cycles.

Presents logging costs (from time series data) and harvest revenues (assuming average yields and market prices) for three thinning treatments (75, 60, and 45 ft² residual BA) and a clearcut in 60-year-old West Virginia Allegheny hardwoods. Logging costs include felling, bucking, skidding, loading, hauling, and roads.


Details a study to determine the timber yield and financial return resulting from Forestry Incentive Program operations administered in 1974. Gives estimated average rates of return for hardwood operations including timber stand improvement in northern hardwoods, oak-hickory stands, cove hardwoods, and black walnut stands; hardwood planting; and black walnut pruning.


Compares present net worth of seven timberland investments of various investment durations – Lake States coppice managed aspen, red pine plantations, and uneven-aged northern hardwoods; Central States black walnut plantations and uneven-aged oak-hickory; and Southeastern loblolly pine plantations and naturally regenerated even-aged upland hardwoods. Present net worths are for a 4% real interest rate, exclude land costs, and are calculated with constant prices and real price increases. Discusses markets, non-timber value, risk, price fluctuations, and technological knowledge as related to each investment.


Discusses financial maturity of timber in terms of value growth percent. Example calculations are given for an individual white oak tree and an even-aged upland oak stand. Includes very brief discussion of the effect of income taxes on financial maturity.


Discusses costs/returns from two 30-acre Appalachian hardwood woodlots on the Fernow Experimental Forest In Parsons, West Virginia. Four management programs were evaluated for a ten-year period: 1) land owned, logging and cull removal by owner, 2) same as prior except logging hired, 3) same except logging and cull removal hired, and 4) land purchased, logging and cull removal hired. Evaluation is in terms of undiscounted costs/returns and undiscounted value increase from volume, species, and quality changes. Rate of return is given for the fourth management alternative under the assumptions of 1) no value increase from quality and 2) quality increase causes value increase.


Develops a matrix model of uneven-aged northern hardwood growth and uses it jointly with linear programming for simultaneous determination of optimal harvest, residual stocking, and cutting cycle in northern hardwoods.


Expands upon a matrix model of uneven-aged stand management (Buongiorno and Mitchie, 1980) to determine land expectation values (LEVs) under
different conversion alternatives that result in an optimal stand structure. Gives land expectation value and forest value (LEV + initial stand value) for several initial stand structures and conversion in one or two harvests. Does not mention hardwoods, but original study was for northern hardwoods.


Discusses a diameter class matrix model for oak-hickory stands that was used with linear programming to determine the value of two stands under various assumptions of real discount rate, fixed harvest cost, and length of planning horizon. Gives value of liquidating the stand in one harvest, value of liquidation in two harvests, and value of perpetual even-aged management.


Estimates the real rate of return for individual black walnut trees for DBH = 6 to 30 inches, low, medium, and high growth rates, and numerous merchantable height/product combinations. Presents results graphically with annual rate of return plotted over DBH for four butt log product specifications and three growth rates.


Discusses financial maturity of trees in selection forests. Accounts for the impact of successor trees, and discusses the effects of changes in interest rates, prices, and cutting cycle length on financial maturity. No direct mention of hardwoods in the article.


Over 200 hardwood forest management regimes were analyzed to estimate real internal rate of return and general results given. These data were then considered for the inclusion of these regimes into Michigan's Forest Development Fund. The benefits/costs of implementing the Forest Development Fund are discussed.


Presents a diagram that allows rate of return on present value to be estimated for individual black walnut trees with known diameter, grade, and growth rate. Also discusses the effect of pruning and competition release on returns.


Describes the management of State Forests in Pennsylvania. Includes brief discussion of the role of economics in the decision of applying management practices to this hardwood-dominated land base.


Summarizes the results of a 40-year study of nine different even/uneven-aged cutting methods in northern hardwoods. Returns for each method are given and species diversity/tree quality are considered.


Evaluates crop tree release, diameter limit, commercial clearcut, complete clearcut, and light, medium, and heavy selection treatments in 45-year-old northern hardwoods in Wisconsin in terms of diversity and economic returns after 40 years. Diversity was measured by Shannon's index. Economic returns were measured as net present value of the difference between treatments and a control at a 6% nominal discount rate.


Examines the information needed for the economic comparison of even- and uneven-aged hardwood management. Discusses and gives sources of information for management costs, stumpage prices and tree quality/price relationships, silvicultural strategies, growth & yield models, and long-term silvicultural trials.


Gives an economic evaluation of three levels of individual tree selection (60, 75, 90 ft²/ac), an 8-inch diameter limit cut, and a control stand in northeastern Wisconsin hardwoods for a forty-year period. The QUICKSILVER microcomputer program was used to determine undiscounted lumber value, residual lumber value, and net present lumber value for each of the systems.


Divides the Corn Belt (IA, IL, IN, MO, & OH) into 25 areas with relatively homogeneous soil and topographic features and identifies nine areas with soils recommended for black walnut planting. A "typical" black walnut timber management regime was identified for each soil type (one example given), and internal rate of return was calculated for each regime assuming an increase in stumpage prices of 0.5% per year (IRRs not given by soil type). Weighted average (by acreage of soil types) real internal rates of return of black walnut timber production are presented for each of the nine areas and for each state.


Presents log and lumber value loss resulting from 10-year-old skidding wounds in a sugar maple/yellow birch stand. Value loss was also separated into that resulting from root wounds and that resulting from stem wounds. Has guidelines for minimizing value loss from skidding wounds.


Provides equations for estimating the costs of hand planting, machine site preparation, aerial spray, prescribed burning, manual release, and thinning treatments in the Lake States. Costs are not specific to hardwoods, but apply to a variety of forest conditions.


Discusses the effect on stumpage returns of grading and merchandising the hardwood component of a timber sale.


Estimates internal rates of return from extensive (none), low, moderate, and highly intensive management of aspen (SI 80) and paper birch (SI 70) as defined by various combinations of weeding, fertilization, and thinning. Uses an aspen growth model, aspen fertilization and thinning data, and unpublished paper birch growth data for stand projection. Briefly discusses the effects of increased growth response from better management, lower management costs, and higher relative sawtimber prices on future economic management potential.


Uses West Virginia stand and growth data for financial analysis of crop-tree release of 5 red oak crop trees/acre
Crop tree rates of return (nominal) and annual income (1982-1990) are given for 11.0-14.0 inch sawtimber released at no cost and at $5/tree, and 15.0-17.8 inch sawtimber released at no cost. Ten and twenty-year projections of rate of return and annual income are also given for each. Also gives rates of return and annual incomes for precommercially releasing five poletimber trees/acre (35-year projection) and 10 saplings/acre (45-year projection).


Reports on a study in which rate of return and annual income were estimated for applying crop tree release on red oak pole and sawtimber trees in West Virginia. Includes crop tree selection criteria.


Describes the development and application of a dynamic programming bucking-optimization model developed for northern hardwoods. Compares optimal solutions to bucker-produced solutions in terms of volume and gross dollar value.


Gives before- and after-tax compounded (6, 8, and 10%) future investment costs per cubic foot yield with and without land costs for sycamore plantation, natural stand, and timber stand improvement investments in southern bottomland hardwood pulpwood production. Discusses non-industrial and industrial perspectives of the comparisons.


The author estimates age of financial maturity of pulpwood at three interest rates (3, 6, and 9%) for eight hardwood forest site types (muck swamp, branch bottom, upland slopes and ridges, etc.) in the eastern United States. He accomplishes this using the Faustmann formula.


Financial analysis of hardwood timber versus soybean production. Gives per acre revenue of hardwoods and soybeans based on land classification for hardwood timber production (100-400 bd. ft/acre/year). Hardwood timber was valued at one price ($55/MBF), while soybeans were valued at three prices ($2, $4, and $6/bushel).


Compares plantation establishment, natural regeneration, and timber stand improvement of bottomland hardwoods in terms of cost per cubic foot of production. Considers each practice for private and corporate owners.


Discusses the use and importance of quality classification and grading systems for allocating hardwood resources to their most profitable end uses.


Evaluates eight cutting procedures in northern hardwoods on a Michigan forest in terms of discounted returns, managed forest value, and present worth for 1%, 3%, and 5% interest rates using historical regional and constant 1984 prices. Cutting procedures were a light improvement cut, four diameter-limit intensities, and
three selection intensities.


Gives net present value and rate of return (8% real discount rate and 2% stumpage price increase) for a 30-year-old naturally regenerated bottomland hardwood stand in south Mississippi and compares these values to estimates for 25-year-old planted loblolly pine and sycamore obtained through stand projection. Provides volume yields for the natural stand as well as a 16-year-old loblolly pine stand on the same site, and discusses the merits and limitations of natural regeneration versus planting pine or sycamore.


Evaluates four thinning regimes (no treatment, precommercial only, commercial only, and both) for several thinning levels in upland oaks and northern, northeastern, and Allegheny hardwoods in terms of internal rate of return for precommercial thinning and cull tree removal for various site and age classes. Four different micro-computer growth projection systems (STEMS, GROAK, SIM-TIM, and SILVAH) were used with price and cost data from a 1979 Forestry Incentive Program evaluation. Sensitivity analysis was performed for precommercial thinning costs, volumes removed in thinning and harvest, and stumpage prices.


Uses Forestry Incentives Program data and growth and yield models to determine internal rate of return of precommercial thinning and cull-tree removal in upland oaks, northern hardwoods, northeastern hardwoods, and Allegheny hardwoods under sawlog rotations. Each stand was subjected to four management regimes – 1) final harvest only, 2) one pre-commercial thin, 3) one pre-commercial and one or more commercial thins, and 4) one or more commercial thins – using either the STEMS, GROAK, SIM-TIM, or SILVAH growth model for several site index, basal area removed, stocking, and age levels. Includes adjustment factors used in price and cost estimation.


Discusses general equipment and marking recommendations for increasing the economic efficiency of selection thinning in hardwoods.


Solves for optimum thinning and harvest regimes simultaneously with species composition and diameter class distribution in 70-year-old Appalachian hardwoods (SI 70). Uses the MANAGE hardwood stand simulator and Hook and Jeeves' non-linear programming algorithm for solution, and compares results with those of silvicultural recommendations.


Presents a break-even yield analysis, internal rate of return, and present net worth for two intensive culture poplar systems (three 5-year rotations, one 15-year rotation) from estimated costs and yields. Includes sensitivity analysis of costs.


Uses time-study data from four Allegheny hardwood stands (average dbh 10 inches) in West Virginia to determine costs of thinning with three-man crews using chain saws and either a cable skidder or truck-mounted crane. Presents costs on an hourly and per unit basis. Gives a table of production rates by tree volume and distance between trees and explains how to use this data to determine costs.


Discusses biological and economic guides for maximizing fiber production in Appalachian hardwood stands. Explains the process of economic evaluation through applying marginal analysis techniques. Concentrates on biological guides.


Explains how to estimate present and future values of yellow-poplar stands. The system is based on included regression equations to determine tree grade as a function of dbh.


Discusses the economic and other advantages of separating and marketing hardwoods by grade and product. Also discusses other ways to increase profits from hardwoods.


Evaluates the impact of group selection harvesting on productivity and cost of skyline yarder, feller-buncher/cable skidder, and chain saw-felling/cable skidder harvesting systems in Appalachian hardwoods. Compares results with those obtained from clearcutting.


Evaluates sheared versus sawhead-felled stump heights and damage on six mixed pine-hardwood clearcut sites in the Virginia coastal plain. Evaluates revenue loss from lost volume due to high stump height.


Describes two growth and yield models - TWIGS and ERGYS. Twigs was designed for Lake and Central states hardwoods, and has economic analysis options for cash flow, present net worth, internal rate of return, and benefit/cost ratio. The program will perform sensitivity analysis on these criteria for a specified management system. ERGYS was developed for the eastern region and incorporates TWIGS along with nine other growth and yield models.

Uses the TWIGS growth model linked to a gray squirrel habitat suitability model to evaluate timber yields, squirrel habitat quality, and financial returns from two different management options for hardwood stands in southern Indiana. Option 1 was a silviculture-only recommendation while option 2 favored squirrel habitat, aesthetics, and water quality. Net present value was determined for each option for interest rates of 0-10%.


Four large fixed and three field operating log merchandising systems are compared in terms of net present value when used for Minnesota aspen. Sensitivity analysis was performed for changes in sawlog volume recovered, operating costs and product prices, the discount rate, and capital investment.


Discusses how timber costs and returns are treated under federal income tax law, with emphasis on changes made by the 1986 Tax Reform Act. No direct reference to hardwoods.


Provides a general discussion of existing literature pertaining to the economics of even-aged vs. uneven-aged management of eastern hardwoods. Summarizes even- and uneven-aged management in terms of species composition, diameter growth, volume and value growth, stand regulation, markets, logging costs, roads, residues, injuries, water, wildlife, aesthetics and monetary returns. Presents a theoretical comparison of the systems for upland hardwoods in terms of volume/value yields.


General discussion of the economic aspects of even-aged management of hardwoods. Concentrates on the relationship of financial maturity to the different canopy strata.


Describes methods of application and presents some broad economic guidelines for single-tree selection, diameter-limit, and financial maturity cutting methods in hardwoods. Specific items discussed include expected rates of return and the economic effects of changes in species composition, road building, cutting cycle length, inventory, minimum cutting diameters, and pole-timber management.


Describes 34-year results of stand development, growth, and value for no management, commercial clearcut, 15.5 inch diameter limit, 11.0 inch dbh and up selection, and 5.0 inch dbh and up selection management in Appalachian hardwoods. Stand value includes present stand value (1983) and prior stumpage revenue compounded at 6% annually.

Discusses establishment, survival, growth and yield, and economic feasibility of sycamore, yellow-poplar, and sweetgum plantations as well as pine plantations. Seventy hardwood plantations were used as a basis for sweetgum plantations as well as pine plantations.

Maximum soil rent (i.e. optimum rotation age), maximum present net worth, and break-even harvest value were determined at 6, 8, and 10% interest rates for four establishment costs/intensities and eight stumpage values.


Presents costs, returns, internal rate of return, present net worth, and benefit/cost ratio for two black walnut multicropping options (18x18 and 40x40 spacing, both with nut and fescue seed production and an 80-year rotation).


Reviews the methods, strengths, and weaknesses of individual tree selection, group selection, diameter-limit, and financial maturity cutting practices in central Appalachian hardwoods.


Presents an argument for increased diameter limits by demonstrating the financial gain from leaving trees to grow that have the potential to improve butt-log grade. Also gives a table of financial maturity diameters for hardwoods by species for several real interest rates and site indices.


Evaluates six-year results of 30-, 50-, and 70% residual stocking thinning treatments in 29-year-old oak/yellow-poplar/red maple/aspen stands in Ohio in terms of growth and stem quality. Evaluates the impact of thinning on live, dead, and epicormic branches, but has no direct discussion of economics.


**Economic evaluation of Lake States tree improvement programs.** M.S. Thesis, University of Wisconsin, Madison, Wisconsin.


**Evaluation of oak decline areas in the South.** Atlanta, Georgia, USDA Forest Service, Southern Region, Protection Report R8-PR-17. 36 pp.

Discusses the symptoms and causes of upland oak decline and presents the results of a survey of 38 decline areas in the northern and southern Appalachians, the Ozarks, and the Mid-South. Includes a section on the economic impact of decline in these stands. Present value at a 4% discount rate was calculated for current (1985) and projected (1995) stand volumes with and without the presence of decline. Subsequent value losses are presented.


General discussion of the economic and other considerations of artificial regeneration of hardwoods. Discusses the need, feasibility, costs, and profit potential of artificial regeneration.


For genetic tree improvement programs for 19 timber species (10 hardwood) in the North Central region, presents benefit/cost ratios (at 4% and 6% interest) by state and species, and present values of costs and benefits (at 4%) by species.


Derives costs and estimates revenues from harvesting oak for individual home heating and commercial energy use in California.


Identifies state provided cost-share programs in the United States and discusses their common and individual characteristics and requirements.


Evaluates the influence of the Pennsylvania Bureau of Forestry's land holdings and management practices on prices in local markets. Discusses and gives suggestions for improving the Bureau's policies.


Reports the costs associated with crop tree release in Kentucky white oaks by the crown touching technique. Costs were from time-study data for chain saw felling with 20 and 34 crop trees per acre.


Discusses epicormic branching of South Carolina bottomland hardwoods resulting from a seed tree cut and a selection cut. Very limited discussion of economic losses.


Reports on five case studies of harvesting hardwood thinnings in northern Michigan and Wisconsin hardwoods. Case I gives average cost and productivity, by harvesting phase, of a mechanized system with whole tree chipping for pole-sized hardwoods. Case II gives cost and productivity, by machine, for strip-selection thinning with whole-tree chipping for pole-sized hardwoods. Case III gives costs, by machine, for both harvesting pole timber for pulpwood and harvesting sawtimber with tops utilized for pulpwood for mechanized selective thinning in mixed hardwoods using three different feller/bunchers. Case IV gives costs by harvesting phase for strip-selection thinning in red oak pole timber under three levels of mechanization. Case V gives cost of strip-selection thinning of northern hardwood pole timber on steep slopes (up to 50%) using a Timberjack feller/buncher.


Gives and compares costs and revenues for four clearcut harvesting configurations in Michigan hardwoods from time study-data. Harvesting methods studied were 1) all volume chipped in woods, 2) saw logs skidded to trailer along with chip material, 3) chips out first, then sawlogs out with forwarder, and 4) sawlogs out first with forwarder, then chips out.

Explores the economic returns possible with pre-commercial and commercial selection thinning of northern Michigan pole-timber-sized northern hardwoods. Gives present net worth and internal rate of return at 2% and 4% real discount rates, with and without 1.5% annual real price increases, and with and without land purchase and sale for four different thinning cases. These cases are 1) no initial thinning, with commercial thinning thereafter, 2) pre-commercial initial thinning, then commercial thinning, 3) commercial initial thinning that only covers costs, and 4) commercial initial thinning that results in profit. Thinnings are on a 10-year cycle and are carried out for 50 years, at which time the harvest is identical for each of the cases.


Uses time-study data to evaluate the productivity, delimming/debarking quality, and cost of a portable chain flail delimber/debarker in production of whole-tree chips in northern hardwoods.


A productivity/cost analysis of chain saw felling/forwarding to roadside in the thinning of a northern hardwood pole-timber stand.


Uses quadratic and power function models to determine the combination of southern pine, ash, gum, and oak; midwestern white and red pine, aspen, and red oak; and common stock, corporate bond, and US government bond and treasury bill investments that maximize utility of investors for various levels of risk aversion in single- and multi-period portfolios.


Butt-log grade data taken from unmanaged hardwoods on the Fernow Experimental Forest in West Virginia are used to determine dbh-to-butt-log grade relationships for sugar maple, chestnut oak, red oak, white oak, yellow-poplar, and beech. Smoothed and adjusted curves are presented for percentage of trees by dbh class with a factory grade, grade 1 or 2, or grade 1 butt log. Not specifically about economics, but the data can be used with growth and value data to determine financial maturity, etc.


Introduces an economically efficient marking guide for single-tree selection cutting in sawtimber-sized Appalachian hardwoods on a 10-year cycle. The system uses a silvicultural marking guide followed by a "financial maturity" marking guide that takes into account various desired rates of return, species, and site classes. Includes derivation of the system and gives
general silvicultural and economic considerations to be taken into account when using the system.


Discusses financial maturity of northern red oak, white oak, and chestnut oak based on tree growth and quality data collected in West Virginia. Uses 1968 lumber price data, quality indexes, and conversion costs to determine present value. Presents tables of the ranges of expected 10-year value increase for growth increase alone and for growth and quality increases by dbh, site index, and vigor class. Presents financial maturity diameters based on growth of grade 1 or 2 logs by site index, average log height, and vigor class using 2%, 4%, and 6% interest rates.


Using data from the Fernow Experimental Forest in Parsons, West Virginia, the author discusses the effect of diameter-limit harvesting on species composition, percent cull volume, residual log quality, growth, value of cuts, and residual stand value. Compares diameter-limit to single-tree selection in these respects.


Presents general economic trends and national forest products production, consumption, trade, and price statistics for the period of 1950-1986. Statistics are divided by softwood/hardwood, sawlogs/pulpwood, and timber/lumber/veneer/pulp/particleboard/etc.

417. USDA Forest Service 1975. How profits are left in the woods. Atlanta, Georgia, USDA Forest Service, Southeast Area, State and Private Forestry, Information Leaflet. 5 pp.


Gives data pertaining to and discusses domestic and foreign forest product markets and their demand for and supply of timber products, the domestic timber resource, timber demand and supply projections, resource impacts of continuing trends, and opportunities to extend future supplies.


Briefly discusses federal income tax incentives affecting forestry investments and illustrates their effect on rate of return for a hypothetical hardwood stand.


Considers factors in the decision to regenerate or rehabilitate poor quality or stagnated upland hardwood stands. Factors include stand age, density, site quality, log quality, species composition, management objectives, and economics. Devotes a section to the role of economic analysis in the decision. Discusses cost, return, and tax considerations. Has an example of the use of net present value in determining a course of action for a stagnated oak stand and high-graded mixed hardwood stand.


Presents net annual equivalent income for Mid-South bottomland hardwoods on the basis of site productivity for several interest rates and pulpwood and sawtimber price levels.


Uses the PAR-3 computer program to determine present net worth and internal rate of return using an 8% interest rate for existing and regenerated upland oak stands with and without management for a range of site indices, initial and periodic costs, stumpage prices, rotation ages, and thinning initiation dates with ten year thinning intervals. Also explains how to compare the results with alternative investments.

Identifies and briefly describes the provisions and requirements of financial assistance programs available to forest landowners. Discusses federal (ACP, CRP, TAP, FSP/SIP) as well as state (AL, FL, MS, NC, SC, TX, VA) programs.


Lists and describes in detail the steps involved in the financial analysis of hardwood timber management. Discusses taxes, present net worth, rate of return, benefit/cost ratio, annual equivalent value, and special problems encountered with hardwood investment analysis. Gives a description and sample run of the Forestry Investment Analysis micro-computer program.


Presents estimated costs and revenues for harvesting and marketing Gambel oak as fuelwood using growth and price data for north central Utah. Also discusses financial maturity of these stands.


Identifies and briefly describes the provisions and requirements of financial assistance programs available to forest landowners. Discusses federal (ACP, CRP, TAP, FSP/SIP) as well as state (AL, FL, MS, NC, SC, TX, VA) programs.


Discusses social and economic factors that may affect demand for and supply of northern hardwoods through the year 2000 and gives predictions of market activity for this period.


Discusses Mississippi's Forest Resource Development program and its funding through severance taxes.


Uses Forest Service Forest Survey data to construct marginal cost schedules for determination of optimum allocation of funds between planting softwoods, cleaning/cull removal in hardwood saplings, and thinning hardwood poletimber in Pennsylvania.


Discusses timber investment opportunities on the Elk State Forest in Pennsylvania. Rate of return on
thinning investment is calculated for northern hardwood, oak, and aspen pole timber and small sawtimber stands. Also discusses allocation of a given budget.


Discusses supply and demand issues for hardwoods in the northern U.S. Discusses how technological developments, external economic forces, and institutional and demographic forces are affecting or may affect the value of hardwood resources in the region.


General discussion of the increased economic importance of hardwoods, economic factors affecting hardwood management, rates of return from investing in hardwoods, and factors that must be addressed to ensure strong hardwood markets.


Gives a general discussion of information needs and critiques existing studies for determining rate of return on investment for timber stand improvement operations in oak stands. Includes a discussion of cost sharing.


Discusses interest rates, incomplete knowledge, leadership skills, and communication skills as they affect the productivity of hardwood management.


Uses a hypothetical uneven-aged mixed upland hardwood stand in Illinois (white oak SI=70 ft , RBA=70 ft , LDT=32 in., q=1.3) and the TWIGS growth model to determine tree size that maximizes present value for two levels of management. The first level maximizes general growth rates, while the second maximizes growth with emphasis on the highest valued trees by favoring veneer and higher-grade sawlog production. Three economic analyses are then performed. The first uses a modified Faustmann approach for "idealized" marginal analysis of a single tree with market values that increase proportionally with tree size/quality. The second uses markets that do not proportionately relate tree size to value. The final analysis examines per acre returns from stands using the optimal tree sizes from the first two analyses and cutting periods of 5, 10, and 15 years.


Briefly discusses government policies that may affect timberland management, including forest regulation, tax laws, and trade policy.


Discusses the impact of spotted-owl related harvest restrictions in the Pacific Northwest on the forest products industry in the West and in the East. Focuses on the substitution of hardwood products for conifers in the shake and shingle, veneer and plywood, structural lumber, and secondary processing industries.


Gives average costs of forestry practices in Michigan, Minnesota, and Wisconsin as estimated from a survey of industry, consulting, state, and federal organizations. Provides hardwood-specific estimates for planting, timber stand improvement, and pruning.


Discusses factors affecting supply and demand for hardwoods in the Southeast. Focuses on using low-grade hardwoods.


Provides tables for determining the economically optimum combination of sawbolt, stave, and veneer material for a standing white oak tree 16-30 inches dbh and 1-4 logs in height. Gives examples of the practical use of these tables for maximizing returns.


Provides a 10-year evaluation of the "let it grow" management alternative in terms of physical product increases, value-per-acre increases, and rate of return on investment for fully-stocked upland oak stands of various ages and site indices with several marketing alternatives using stumpage values from Ohio, Kentucky, and Indiana. The effects of changes in custodial charges and land values are discussed.


Describes the use of the System of Timber Utilization and Mill Processing (STUMP) micro-computer program to evaluate standing hardwood timber from field cruise data. Output includes value of the tract by lumber grade or log grade using known lumber, stumpage, and log prices.


Presents equations that allow the estimation of International 1/4-inch volumes and number of logs by grade from ordinary cruise data for 11 hardwood species. Can be used to help set purchase/sale prices.


Brief, general discussion of hardwood management that includes a section on financial assistance.


Discusses the costs/benefits of supplemental pine planting in naturally regenerated upland hardwoods.


Gives inventory information for several thinning treatments in 20-year-old aspen stands in Minnesota at age 40. Costs and returns from a control plot and a 13x13-spaced crop tree thinning plot are compared, and break-even thinning cost is estimated.


Discusses put and call options in the context of forest management. Gives an example of an abandonment option for a black walnut agroforestry system.

Discusses the role of marketing in the management of hardwood timber. Presents a forest management decision model that uses basic macro- and micro-economic concepts to aid in decision making. Defines many macro-economic concepts and explains market analysis of primary, intermediate, and final products. Also gives sources of useful information for making market analyses.


General discussion of timber markets and their effect on forest management decisions. Addresses potential products and markets, market information sources, marketing opportunities and planning, and marketing/management assistance.


Discusses the economics of planting hardwoods on surface mined lands for sawtimber production. Discusses the relevant costs and returns and has an economic analysis of planting oak on mine spoils. Presents real rates of return and land expectation values for oak plantations for several site indices, rotation ages, relative stumpage price increases, establishment and management costs, and with and without fertilization and pruning (assumes that plantings on a mine spoil site will grow like those planted on natural sites). Details the relative economic advantages and disadvantages of growing hardwoods on mined sites.