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

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The Economics of Hardwood Timber Management in the United States: 1950–1995

An Annotated Bibliography

By

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and

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FWRC

Forest and Wildlife Research Center

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Contents

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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Anderson, 1985 #10]

CROP TREE MANAGEMENT
[Miller, 1984 #314; Niese, 1992 #338; Perkey, 1991 #347; Perkey, 1993 #348; Stringer, 1988 #397]

DEMAND
[Abt, 1994 #1; Baughman, 1988 #17; Binkley, 1983 #33; Binkley, 1986 #32; Buchanan, 1988 #53; Clark, 1986 #83; DeSteiguer, 1989 #107; Doak, 1987 #108; Duerr, 1987 #111; Frye, 1989 #149; Hardie, 1989 #183; Haynes, 1988 #188; Hoover, 1985 #207; Irland, 1989 #216; Kellison, 1988 #225; Kronrad, 1985 #239; Luppold, 1987 #283; Luppold, 1995 #284; Ulrich, 1988 #416; Wallace, 1987 #429; Webster, 1983 #435; Wiedenbeck, 1993 #442; Wishart, 1985 #445]

DISEASE
[Baker, 1985 #14; Baughman, 1985 #16; Starkey, 1989 #391]

EPICORMIC BRANCHING
[Meadows, 1995 #305; Stubbs, 1986 #400]

EVEN-AGED MANAGEMENT
[Baumgras, 1990 #18; Baumgras, 1992 #20; Baumgras, 1995 #25; Bullard, 1983 #54; Bullard, 1985 #57; Campbell, 1987 #70; Campbell, 1987 #75; Countryman, 1989 #89; Filip, 1967 #141; Holley, 1976 #203; Miller, 1989 #316; Miller, 1994 #319; Mills, 1988 #326; Mills, 1979 #327; Mitchie, 1986 #331; Niese, 1993 #337; Niese, 1990 #339; Niese, 1992 #338; Smith, 1975 #381; Smith, 1987 #382; Smith, 1987 #384; Sturos, 1983 #402]

FERTILIZATION
[Bowersox, 1976 #45; Lea, 1986 #253; Perala, 1983 #346]

FINANCIAL ANALYSIS
[Gardner, 1995 #158; Gunter, 1983 #173; Gunter, 1986 #174; Gunter, 1994 #175; Hoover, 1987 #210; Leak, 1980 #255; Martin, 1988 #291; Utz, 1981 #422; Vasievich, 1984 #425; Webster, 1971 #437]

FINANCIAL MATURITY
[Adams, 1975 #7; Arner, 1990 #11; Bickford, 1953 #29; Buongiorno, 1993 #62; Burkle, 1952 #63; Campbell, 1955 #76; Culhane, 1986 #94; Cummings, 1953 #95; Davies, 1991 #98; DeBald, 1971 #102; Dennis, 1987 #103; Duerr, 1952 #112; Duerr, 1956 #113; Gansner, 1987 #154; Gansner, 1990 #152; Gansner, 1990 #155; Giese, 1984 #161; Godman, 1978 #165; Godman, 1985 #164; Graham, 1985 #171; Grisez, 1972 #172; Guttenburg, 1951 #177; Haight, 1985 #180; Hansen, 1987 #182; Herrick, 1956 #194; Herrick, 1984 #197; Herrick, 1985 #198; Hoover, 1983 #206; Leak, 1968 #256; Leak, 1969 #254; McCay, 1973 #301; Mendel, 1969 #306; Mendel, 1969 #310; Mendel, 1973 #309; Mills, 1979 #327; Mize, 1988 #332; Murphy, 1987 #333; Naughton, 1973 #335; Porterfield, 1972 #352; Smith, 1987 #382; Smith, 1979 #398; Trimble, 1969 #414; Trimble, 1974 #413; Wagstaff, 1984 #428]

FUELWOOD
[Bromley, 1983 #51; Stine, 1980 #394; Wagstaff, 1984 #427]

GENERAL
[Anderson, 1974 #9; Anderson, 1987 #8; Baughman, 1988 #17; Bommer, 1983 #42; Brabander, 1985 #46; Callahan, 1966 #64; Cook, 1978 #88; Doak, 1987 #108; Gardner, 1995 #158; Hobbes, 1987 #201; Hoover, 1989 #210; Hopper, 1987 #211; Irland, 1988 #215; Kennedy, 1984 #227; Kingsley, 1987 #233; Krambeer, 1992 #236; Loomis, 1995 #275; McGee, 1982 #303; Mendel, 1970 #308; Miller, 1989 #316; Nelson, 1987 #336; Rast, 1987 #356; Roberts, 1986 #361; Screpetis, 1972 #372; Ulrich, 1988 #416; USDA, 1982 #418; Vasievich, 1989 #426; Webster, 1986 #436; White, 1987 #439; Wiedenbeck, 1993 #442; Yaussy, 1988 #449; Young, 1993 #450; Zinkhan, 1995 #453; Zinn, 1986 #454]

GRADING
[Campbell, 1951 #72; Campbell, 1959 #74; Church, 1966 #82; Herrick, 1956 #194; McCauley, 1969 #295; Pelkki, 1994 #345; Rast, 1987 #356; Trimble, 1965 #412]

HARVESTING
[Baumgras, 1985 #26; Baumgras, 1989 #22; Baumgras, 1991 #23; Baumgras, 1992 #24; Baumgras, 1995 #25; Blinn, 1986 #40; Blinn, 1986 #38; Blinn, 1988 #35; Campbell, 1953 #73; Cubbage, 1985 #92; Cubbage, 1989 #93; Filip, 1967 #141; Frame, 1986 #145; Hall, 1989 #181; Hartsough, 1992 #185; Hazenstab, 1987 #189; Herrick, 1983 #195; Jackson, 1989 #217; Kaya, 1989 #221; Kaya, 1987 #222; LeDoux, 1985 #257; LeDoux, 1989 #261; LeDoux, 1989 #262; LeDoux, 1991 #264; LeDoux, 1993 #265; LeDoux, 1985 #267; LeDoux, 1990 #269; Miller, 1986 #322; Ohman, 1970 #343; Shaffer, 1992 #374; Shaffer, 1993 #373; Sturos, 1986 #401; Sturos, 1983 #402]

INVESTMENT MANAGEMENT
[Mills, 1982 #325; Mills, 1988 #326; Thomson, 1991 #408; Thomson, 1992 #409]

MANAGEMENT COMPARISONS
[Adams, 1976 #4; Baumgras, 1995 #25; Bullard, 1983 #56; Callahan, 1974 #65; Campbell, 1987 #70; Countryman, 1989 #89; Debald, 1976 #100;

MANAGEMENT (Cont.)
Erdmann, 1973 #126; Erickson, 1989 #129; Erickson, 1989 #130; Erickson, 1990 #131; Farrell, 1964 #134; Ferrell, 1969 #138; Filip, 1962 #142; Filip, 1967 #141; Garrett, 1980 #159; Gove, 1992 #169; Haight, 1985 #178; Haight, 1993 #179; Herrick, 1968 #196; Holley, 1976 #203; Kaya, 1987 #222; Kurtz, 1989 #242; Lewis, 1964 #274; Lu, 1993 #280; McCay, 1980 #300; Miller, 1991 #320; Miller, 1993 #318; Miller, 1993 #321; Miller, 1994 #319; Mitchell, 1961 #328; Murray, 1989 #334; Niese, 1992 #338; Perala, 1983 #346; Reed, 1986 #358; Roise, 1988 #363; Shifley, 1986 #376; Smith, 1973 #386; Smith, 1975 #381; Smith, 1987 #383; Smith, 1987 #384; Smith, 1980 #387; Utz, 1970 #420; Utz, 1981 #422; Vasievich, 1989 #426; White, 1988 #440; Worley, 1970 #447]

MAPLE
[Countryman, 1989 #89; Dennis, 1987 #103; Godman, 1978 #165; Godman, 1985 #164; Grisez, 1972 #172; Mendel, 1973 #309; Miller, 1984 #313; Ohman, 1970 #343; Trimble, 1965 #412]

MERCHANDISING
[Baumgras, 1989 #22; Baumgras, 1989 #21; Blinn, 1983 #39; Blinn, 1986 #37; Blinn, 1986 #40; Blinn, 1986 #38; Blinn, 1988 #35; Kimbrough, 1992 #230; Kimbrough, 1992 #229; Pelkki, 1994 #345; Screpetis, 1972 #372; Sibal, 1984 #378; Sturos, 1983 #402; Worley, 1963 #446]

NORTHEASTERN REGION
[Duerr, 1987 #111; Risbrudt, 1986 #361; Risbrudt, 1987 #360]

NORTHERN HARDWOODS
[Adams, 1974 #3; Adams, 1974 #6; Adams, 1975 #7; Adams, 1976 #4; Bare, 1988 #15; Biltonen, 1976 #30; Blinn, 1983 #39; Blinn, 1986 #40; Blinn, 1988 #35; Bullard, 1985 #57; Buongiorno, 1980 #61; Buongiorno, 1994 #60; Canham, 1987 #77; Church, 1966 #82; Erdmann, 1973 #126; Erickson, 1989 #129; Erickson, 1989 #130; Erickson, 1990 #131; Filip, 1962 #142; Frayer, 1995 #148; Gove, 1989 #168; Gove, 1992 #169; Gunter, 1983 #173; Haight, 1985 #178; Haight, 1985 #180; Hazenstab, 1987 #189; Herrick, 1983 #195; Huyler, 1982 #214; Johnson, 1979 #219; Kaya, 1989 #221; Kaya, 1987 #222; Kingsley, 1987 #234; Lamson, 1987 #249; Lancaster, 1975 #250; Lea, 1986 #253; Leak, 1969 #254; Leak, 1980 #255; Lee, 1989 #270; Lu, 1992 #279; Lu, 1993 #280; Lyon, 1986 #285; Manthy, 1970 #288; Martin, 1982 #292; Mattson, 1993 #293; McCauley, 1969 #297; McCauley, 1972 #298; Mendel, 1969 #306; Mills, 1978 #324; Mills, 1988 #326; Mitchie, 1981 #329; Mitchie, 1985 #330; Niese, 1993 #337; Niese, 1992 #338; Niese, 1995 #340; Pickens, 1992 #349; Reed, 1986 #358; Risbrudt, 1986 #361; Risbrudt, 1987 #360; Sturos, 1986 #401; Thiede, 1986 #403; Thompson, 1991 #405; Thompson, 1991 #404; Webster, 1960 #433; Webster, 1963 #434]

OAKS
[Baumgras, 1990 #18; Baumgras, 1992 #20; Bullard, 1992 #55; Burkle, 1952 #63; Campbell, 1987 #70; Chang, 1985 #81; Clatterbuck, 1989 #84; Countryman, 1989 #89; Cummings, 1953 #95; Dale, 1986 #96; Debald, 1976 #100; DeBald, 1971 #102; Dennis, 1987 #103; Donley, 1985 #109; DuBois, 1984 #110; Duerr, 1956 #113; Dwyer, 1988 #119; Dwyer, 1988 #123; Dwyer, 1990 #124; Dwyer, 1993 #122; Dwyer, 1993 #121; Farooq, 1995 #133; Farrell, 1964 #134; Feicht, 1985 #136; Guttenburg, 1951 #177; Herrick, 1968 #196; Hilt, 1987 #200; Kronrad, 1985 #239; LeDoux, 1989 #262; LeDoux, 1990 #269; Loomis, 1995 #275; Luppold, 1995 #284; Manthy, 1970 #288; McCauley, 1969 #295; McCay, 1973 #301; Mills, 1978 #324; Mills, 1988 #326; Mills, 1979 #327; Mitchie, 1986 #331; Perkey, 1991 #347; Perkey, 1993 #348; Rich, 1989 #359; Risbrudt, 1986 #361; Risbrudt, 1987 #360; Starkey, 1989 #391; Stringer, 1988 #397; Sturos, 1986 #401; Thomson, 1991 #408; Thomson, 1992 #409; Trimble, 1965 #412; Trimble, 1969 #414; Utz, 1970 #420; Utz, 1981 #422; Wagstaff, 1984 #428; Webster, 1963 #434; Webster, 1971 #437; Worley, 1963 #446; Worley, 1970 #447; Zipper, 1983 #456]

OZARK REGION
[DuBois, 1984 #110; Farrell, 1964 #134; Kurtz, 1981 #244]

PAULOWNIA
[Hardie, 1989 #183]

PESTS
[Donley, 1985 #109; Feicht, 1985 #136; Gansner, 1987 #153; Hicks, 1989 #199; LeDoux, 1990 #269; McCay, 1973 #302; Starkey, 1989 #391]

POLICY
[Caulfield, 1992 #79; Murray, 1989 #334; Strauss, 1987 #396; Webster, 1983 #435; White, 1986 #441]

POPLAR, HYBRID
[Bowersox, 1976 #45; Giese, 1984 #161; Hartsough, 1992 #185; Jorgens, 1987 #220; Lothner, 1983 #276; Lothner, 1986 #277]

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[Holley, 1976 #203; Kurtz, 1981 #244; Manthy, 1970 #288; McCauley, 1969 #297; Miller, 1984 #313; Miller, 1986 #315; Perkey, 1991 #347; Zasada, 1952 #452]

PRICES
[Abt, 1994 #1; Binkley, 1983 #33; Binkley, 1986 #32; Campbell, 1951 #72; Campbell, 1989 #71; DeBald, 1991 #99; Dennis, 1985 #104; DeSteiguer, 1989 #107; Haynes, 1988 #188; Holmes, 1990 #204; Kingsley, 1987 #234; Kronrad, 1985 #239; Luppold, 1987 #283; Luppold, 1995 #284; McCauley, 1969 #295; Mendel, 1976 #307; Ulrich, 1988 #416]

PRUNING
[Baker, 1985 #14; Dwyer, 1988 #119; Dwyer, 1988 #123; Dwyer, 1990 #124; Farooq, 1995 #133]

PULPWOOD
[DeBald, 1976 #101; Gansner, 1969 #156; Porterfield, 1972 #352; Schick, 1986 #369]

REGENERATION
[Brodie, 1982 #50; Bullard, 1992 #55; Franklin, 1989 #146; Hepp, 1989 #193; Holley, 1976 #203; Kellison, 1982 #224; Kellison, 1984 #226; Malac, 1979 #287; Manuel, 1993 #289; Porterfield, 1977 #351; Porterfield, 1979 #354; Rich, 1989 #358; Smith, 1973 #385; Steiner, 1987 #392; Utz, 1970 #420; Zahner, 1982 #451; Zipper, 1983 #456]

SCARLET/BLACK OAK
[Dale, 1986 #96; DuBois, 1984 #110; Dwyer, 1988 #119; Dwyer, 1988 #123; Dwyer, 1990 #124; Kurtz, 1981 #244]

SOUTHERN REGION
[Anderson, 1985 #10; Bullard, 1992 #55; Burkle, 1952 #63; Caulfield, 1992 #79; Clatterbuck, 1989 #84; Cubbage, 1989 #93; Cummings, 1953 #95; Guttenburg, 1951 #177; Hatcher, 1993 #186; Hepp, 1989 #193; Jackson, 1989 #217; Kellison, 1984 #226; Killcreas, 1976 #228; Kimbrough, 1992 #229; Kimbrough, 1992 #230; LeDoux, 1995 #266; Leopold, 1989 #271; McGee, 1982 #303; Meadows, 1995 #304; Porterfield, 1977 #351; Porterfield, 1972 #352; Porterfield, 1975 #353; Porterfield, 1979 #354; Rich, 1989 #358; Starkey, 1989 #391; Thomson, 1987 #407; Utz, 1977 #421; Wishart, 1985 #445; Zahner, 1982 #451]

SHORT-ROTATION INTENSIVE CULTURE
[Bowersox, 1976 #45; Dutrow, 1976 #118; Ferguson, 1981 #137; Giese, 1984 #161; Hartsough, 1992 #185; Jorgens, 1987 #220; Lothner, 1986 #277; Rose, 1976 #365]

SUPPLY
[Abt, 1994 #1; Baughman, 1988 #17; Binkley, 1983 #33; Binkley, 1986 #32; Buchanan, 1988 #53; Clark, 1986 #83; DeSteiguer, 1989 #107; Duerr, 1987 #111; Frye, 1989 #149; Haynes, 1988 #188; Hoover, 1985 #207; Irland, 1989 #216; Kellison, 1988 #225; Luppold, 1987 #283; Luppold, 1995 #284; May, 1992 #294; Ulrich, 1988 #416; Wallace, 1987 #429; Webster, 1983 #435; Wishart, 1985 #445]

SWEETGUM
[Clatterbuck, 1989 #84; Duerr, 1956 #113; Guttenburg, 1951 #177; Kellison, 1984 #226; Smith, 1973 #385; Thomson, 1991 #408; Thomson, 1992 #409]

SYCAMORE
[Dutrow, 1976 #118; Holley, 1976 #203; Rich, 1989 #358; Smith, 1973 #385]

TAXES
[Dennis, 1991 #105; Field, 1983 #139; Hoover, 1989 #209; Hoover, 1989 #210; Mills, 1979 #327; Siegel, 1987 #379; Utz, 1970 #420; Utz, 1985 #419]

THINNING
[Baumgras, 1989 #21; Baumgras, 1991 #23; Baumgras, 1992 #20; Baumgras, 1995 #25; Beck, 1989 #27; Biltonen, 1976 #30; Brock, 1986 #49; Bullard, 1983 #54; Bullard, 1983 #56; Bullard, 1985 #57; Canham, 1987 #77; Dale, 1986 #96; DuBois, 1984 #110; Dwyer, 1988 #119; Dwyer, 1988 #123; Dwyer, 1990 #124; Dwyer, 1993 #121; Hall, 1989 #181; Herrick, 1968 #196; Huyler, 1982 #214; Huyler, 1991 #213; Johnson, 1979 #219; Kearse, 1985 #223; Kurtz, 1981 #244; LeDoux, 1988 #260; LeDoux, 1989 #262; LeDoux, 1987 #268; Mattson, 1993 #293; McCauley, 1969 #297; McCauley, 1972 #298; Miller, 1984 #314; Miller, 1984 #313; Miller, 1986 #315; Miller, 1986 #322; Perala, 1983 #346; Perkey, 1991 #347; Risbrudt, 1986 #360; Risbrudt, 1987 #359; Roberts, 1986 #361; Roise, 1988 #362; Sarles, 1985 #368; Sonderman, 1984 #389; Sturos, 1986 #401; Thiede, 1986 #403; Thompson, 1991 #405; Webster, 1960 #433; Webster, 1963 #434; Zasada, 1952 #452]

TIMBER STAND IMPROVEMENT
[Gunter, 1983 #173; Herrick, 1968 #196; Lamson, 1987 #249; Lancaster, 1975 #250; Leak, 1980 #255; Manthy, 1970 #288; Miller, 1986 #315; Mills, 1978 #324; Porterfield, 1977 #351; Porterfield, 1979 #354; Risbrudt, 1986 #359; Utz, 1970 #420; Webster, 1960 #433; Webster, 1971 #437]

UNEVEN-AGED MANAGEMENT
[Adams, 1974 #3; Adams, 1974 #6; Adams, 1975 #7; Adams, 1976 #4; Bare, 1988 #15; Baumgras, 1995 #25; Beck, 1989 #27; Boucher, 1989 #44; Buongiorno, 1980 #61; Buongiorno, 1994 #60; Cummings, 1953 #95; Dale, 1987 #97; Duerr, 1952 #112; Erdmann, 1973 #126; Erickson, 1989 #130; Erickson, 1989 #129; Filip, 1962 #142; Filip, 1967 #141; Gove, 1989 #168; Gove, 1992 #169; Haight, 1985 #178; Haight, 1985 #180;

UNEVEN-AGED (Cont.)
Hansen, 1987 #182; Kaya, 1989 #221; LeDoux, 1991 #264; LeDoux, 1993 #265; Lu, 1993 #280; Lyon, 1986 #285; Martin, 1982 #292; McCauley, 1975 #296; McCauley, 1972 #299; McCay, 1980 #300; Miller, 1989 #316; Miller, 1991 #320; Miller, 1991 #317; Miller, 1991 #311; Miller, 1993 #318; Miller, 1993 #321; Miller, 1994 #319; Mills, 1988 #326; Mitchie, 1981 #329; Mitchie, 1985 #330; Murphy, 1987 #333; Niese, 1990 #339; Niese, 1993 #337; Niese, 1992 #338; Niese, 1995 #340; Rudolph, 1982 #366; Shaffer, 1993 #373; Smith, 1975 #381; Smith, 1987 #383; Smith, 1987 #384; Smith, 1980 #387; Trimble, 1971 #415; Trimble, 1974 #413; White, 1988 #440]

UPLAND HARDWOODS
[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]

VERSUS PINE
[Cubbage, 1989 #93; Franklin, 1989 #146; Hepp, 1989 #193; Herrick, 1968 #196; Leopold, 1989 #271; Mills, 1988 #326; Rich, 1989 #358; Smith, 1973 #385; Thomson, 1991 #408; Thomson, 1992 #409]

YELLOW-POPLAR
[Bickford, 1953 #29; Burkle, 1952 #63; Campbell, 1959 #74; Cummings, 1953 #95; Duerr, 1956 #113; Holley, 1976 #203; Kronrad, 1984 #241; Lucas, 1969 #281; Luppold, 1995 #284; McCauley, 1969 #295; Mendel, 1969 #310; Schroeder, 1984 #371; Smith, 1973 #385; Trimble, 1965 #412]

Article Summaries

1. Abt, R. C., F. W. Cubbage and G. Pacheco 1994. **Hardwood availability: who will meet the demand?** *Forest Farmer* 53(2): 13-14, 32-34.

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.

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2. Adams, D. M. 1974. **Derivation of optimal management guides**. In: *Proceedings of the Midwestern Forest Mensurationists Workshop*, Wisconsin Dells, Wisconsin.

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3. Adams, D. and A. R. Ek 1974. **Optimizing the management of uneven-aged forest stands**. *Canadian Journal of Forest Research* 4: 274-287.

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.

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4. Adams, D. M. 1976. **A note on the interdependence of stand structure and best stocking in a selectiou forest**. *Forest Science* 22(2): 180-184.

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.

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5. Adams, D. M. 1989. **Cost share programs and assistance**. In: *The continuing quest for quality: Proceedings of the 4th Black Walnut Symposium*, Carbondale, Illinois, July 30-August 2, 1989. Indianapolis, Indiana, Walnut Council. pp. 281-287.

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.

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6. Adams, D. M. and A. R. Ek 1974. **Derivation of optimal size class structures for northern hardwood stands**. In: *Whole tree utilization of hardwoods-an international meeting. Proceedings: Second Annual Hardwood Symposium of the Hardwood Research Council*, Cashiers, North Carolina, May 2-4, 1974. Hardwood Research Council. pp. 109-116.

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.

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7. Adams, D. M. and A. R. Ek 1975. **Derivation of optimal management guides for individual stands**. In: J. Meadows, B. Bare, K. Ware and C. Row Eds. *Systems Analysis and Forest Resource Management: Proceedings of a Workshop*, Athens, Georgia, August 11-13, 1975. Society of American Foresters, Systems Analysis Working Group. pp. 132-147.

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.

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8. Anderson, D. L. 1987. **Industrial management of corporate land**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 132-134.

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

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9. Anderson, W. C. 1974. **An economist's view of the pine-site hardwood problem**. *Forest Products Journal* 24(4): 14-16.

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

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10. Anderson, W. C. and R. M. Krinard 1985. **The investment potential of cottonwood sawtimber plantations**. In: *Proceedings of the 3rd Biennial*

Southern Silvicultural Research Conference, Atlanta, Georgia, November 7-8, 1984. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-54. pp. 190-197.

Examines 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.

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11. Arner, S. L., D. A. Gansuer and T. W. Birch 1990. **Rate of value change in New England timber stands**. Radnor, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-639. 7 pp.

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.

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12. Arola, R. A., E. S. Miyata, J. Bruhn and H. M. Steinhilb 1987. **Mechanized selective thinning of pole-size hardwoods**. Houghton, Michigan, USDA Forest Service, North Central Forest Experiment Station.

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13. Arthaud, G. J. 1991. **Aspen timber value and ruffed grouse habitat: economic trade-offs considering spatial and temporal dimensions**. Ph.D. Dissertation, University of Minnesota. 133 pp.

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.

---

14. Baker, F. A. and D. W. French 1985. **Economic effectiveness of operational therapeutic pruning for control of Dutch elm disease**. *Journal of Arboriculture* 11(8): 247-249.

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

---

15. Bare, B. B. and D. Opalach 1988. **Determining investment-efficient diameter distributions for uneven-aged northern hardwoods**. *Forest Science* 34(1): 243-249.

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.

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16. Baughman, M. J. 1985. **Economics of dutch elm disease control: a model and case study**. *Journal of Forestry* 83(9): 554-557.

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.

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17. Baughman, W. D. 1988. **Hardwood management in a hardwood-based company**. In: O. F. Hall and R. L. McElwee Eds. *Eastern hardwoods-an emerging forestry frontier: Proceedings of the 18th Forestry Forum*, Blacksburg, Virginia, April 21-22, 1988. Virginia Polytechnic Institute and State University. pp. 81-83.

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

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18. Baumgras, J. E. 1990. **The effects of product markets and multiproduct harvesting on the economics of managing even-aged upland oak stands**. Ph.D. Dissertation, West Virginia University, Ann Arbor, Michigan, University Microfilms International. 220 pp.

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.

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19. Baumgras, J. E. and D. O. Yandle 1986. **APTHIN: a microcomputer program to evaluate multiproduct utilization alternatives for thinnings in Appalachian hardwood stands**. In: H. V. Wiant, D. O. Yandle and W. E. Kidd Eds. *Proceedings Forestry Microcomputer Software Symposium*, Morgantown, West Virginia, June 29-July 2, 1986. West Virginia University. pp. 402-421.

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

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20. Baumgras, J. E. 1992. **Effects of silvicultural prescriptions and roundwood markets on the economic feasibility of hardwood thinnings**. In: *Proceedings of the Twentieth Annual Hardwood Symposium of the Hardwood Research Council: The future of multiple use in eastern hardwood forests*, Cashiers, North Carolina, June 1-3, 1992. Memphis, Tennessee, Hardwood Research Council. pp. 131-142.

Uses the OAKSIM computer growth & yield model and a harvesting simulation model developed by the author to evaluate the feasibility of different thinning regimes in a 50-acre upland oak stand ($SI_{50} = 70$). Net revenue is given for combinations of thinning at ages 30, 40, 50, 60, and 70 to residual stocking of 45%, 60%, and 75% under various combinations of high, medium, and low stumpage price levels for pulpwood/fuelwood, sawbolts, and sawlogs. The effect of merchandising is shown by estimating net revenue for the 60-year-old, 60% residual stocking treatment 1) with all wood sold as pulpwood/fuelwood, 2) multiproduct sorting with 8 inch minimum sawbolt scaling diameter, and 3) multiproduct sorting with 6 inch minimum sawbolt scaling diameter, all for various product prices. Also discusses the effect of road costs, marking costs, and sale administration costs on net revenues/feasibility.

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21. Baumgras, J. E. and C. B. LeDoux 1989. **Impact of product mix and markets in the economic feasibility of hardwood thinning**. In: *Proceedings of the Seventh Central Hardwood Conference*, 1989. USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-132. pp. 185-189.

Demonstrates the effect of multiproduct harvesting on thinning revenue and evaluates the economic feasibility of hardwood thinnings as a function of price level and haul distance to markets. Product marketing alternatives were 1) pulpwood only, 2) pulpwood and large sawlogs, and 3) pulpwood, sawbolts, and small and large sawlogs. Feasibility determination assumes multiproduct harvest. Costs were determined using the ECOST program and 20, 40, and 60 mile haul distances. Revenues were determined using the APTHIN program with low, medium, and high prices.

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22. Baumgras, J. E. and C. B. LeDoux 1989. **Production analysis of two tree-bucking and product-sorting methods for hardwoods**. In: *Proceedings of the Southern Regional Council on Forest Engineering*, Auburn, Alabama, May 3-4, 1989. Auburn, Alabama, USDA Forest Service, Southern Forest Experiment Station; Auburn University, School of Forestry. pp. 88-96.

Gives a production analysis of 1) chain saw bucking of northern hardwoods with veneer logs, factory sawlogs, low-grade sawlogs, and pulpwood sorted, and 2) slasher bucking of red and white oaks with factory sawlogs, low-grade sawlogs, and pulpwood sorted. Includes a cost analysis section with a table of bucking/decking costs per unit volume for each system as a function of felling/skidding production rates and volume/logs per turn.

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23. Baumgras, J. E. and C. B. LeDoux 1991. **Integrating forest growth and harvesting cost models to improve forest management planning**. In: *Proceedings: 8th Central Hardwood Forest Conference*, University Park, Pennsylvania, March 4-6, 1991. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-148. pp. 120-131.

Describes and compares two methods of estimating revenue from the thinning and harvesting of hardwood stands. These methods involve the integration of growth-and-yield models with either reported stumpage prices or delivered prices minus estimated harvesting and haul costs. Entry cash flows and rotation net present value were estimated for three even-aged management options that included one to three thinnings with a 90-year rotation.

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24. Baumgras, J. E. and C. B. LeDoux 1992. **Software to estimate timber harvesting cost and revenue from eastern hardwoods**. In: *American forestry – an evolving tradition: Proceedings of the 1992 Society of American Foresters National Convention*, Richmond, Virginia, October 25-27, 1992. Bethesda, Maryland, Society of American Foresters. pp. 573-574.

Briefly describes the THIN, GB-SIM, ECOST, and PROFIT-PC computer programs, all of which, except for THIN, were designed to aid in harvesting decisions in eastern hardwoods. Provides information on how to obtain the programs.

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25. Baumgras, J. E., G. W. Miller and C. B. LeDoux 1995. **Economics of hardwood silviculture using skyline and conventional logging**. In: *Proceedings of the Twenty-Third Annual Hardwood Symposium – Advances in hardwood utilization: following profitability from the woods through rough dimension*, Cashiers, North Carolina, May 17-20, 1995. National Hardwood Lumber Association. pp. 5-17.

Evaluates single-tree selection, group selection, even-aged management, two-age management, 15 in. diameter limit cutting (SI 64 and 70), and two commercial

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.

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26. Baumgras, J. E. and P. A. Peters 1985. **Cost and production analysis of the Bitterroot Miniyarder on an Appalachian hardwood site**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-557. 13 pp.

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 cunit 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.

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27. Beck, D. E. 1989. **Selection thinning in southern Appalachian hardwoods**. In: J. H. Miller Ed. *Proceedings of the Fifth. Biennial Southern Silvicultural Research Conference*, Memphis, Tennessee, November 1-3, 1988. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-74. pp. 291-294.

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.

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28. Bell, R. D. 1989. **Influences of varying stand harvest methods on timber harvesting costs in southeastern Virginia hardwoods**. M.S. Thesis, Virginia Polytechnic Institute and State University, School of Forest and Wildlife Resources, Blacksburg, Virginia. 68 pp.

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29. Bickford, C. A. 1953. **An aid in choosing the right tree to leave**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Station Paper No. 65. 8 pp.

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.

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30. Biltonen, F. E., W. A. Hillstrom, H. M. Steinhilb and R. M. Godman 1976. **Mechanized thinning of northern hardwood pole stands: methods and economics**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Research Paper NC-137. 17 pp.

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.

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31. Binkley, C. S. and C. L. Washburn 1988. **The financial risk of private timberland investments in South Carolina**. Yale University, Working Paper.

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32. Binkley, C. S. and P. A. Cardellichio 1986. **Economic projections of hardwood lumber and timber markets**. In: D. Robertson and J. L. White Eds. *Eastern hardwoods: the resource, the industry, and the markets. Proceedings 47345*, Harrisburg, Pennsylvania, September 9-11, 1985. Forest Products Research Society, Madison, Wisconsin. pp. 19-30.

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.

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33. Binkley, C. S. and P. C. Cardellichio 1983. **Modeling the hardwood sector: issues and prospects**. In: *Forest sector models*. R. Seppala, C. Row and A. Morgan. pp. 71-91.

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.

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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,

Blacksburg, Virginia. 209 pp.

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35. Blinn, C. R. 1988. **Maximizing profitability of harvesting systems.** *Forest Industries* 115(10): 26-29.

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.

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36. Blinn, C. R., D. W. Rose and M. L. Belli 1988. **Guide to analyzing investment options using TWIGS**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-123. 15 pp.

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.

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37. Blinn, C. R. and S. A. Sinclair 1986. **Economics of integrating the harvesting and marketing of eastern hardwood timber**. In: J. L. White Ed. *Eastern hardwoods: the resource, the industry, and the markets*, Harrisburg, Pennsylvania, September 9-11, 1985. Forest Products Research Society, Madison, Wisconsin; Hardwood Research Council. pp. 157-169.

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).

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38. Blinn, C. R. and S. A. Sinclair 1986. **Profitability of various timber harvesting systems as affected by product sorting and timber stand parameters.** *Northern Journal of Applied Forestry* 3: 167-172.

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.

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39. Blinn, C. R., S. A. Sinclair and A. R. Ek 1983. **A method for estimating the multi-product value of hardwood timber stands**. *Forest Products Journal* 33(3): 49-54.

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.

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40. Blinn, C. R., S. A. Sinclair, C. C. Hassler and J. A. Mattson 1986. **Comparison of productivity, capital, and labor efficiency of five timber harvesting systems for northern hardwoods**. *Forest Products Journal* 36(10): 63-69.

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.

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41. Bliss, J. C. and A. J. Martin 1989. **Data gap in growth and investment projections of black walnut plantations.** *Northern Journal of Applied Forestry* 6: 169-171.

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

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42. Bommer, R. H., Jr. 1983. **Economic considerations in the management of the nonindustrial hardwood resonrce**. In: *America's hardwood forests – opportunities unlimited. Proceedings of the 1982 Convention of the Society of American Foresters*, Cincinnati, Ohio, September 19-22, 1982. Society of American Foresters, SAF Publication 83-04. pp. 38-41

General discussion of the economic considerations of managing and marketing hardwood timber for the non-industrial forest owner.

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43. Boucher, B. A. 1989. **Development of a method for implementing group selection in Appalachian hardwoods**. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 121 pp.

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44. Boucher, B. A. and O. F. Hall 1989. **Implementing group selection in Appalachian hardwoods using economic guidelines**. In: *Proceedings of the Seventh Central Hardwood Forest Conference*, Carbondale, Illinois, March 5-8, 1989. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-132. pp. 221-230.

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.

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45. Bowersox, T. W. and W. W. Ward 1976. **Economic analysis of a short-rotation fiber production system for hybrid poplar**. *Journal of Forestry* 74(11): 750-753.

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.

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46. Brabander, J. J., R. E. Masters and R. M. Short 1985. **Bottomland hardwoods of eastern Oklahoma: a special study of their status, trends, and values**. Oklahoma Department of Wildlife Conservation; US Fish and Wildlife Service. 145 pp.

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.

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47. Brisbin, R. L. 1985. **Quality hardwoods – what a forester needs to know**. In: *Proceedings of the 1985 Pennsylvania State Forest Resources Issues Conference*, University Park, Pennsylvania, Pennsylvania State University.

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48. Brock, S. M., R. B. Anderson and J. O. Ruan 1986. **Developing and testing models for predicting hardwood stumpage prices in West Virginia**. In: West Virginia University, Agricultural and Forestry Experiment Station, West Virginia Forestry Notes no. 12. pp. 7-10.

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49. Brock, S. M., K. D. Jones and G. W. Miller 1986. **Felling and skidding costs associated with thinning a commercial Appalachian hardwood stand in northern West Virginia**. *Northern Journal of Applied Forestry* 3(4): 159-163.

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.

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50. Brodie, J. D. and P. L. Tedder 1982. **Regeneration delay: economic cost and harvest loss**. *Journal of Forestry* 80(1): 26-28.

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.

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51. Bromley, P. T., M. C. Vodak and R. H. J. Giles 1983. **Managing southern Appalachian hardwoods for firewood and wildlife habitat**. In: *America's hardwood forests-opportunities unlimited. Proceedings of the 1982 Convention of the Society of American Foresters*, Cincinnati, Ohio, September 19-22, 1982. Society of American Foresters, SAF Publication 83-04. pp. 233-237.

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).

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52. Brummel, K. R. 1992. **The impact of group-selection silviculture on timber harvest cost in the southern Appalachians**. M.S. Thesis, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 145 pp.

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53. Buchanan, R. W. J. 1988. A **look ahead at hardwoods in industry**. In: O. F. Hall and R. L. McElwee Eds. *Eastern hardwoods - an emerging forestry frontier: Proceedings of the 18th Forestry Forum*, Blacksburg, Virginia, April 21-22, 1988. Virginia Polytechnic Institute and State University. pp. 1-5.

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

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54. Bullard, S. H. 1983. **Mixed-hardwood thinning optimization**. Ph.D. Dissertation, Virginia Polytechnic Institute and State University, Blacksburg, Virginia. 189 pp.

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.

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55. Bullard, S.H., J. D. Hodges, R. L. Johnson and T. J. Straka 1992. **Economics of direct seeding and planting for establishing oak stands on old-field sites in the South**. *Southern Journal of Applied Forestry* 16(1): 34-40.

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.

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56. Bullard, S. H. and W. D. Klemperer 1983. **Thinning optimization for mixed-species stands**. In: *Proceedings of the 1983 Society of American Foresters National Convention: New forests for a changing world*, Portland, Oregon, October 16-20, 1983. Society of American Foresters. pp. 525-529.

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.

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57. Bullard, S. H., H. D. Sherali and W. D. Klemperer 1985. **Estimating optimal thinning and rotation for mixed-species timber stands using a random search algorithm**. *Forest Science* 31(2): 303-315.

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.

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58. Bullard, S. H. and T. J. Straka 1988. **Structure and funding of state-level forestry cost-share programs**. *Northern Journal of Applied Forestry* 5(2): 132-135.

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

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59. Buongiorno, J., S. Dahir, H. C. Lu and C. R. Lin 1992. **Structural diversity and economic returns in managed forest stands**. Madison, Wisconsin, University of Wisconsin, Department of Forestry. 25 pp.

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60. Buongiorno, J., S. Dahir, H. C. Lu and C. R. Lin 1994. **Tree size diversity and economic returns in uneveu-aged forest stands**. *Forest Science* 40(1): 83-103.

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.

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61. Buongiorno, J. and B. Mitchie 1980. **A matrix model of nneven-aged forest management**. *Forest Science* 26(4): 609-625.

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.

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62. Buongiorno, J. and J. S. Hseu 1993. **Volume and value growth of hardwood trees in Wisconsin**. *Northern Journal of Applied Forestry* 10(2): 63-69.

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

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63. Burkle, J. L. and S. Guttenberg 1952. **Marking guides for oaks and yellow poplar in the southern uplands**. USDA Forest Service, Southern Forest Experiment Station, Occasional Paper 125. 27 pp.

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.

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64. Callahan, J. C. 1966. **Economic retnrns associated with fifty nonindnstrial-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.

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65. Callahan, J. C. and R. P. Smith 1974. **An economic analysis of hlack walnut plantation enterprises**. West Lafayette, Indiana, Purdue University, Agricultural Experiment Station, Research Bulletin No. 912. 20 pp.

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.

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66. Campbell, G. E. 1988. **The economics of short-rotation intensive culture in Illinois and the central states**. University of Illinois at Urbana-Champaign, Department of Forestry, Forest Research Report 88-12.

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67. Campbell, G. E. 1988. **The impacts of cost-sharing and income taxation on forestry investments: a case stndy**. University of Illinois at Urbana-Champaign, Department of Forestry, Forestry Research Report no. 88-11.

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68. Campbell, G. E. and J. O. Dawson 1988. **The economics of interplanting nitrogen-fixing nurse trees with eastern black walnut**. University of Illinois at Urbana-Champaign, Department of Forestry, Forestry Research Report 88-14.

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69. Campbell, G. E. and J. O. Dawson 1989. **Growth, yield, and value projections for black walnut interplantings with black alder and antumn olive**. *Northern Journal of Applied Forestry* 6: 129-132.

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.

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70. Campbell, G. E. and R. W. Koenig 1987. **A financial analysis of three upland oak sites in southern Illinois**. In: *Proceedings of the Central Hardwood Forest Conference VI*, Knoxville, Tennessee, February 24-26, 1987. University of Tennessee, Department of Forestry, Wildlife, and Fisheries; USDA Forest Service, Southern Forest Experiment Station; Society of American Foresters. pp. 149-158.

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. LEV's were determined on a before- and after-tax basis. A sensitivity analysis is also included.

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71. Campbell, G. E. and D. C. White 1989. **Interpretations of Illinois stumpage price trends**. *Northern Journal of Applied Forestry* 6(3): 115-120.

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.

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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.

Preseuts 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.

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73. Campbell, R. A. 1953. **Logging methods and costs in the southern Appalachians**. USDA Forest Service, Southeastern Forest Experiment Station, Station Paper 30. 29 pp.

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.

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74. Campbell, R. A. 1959. **Tree grades give accurate estimates of second growth yellow poplar values**. Asheville, North Carolina, USDA Forest Service, Southeastern Forest Experiment Station, Station Paper 108. 14 pp.

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.

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75. Campbell, G. and R. Koenig 1987. **A financial analysis of upland hardwood even-aged management in Illinois**. Illinois Agricultural Experiment Station, Forestry Research Report No. 87-14. 15 pp.

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.

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76. Campbell, R. A. 1955. **Tree grades and economic maturity for some Appalachian hardwoods**. Asheville, North Carolina, USDA Forest Service, Southeastern Forest Experiment Station, Station Paper 53. 22 pp.

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.

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77. Canham, H. O. and S. L. Guerin 1987. **Economic thinning guides for northern hardwoods**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 143-158.

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.

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78. Casey, L. R. 1992. **Federal cost/share programs for planting black walnut and other hardwood species**. *Walnut Council Bulletin* 19(1): 1-3.

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

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79. Caulfield, J., J. Welker and R. Meldahl 1992. **Economic tradeoffs of streamside management zones**. In: J. C. Welker Ed. *Proceedings of the 1992 Southern Forest Economics Workshop on the Economics of Southern Forest Productivity: Competing in world markets*, Mobile, Alabama, April 29-May 1, 1992. pp. 211-224.

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.

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80. Cayen, T. J. and O. F. Hall 1987. **Using economic factors in managing hardwoods for high quality**. In:

R. L. Hay, F. W. Woods and H. DeSelm Eds. *Proceedings of the Central Hardwood Forest Conference VI*, Knoxville, Tennessee, February 24-26, 1987. University of Tennessee, Dept. of Forestry, Wildlife and Fisheries; USDA Forest Service, Southern Forest Experiment Station; Society of American Foresters. pp. 159-167.

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.

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81. Chang, S. J. 1985. **An economic analysis of a new growth and yield model for oaks in New England**. In: C. D. Risbrudt and P. J. Jakes, Compilers. *Forestry research evaluation: current progress, future directions*, St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-104. pp. 79-81

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.

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82. Church, T. W. J. 1966. **The cost of scaling & grading hardwood sawlogs**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-49. 21 pp.

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.

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83. Clark, F. B. 1986. **The hardwood resource**. In: J. L. White Ed. *Eastern hardwoods: the resource, the industry, and the markets. Proceedings 47345*, Harrisburg, Pennsylvania, September 9-11, 1985. Forest Products Research Society, Madison, Wisconsin. pp. 13-18.

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

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84. Clatterbuck, W. K. and B. Orr 1989. **A financial comparison of short and long timber rotations associated with two patterns of cherrybark oak development**. In: *Proceedings of the Fifth Biennial Southern Silvicultural Research Conference*, Memphis, Tennessee, November 1-3, 1988. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-74. pp. 309-315.

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.

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85. Clawson, M. 1977. **Decision making in timber production, harvesting, and marketing**. Washington, D.C., Resources for the Future, Inc., Research Paper R-4. 127 pp.

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86. Coen, J. A., C. Schnepf and J. F. Geunthner 1992. **Market opportunities: hybrid poplars**. University of Idaho, Agricultural Extension Service, CIS 1006. 4 pp.

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87. Conkin, M. E. 1971. **Cost of timber management for selected areas in the northern region of the United States**. M.S. Thesis, Iowa State University, Ames, Iowa. 103 pp.

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88. Cook, D. W. 1978. **What rates of return on NIPF investments**. *Journal of Forestry* 76(7): 411-413.

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.

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89. Countryman, D. W. and H. R. Miller 1989. **Investment analysis of upland oak stands with sugar maple understories: management for oak vs. conversion to sugar maple in Iowa and Missouri**. *Northern Journal of Applied Forestry* 6(4): 165-169.

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.

90. Crow, T. R. 1985. **Diameter limit cutting.** In: J. G. Hutchinson Ed. *Northern Hardwood Notes*, St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station.

91. Cubbage, F. W. and A. H. Gorse, IV. 1984. **Harvesting mountain hardwoods with a small skidder.** In: *1984 Winter Meeting of the American Society of Agricultural Engineers*, St. Joseph, Michigan, American Society of Agricultural Engineers. pp. 12.

92. Cubbage, F. W. and J. R. Saucier 1985. **Hardwood fuelwood in north Georgia: resonrces, utilization, and harvesting.** Georgia Forestry Commission, Research Division, Georgia Forest Research Paper 58. 10 pp.

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.

93. Cubbage, F. W., W. D. Greene and J. P. Lyon 1989. **Tree size and species, stand volnme, and tract size: effects on southern harvesting costs.** *Southern Journal of Applied Forestry* 13(3): 145-152.

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.

94. Culhane, J. C. and J. E. Gunter 1986. **Biological and financial rotation age of established aspen stands.** Michigan State University, Agricultural Experiment Station, Research Report 478. 7 pp.

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.

95. Cummings, W. H. and T. C. Zarger 1953. **Guide for improved forest management for sawtimber from the major hardwoods in the Tennessee Valley.** TVA, Division of Forestry Relations. 56 pp.

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.

96. Dale, M. E. and D. E. Hilt 1986. **Thinning pole and small sawtimber mixed oak stands.** In: H. C. Smith and M. C. Eye Eds. *Proceedings: Guidelines For Managing Immature Appalachian Hardwood Stands*, Morgantown, West Virginia, May 28-30, 1986. West Virginia University, College of Agriculture and Forestry, SAF Publication 86-02. pp. 99-117.

Uses the OAKSIM growth and yield simulator to project the effects of thinning upland oak stauds 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.

97. Dale, V. H. 1987. **Using a model of forest community dynamics for decision making.** In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service, pp. 210-219.

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.

98. Davies, K. 1991. **Forest investment considerations for planning thinnings and harvests.** *Northern Journal of Applied Forestry* 8: 129-131.

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.

99. DeBald, P. S. and M. E. Dale 1991. **Tree value conversion standards revisited.** Broomall, Pennsylvania, USDA Forest Service, Northeast Forest Experiment Station, Research Paper NE-645. 32 pp.

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.

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100. Debald, P. S. and J. Mendel 1976. **An individual-tree approach to making stand evaluation**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-336. 13 pp.

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 .

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101. DeBald, P. S. and J. J. Mendel 1976. **Composite volume and value tables for hardwood pnlpwood**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-338. 43 pp.

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.

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102. DeBald, P. S. and J. J. Mendel 1971. **Determining the rate of valne increase for oaks**. In: *Proceedings: The Oak Symposium*, Morgantown, West Virginia, August 16-20, 1971. USDA Forest Service, Northeastern Forest Experiment Station, Un-numbered Series. pp. 142-151.

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.

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103. Dennis, D. F. 1987. **Rates of value change on un-cut forest stands in New Hampshire**. *Northern Journal of Applied Forestry* 4: 64-66.

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.

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104. Dennis, D. F. and S. B. Remington 1985. **The influence of price expectations on forestry decisions**. *Northern Journal of Applied Forestry* 2: 81-83.

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.

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105. Dennis, D. F. and P. E. Sendak 1991. **An alternative property tax program requiring a forest management plan and scheduled harvesting**. In: *Proceedings: 8th Central Hardwood Forest Conference*, University Park, Pennsylvania, March 3-6, 1991. USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-148. pp. 15-22

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.

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106. DeSteiguer, J. E., L. W. Hayden, D. L. Holley, Jr., W. G. Luppold, W. G. Martin, D. H. Newman and R. M. Sheffield 1989. **Southern Appalachian timber stndy**. USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-56. 45 pp.

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107. DeSteiguer, J. E., L. W. Hayden, D. L. Holley, Jr., W. G. Luppold, W. G. Martin, D. H. Newman and R. M. Sheffield 1989. **Southern Appalachian hardwood timber market trends**. *Southern Journal of Applied Forestry* 13(1): 29-33.

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.

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108. Doak, S. C., B. Stewart and P. Tuazon 1987. **Economic forces affectiug California's hardwood resource**. In: T. R. Plumb and N. H. Pillsbury Tech. Coords. *Proceedings of the Symposium on Multiple-Use Management of California's Hardwood Resources*, San

Luis Obispo, California, November 14-16, 1986. Berkeley, California, USDA Forest Service, Pacific Southwest Forest Experiment Station, General Technical Report PSW-100. pp. 268-272.

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

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109. Donley, D. E. and D. L. Feicht 1985. **Oak sawtimber losses in stands defoliated by gypsy moth**. In: J. O. Dawson and K. A. Majerus Eds. *Proceedings: Fifth Central Hardwood Forest Conference*, Urbana-Champaign, Illinois, April 15-17, 1985. University of Illinois, Dept. of Forestry. pp. 275-279.

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.

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110. DuBois, M. R., R. Rogers, W. B. Kurtz and H. E. Garrett 1984. **An economic evaluation of thinning black oak stauds in the Missouri Ozarks**. In: R. W. Guldin Ed. *Payoffs from new techniques for managing and processing southern hardwoods. Proceedings: 1984 Southern Forest Economics Workshop*, Memphis, Tennessee, March 13-15, 1984. pp. 40-52.

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.

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111. Duerr, W. A. 1987. **Eastern hardwood management: some economic background**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 1-9.

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.

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112. Duerr, W. A. and W. E. Bond 1952. **Optimal stocking of a selection forest**. *Journal of Forestry* 50(1): 12-16.

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.

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113. Duerr, W. A., J. Fedkiw and S. Guttenburg 1956. **Financial Maturity: a guide to profitable timber growing**. USDA, Technical Bulletin No. 1146. 74 pp.

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.

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114. Durham, J. F. 1982. **The economic and silvicultural feasibility of thinning mixed stands of oak in southern Missouri**. M.S. Thesis, University of Missouri-Columbia. 77 pp.

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115. Dutrow, G. 1980. **Economic considerations in artificial and natural regeueratiou of hardwoods**. In: *Proceedings of the Hardwood Regeneration Symposium*, Atlanta, Georgia, Southeast Lumber Manufacturing Association. pp. 48-57.

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116. Dutrow, G. 1976. **Cottonwood plantations and the question of profit**. In: B. A. Thiegles and S. B. Land Eds. *Proceedings: Symposium on Eastern Cottonwood and Related Species*, Greenville, Mississippi, September 28-October 3, 1976. Baton Rouge, Louisiana, Louisiana State University, Division of Continuing Education. pp. 432-437.

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

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117. Dutrow, G. F., J. S. McKnight and S. Guttenburg 1970. **Investment guide for cottonwood planters**. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, Research Paper SO-59. 15 pp.

Estimates rate of return of both pulpwood and sawtimber rotation cottonwood plantations under

varying degrees of site quality, discount rate, and stumpage price and for single and perpetual harvests. The author identifies cost assumptions and also discusses the inclusion of revenue from combined cottonwood/agricultural crop production.

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118. Dutrow, G. F. and J. R. Saucier 1976. **Economics of short rotation sycamore**. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, Research Paper SO-114. 16 pp.

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.

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119. Dwyer, J. P. 1988. **Evaluation of the long-term silvicultural and economic effects of thinning and pruuing treatments on a scarlet and black oak timber stand in southeastern Missouri**. Ph.D. Dissertation, University of Missouri, Columbia, Missouri. 268 pp.

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.

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120. Dwyer, J. P. 1995. **Log quality from stump to mill**. In: *Proceedings of the Twenty-Third Annual Hardwood Symposium – Advances in hardwood utilization: following profitability from the woods through rough dimension*, Cashiers, North Carolina, May 17-20, 1995. National Hardwood Lumber Association. pp. 27-35.

Describes a log bucking training course offered by the Vermont Forest Products Association that is designed to improve value recovery from logs including hardwoods.

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121. Dwyer, J. P., D. C. Dey and W. B. Kurtz 1993. **Profitability of precommercially thiuning oak stump sprouts**. *Northern Journal of Applied Forestry* 10(4): 179-183.

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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122. Dwyer, J. P., D. C. Dey and W. B. Kurtz 1993. **Profitability of precommercially thinning oak stump sprouts**. In: A. R. Gillespie Ed. *Proceedings 9th Central Hardwood Forest Conference*, West Lafayette, Indiana, March 8-10, 1993. USDA Forest Service, General Technical Report NC-161. pp. 373-380.

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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123. Dwyer, J. P. and K. E. Lowell 1988. **Long-term effects of thinning and pruning ou the quality, quantity, and value of oak lumber**. *Northern Journal of Applied Forestry* 5: 258-260.

Presents 32-year lumber yield, grade, and value differences between five thinning regimes, with and without pruning in a scarlet/black oak stand in Missouri. Thinning regimes were control; 100 crop trees with light, moderate, or heavy competition control; and 50 crop trees with heavy competition control. Pruning was to 17 feet. Lumber value was calculated on a per tree/by species basis and per stand basis.

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124. Dwyer, J. P., R. L. Plain and W. B. Kurtz 1990. **Managing oak timberlands for profitability**. *Journal of the American Society of Farm Managers and Rural Appraisers* 54(2): 69-75.

Reports on a study of thinning and pruning in 30-year-old scarlet/black oak stands in Missouri. The study included control plots with no thinning and plots with 100 crop trees/acre under heavy, moderate, and light thinning as well as plots with 50 crop trees/acre and heavy thinning. At age 60, random trees from each treatment were cut, sawn, and graded; and their lumber value was determined. Net present worth was determined at 4.62% interest for each thinning/pruning combination. Study results were then used in conjunction with the TWIGS growth model to determine a thinning/management regime that would maximize net present value of a 30-year-old stand under a 63-year rotation.

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125. Ellefson, P. V. 1984. **Encouraging growth and**

use of eastern hardwoods: public and private programs for the task. *Forest Products Journal* 34(10): 18-23.

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

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126. Erdmann, G. G. and R. R. Oberg 1973. **Fifteen-year results from six cutting methods in second-growth northern hardwoods**. USDA Forest Service, North Central Forest Experiment Station, Research Paper NC-100. 12 pp.

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.

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127. Erickson, M. D. 1989. **An economic analysis of northern hardwood management practices: 32-year results**. M.S. Thesis, Michigan Technical University, School of Forestry & Wood Products, Houghton, Michigan. 57 pp.

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128. Erickson, M. D., C. C. Hassler and C. B. LeDoux 1992. **Group selection harvests: influence of group size on harvesting costs and productivity**. In: *Council on Forest Engineering 15th Annual Meeting*, Hot Springs, Arkansas, August 10-13, 1992.

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129. Erickson, M. D., G. D. Mroz and D. D. Reed 1989. **An economic comparison of lumber grade yields in northern hardwood stands managed under alternative cutting methods**. In: *Making the most of the hardwood resource: Proceedings of the 17th Annual Hardwood Symposium of the Hardwood Research Council*, Merrimac, Wisconsin, May 7-10, 1989. Hardwood Research Council. pp. 53-67.

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.

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130. Erickson, M. D., D. D. Reed and G. D. Mroz 1989. **A 32-year study of stand development and financial returns for eight cutting methods in northern hardwood stands**. In: C. W. Martin, S. C. Tattersall and L. M. Tritton Eds. *New perspectives on silvicultural management of northern hardwoods. Proceedings of the 1988 Symposium on the Conflicting Consequences of Practicing Northern Hardwood Silviculture*, Durham, New Hampshire, June 9-10, 1988. Broomall, Pennsylvania, USDA Forest Service, Northeast Forest Experiment Station, General Technical Report NE-124. pp. 81-83.

Briefly reviews the 32-year financial results of a study (Reed, D.D.; Holmes, M.J.; Johnson, J.A. 1986) of light improvement; 22, 16, 12, and 5 inch diameter limit; and 90, 70, and 50 ft.^{2} single tree selection harvests in Baraga county, Michigan northern hardwoods. Gives 32-year stand tables, tree grade distribution by treatment, and volume to be removed for the study.

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131. Erickson, M. D., D. D. Reed and G. D. Mroz 1990. **Stand development and economic analysis of alternative cutting methods in northern hardwoods: 32-year results**. *Northern Journal of Applied Forestry* 7(4): 153-158.

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 ft^2) in Michigan hardwoods.

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132. Fairweather, S. E. 1987. **Harvest scheduling economics - integrating biological, financial, and operational considerations**. In: *Economics of Eastern Hardwood Management; Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. University Park, Pennsylvania, The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service, pp. 254-261

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.

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133. Farooq, M., W. B. Kurtz and J. P. Dwyer 1995. **Artificial pruning of immature oak stands is not profitable**. *Southern Journal of Applied Forestry* 19(1): 14-17.

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.

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134. Farrell, J. H. 1964. **Timber income potential from small forests in the Missouri Ozarks**. St. Paul, Minnesota, USDA Forest Service, Central States Forest Experiment Station, Research Paper CS-11. 74 pp.

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.

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135. Fautley, R. 1988. **Economic returns to private woodlots utilizing aspen for sale in pulping**. In: *Forestry or agriculture: a case for diversification*. FRDA Report 42. Canada/B.C. Forest Resource Development Agreement. pp. 46-49.

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136. Feicht, D. L. and R. Acciavatti 1985. **Pilot test of red oak borer silvicultural control in commercial forest stands**. In: J. O. Dawson and K. A. Majerus Eds. *Proceedings: Fifth Central Hardwood Forest Conference*, Urbana-Champaign, Illinois, April 15-17, 1985. University of Illinois, Dept. of Forestry. pp. 280-284.

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

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137. Ferguson, K. D., D. W. Rose, D. C. Lothner and J. Zavitokovski 1981. **Hybrid poplar plantations in the Lake States - a financial analysis**. *Journal of Forestry* 79(10): 664-667.

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

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138. Ferrell, R. S. and W. R. Bentley 1969. **Plantation investment opportunities in black walnut**. *Journal of Forestry* 67(4): 250-254.

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

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139. Field, D. B. 1983. **The influence of property taxation on hardwood forest management**. In: *America's hardwood forests – opportunities unlimited. Proceedings of the 1982 Convention of the Society of American Foresters*, Cincinnati, Ohio, September 19-22, 1982. SAF Publication 83-04. pp. 33-37

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.

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140. Filip, S. M. 1978. **Impact of beech bark disease on uneven-age management of a northern hardwood forest: 1952 to 1976**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-45. 7 pp.

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141. Filip, S. M. 1967. **Harvesting costs & returns under 4 cutting methods in mature beech-birch-maple stands in New England**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-87. 14 pp.

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 multi-product bucking. Average local costs and prices were used, and the cost of marking in selection and patch cuts was not included in the analysis.

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142. Filip, S. M. and W. B. Leak 1962. **Profitable woodlot management in New England**. USDA Forest Service, Northeasteru Forest Experiment Station, Station Paper 170. 17 pp.

Gives costs aud 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, aud 3) owner marks and sells stumpage.

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143. Fix, W. L. and R. M. Nacker 1975. **Economic returns from Indiana demonstration woodlands**. Purdue University, Purdue Cooperative Extension Publication F-66. 10 pp.

144. Foster, L. H. and F. H. Kung 1980. **Economic efficiency of two pruning heights in black walnut**. In: *Proceedings: Third meeting of the central hardwood conference*. pp. 390-400.

145. Frame, E. D. 1986. **How profits are lost in the woods**. In: *Proceedings of the 14th Annual Hardwood Symposium of the Hardwood Research Council*, Memphis, Tennessee. Hardwood Research Council. pp. 162-176.

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

146. Franklin, E. C. 1989. **Managed mixed pine-hardwood stands can yield high rates of return on investment**. In: *Proceedings of a symposium on pine-hardwood mixtures: a symposium on management and ecology of the type*, Atlanta, Georgia, April 18-19, 1989. Asheville, North Carolina, USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-58. pp. 230-235.

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 micro-computer 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.

147. Fraser, R. F. 1993. **Changes in US hardwood supply in the loug term**. Morgantown, West Virginia, West Virginia University, Appalachian Export Center for Hardwoods. 18 pp.

148. Frayer, W. E., J. B. Pickens and J. Engal 1995. **HW-BUCK: a computer game to help hardwood log buckers improve value recovery**. In: *Proceedings of the Twenty-Third Annual Hardwood Symposium – Advances in hardwood utilization: following profitability from the woods through rough dimension*, Cashiers, North Carolina, May 17-20, 1995. National Hardwood Lumber Association. pp. 37-44.

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 bncking value recovery from hardwoods.

149. Frye, L. R. 1989. **Quality requirements of black walnut lumber and veneer**. In: *The continuing quest for quality: Proceedings of the 4th Black Walnut Symposium*, Carbondale, Illinois, July 30-August 2, 1989. Indianapolis, Indiana, Walnut Council. pp. 12-14.

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

150. Funk, D. T., R. C. Schlesinger and D. J. Polak 1978. **Value gains from sclective thinning of Juglans nigra**. In: *IUFRO Proceedings: Symposium on establishment and treatment of high-quality hardwood forests in the temperate climatic region*, Nancy-Champenoux, France, IUFRO. pp. 286-296.

151. Gansner, D. A. 1968. **An evaluation of pulpwood investment management opportunities in upland hardwood forests of southeastern Ohio**. M.S. Thesis, Ohio State University, Columbus, Ohio. 68 pp.

152. Gansner, D. A., S. L. Arner and T. W. Birch 1990. **Timber value growth rates in New England**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-632. 14 pp.

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.

153. Gansner, D. A. and O. W. Herrick 1987. **Estimating thc benefits of gypsy moth control on timberland**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Note NE-RN-337. 9 pp.

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 valne 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 attribntable 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**

of value change. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 53-60.

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, diameter, 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.

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155. Gansner, D. A., S. L. Arner and S. J. Zarnoch 1990. **Timber value growth rates in Maiue.** *Northern Journal of Applied Forestry* 7(2): 62-64.

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

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156. Gansner, D. A. and E. T. Shaudys 1969. **Opportunities for pulpwood growing investment in southeastern Ohio.** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-151. 22 pp.

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.

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157. Gardner, W. E. 1980. **Economic comparison of natural regeneration with plantation management.** In: *Hardwood Management Short Course*, Raleigh, North Carolina, North Carolina State Uuiversity, School of Forest Resources. pp. 118-127.

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158. Gardner, W. E. and R. C. Abt 1995. **Finaneial considerations motivating hardwood timber owners.** *Forest Farmer 30th Manual Edition* 54(3): 65-67.

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.

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159. Garrett, H. E. and W. B. Kurtz 1980. **Black walnut multicropping management.** *Walnut Council Bulletin* 7(1): 15-19.

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.

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160. Garrett, H. E. and W. B. Kurtz 1983. **Silvicultural and economic relationships of integrated forestry-farming with black walnut.** *Agroforestry Systems* 1: 245-256.

Financially examines four black walnut multicropping management options in Missouri involviug 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 indexes, three rotation lengths, two growth rates, and precommercial or precommercial and commercial thinning. Financial evaluation involves internal rate of return and present net worth.

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161. Giese, R. and P. C. Jones 1984. **An economic model of short rotation forestry.** *Mathematical Programming* 28: 206-217.

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.

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162. Glaser, E. H. 1950. **A case study of income possibilities from small managed woodlands in Missouri.** M.S. Thesis, University of Missouri, Columbia, Missouri.

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163. Godman, R. M. 1985. **Lumber value and rate of return for sugar maple.** USDA Forest Service, North Central Forest Experiment Station, Northern Hardwood Notes 6.02. 3 pp.

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164. Godman, R. M. 1985. **Economic maturity of sugar maple.** USDA Forest Service, North Central Forest Experiment Station, Northern Hardwood Notes 6.01. 2 pp.

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

growth, height increase, and grade increase.

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165. Godman, R. M. and J. J. Mendel 1978. **Economic values for growth and grade changes of sugar maple in the Lake States**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Research Paper NC-155. 16 pp.

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.

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166. Goodier, J. P. and D. K. Lewis 1990. **The impact on timber supply of increased uneven-aged management on nonindustrial private pine and mixed pine-hardwood forestland in Oklahoma**. In: C. A. Hickman Ed. *Proceedings of the Southern Forest Economics Workshop*, Monroe, Louisiana, March 29-30, 1990. USDA Forest Service, General Technical Report SO-79. pp. 105-112.

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167. Gould, E. M. J. 1951. **Economic prohlems of managing small woodland holdings in New England**. Ph.D. Dissertation, Harvard University, Cambridge, Massachusetts.

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168. Gove, J. H. 1989. **A stochastic optimization model for uneven-aged northern hardwood stands**. Ph.D. Dissertation, Pennsylvania State University, University Park, Pennsylvania. 248 pp.

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.

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169. Gove, J. H. and S. E. Fairweather 1992. **Optimizing the management of uneven-aged forest stands: a stochastic approach**. *Forest Science* 38(3): 623-640.

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.

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170. Graham, G. M. 1984. **Economics of timher/forage production in Rocky Mountain aspen stands**. M.S. Thesis, Colorado State University, Fort Collins, Colorado.

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171. Graham, G. M. and D. R. Betters 1985. **A simulation model for economic analysis of timber/forage production alternatives in rocky mountain aspen stands**. *Forest Ecology and Management* 10: 313-321.

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.

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172. Grisez, T. J. and J. J. Mendel 1972. **The rate of value increase for black cherry, red maple, and white ash**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-231. 26 pp.

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.

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173. Gunter, J. E. 1983. **Analysis of silvicultural investments**. In: J. C. Stier Ed. *Silviculture of established stands in north central forests. Proceedings of the First Society of American Foresters Region V Technical Conference*, Duluth, Minnesota, September 14-16, 1983. Society of American Foresters, SAF Publication 83-11. pp. 45-52.

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.

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174. Gunter, J. E. 1986. **Financial criteria for analyzing hardwood timberland**. In: *Proceedings: 14th Annual Hardwood Symposium of the Hardwood Research Council*, Cashiers, North Carolina, May 18-21, 1986. Memphis, Tennessee, Hardwood Research Council. pp. 20-25.

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.

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175. Gunter, J. E. and S. Anderson 1994. **Economics of hardwood timber management: ranking alternative uses.** In: D. J. Moorhead and K. D. Coder Eds. *Southern hardwood management*, USDA Forest Service, Southern Region, Management Bulletin R8-MB-67. pp. 59-66.

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.

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176. Gutierrez-Espeleta, E. and C. Mize 1986. **BLAWAP, a black walnut size and value growth model.** *Northern Journal of Applied Forestry* 3: 135-136.

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.

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177. Guttenburg, S. and J. A. Putnam 1951. **Financial maturity of bottomland red oaks and sweetgum.** New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, Occasional Paper 117. 24 pp.

Explains the determination of financial maturity of a single tree in terms of rate 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.

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178. Haight, R. G. 1985. **A comparison of dynamic and static economic models of uneven-aged stand management.** *Forest Science* 31(4): 957-974.

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.

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179. Haight, R. G. 1993. **The economics of Douglas-fir and red alder management with stochastic price trends.** *Canadian Journal of Forest Research* 23(8): 1695-1703.

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.

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180. Haight, R. G., J. D. Brodie and D. M. Adams 1985. **Optimizing the sequence of diameter distributions and selection harvests for uneven-aged stand management.** *Forest Science* 31(2): 451-462.

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.

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181. Hall, O. F. 1989. **An expert system for incorporating economic value and growth potential of individual hardwood trees in management decisions.** In: H. E. Burkhart, H. M. Rauscher and K. Johann Eds. *Artificial intelligence and growth models for forest management decisions*, Virginia Polytechnic Institute and State University, School of Forestry and Wildlife Resources, Publication FWS-1-89. pp. 386-395.

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.

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182. Hansen, G. 1987. **Choosing diameter distributions to aid in marking uneven-aged northern hardwood stands.** In: *Managing northern hardwoods: proceedings of a silvicultural symposium*, Syracuse, New York, June 23-25, 1986. State University

of New York, College of Environmental Science and Forestry, Faculty of Forestry Miscellaneous Publication No. 13. pp. 95-210.

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.

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183. Hardie, I., J. Kundt and E. Miyasaka 1989. **Economic feasibility of U.S. paulownia plantations**. *Journal of Forestry* 87(10): 19-24.

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.

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184. Hart, J. H., R. Baughan and N. E. Jennings 1986. **Economic impact of decay on black walnut**. *Northern Journal of Applied Forestry* 3: 116-118.

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 probahle causes of decay and guidelines for reducing decay.

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185. Hartsough, B. R., B. J. Stokes and C. Kaiser 1992. **Short-rotation poplar: a harvesting trial**. *Forest Products Journal* 42(10): 59-64.

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.

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186. Hatcher, R. L., L. A. Johnson and G. M. Hopper 1993. **Economic potential of black walnut on small acreage tracts**. *Southern Journal of Applied Forestry* 17(2): 64-68.

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.

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187. Haynes, R. W. and D. M. Adams 1992. **The timber situation in the U.S.: analysis and projections to 2040**. *Journal of Forestry* 90(5): 38-43.

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188. Haynes, R. W. 1988. **Long-term demand for hardwoods in the United States**. In: O. F. Hall and R. L. McElwee Eds. *Eastern hardwoods - an emerging forestry frontier: Proceedings of the 18th Forestry Forum*, Blacksburg, Virginia, April 21-22, 1988. Virginia Polytechnic Institute and State University. pp. 6-19.

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

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189. Hazenstab, R. A., J. L. Bowyer, D. P. Bradley and H. M. Hoganson 1987. **An assessment of productivity and harvesting costs for varions forest harvest systems**. In: D. P. Bradley and D. C. Lothner Eds. *Achieving wood energy potentials: evidence in northeastern Minnesota*, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-114. pp. 31-37.

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.

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190. Henly, R. K., P. V. Ellefson and M. J. Baughman 1990. **Minnesota's private forest management assistance program: an evaluation of aspen timber sale assistance**. *Northern Journal of Applied Forestry* 7(1): 31-34.

Analyzes the effect of service forester assistance on physical harvest conditions and barvest retnrns 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.

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191. Hepp, T. E. 1986. **YIELD-MS: a timber planning tool for mixed stands. Second revision**. Norris, Tennessee, TVA, Offices of Natural Resources and Economic Development, Division of Land and Economic Resources.

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192. Hepp, T. E. 1987. **YIELD-MS: a timber yield planning tool for mixed stands**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvauia, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and

Cooperative Extension Service. pp. 220-237.

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.

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193. Hepp, T. E. 1989. **Pine and hardwood regeneration options on a Cumberland Plateau site: an economic perspective**. In: *Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type*, Atlanta, Georgia, April 18-19, 1989. USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-58. pp. 223-229.

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.

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194. Herrick, A. M. 1956. **The quality index in hardwood sawtimber management**. Purdue University Agricultural Experiment Station, Bulletin 632. 26 pp.

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 determiuing 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.

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195. Herrick, O. W. 1983. **Estimating innovation benefits: whole-tree chipping in northern U.S. forests**. In: *America's hardwood forests-opportunities unlimited. Proceedings of the 1982 Convention of the Society of American Foresters*, Cincinnati, Ohio, September 19-22, 1982. Society of American Foresters, SAF Publication 83-04. pp. 245-247.

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.

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196. Herrick, O. W. and J. E. Morse 1968. **Investment analysis of stand improvement and reforestation opportunities in Appalachian forests**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-111. 43 pp.

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 ft^2 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.

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197. Herrick, O. W. 1984. **Rate of value change in Pennsylvania timher stands**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-547. 5 pp.

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.

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198. Herrick, O. W. and D. A. Gansner 1985. **Forest-tree value growth rates**. *Northern Journal of Applied Forestry* 2: 11-13.

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.

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199. Hicks, R. R., Jr, K. S. Riddle and S. M. Brock 1989. **Direct control of insect defoliation in oak stands is economically feasible in preventing timber value loss**. In: *Proceedings of the Seventh Central Hardwood Conference*, Carbondale, Illinois, March 5-8, 1989. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-132. pp. 86-94.

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.

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200. Hilt, D. E. and M. E. Dale 1987. **Developing management guidelines with OAKSIM: an individual-tree growth and yield simulator for managed, even-aged, upland oak stands**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. University Park, Pennsylvania, The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 188-209.

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.

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201. Hobbes, R. O. J. and J. S. Nichols 1987. **Industrial management of private land**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 124-131.

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

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202. Hoffard, W. H., E. L. Heflin and R. L. Anderson 1977. **Economic impact of defects in Missouri-grown black walnut**. USDA Forest Service, Northeastern Forest Experiment Station, Impact Survey D-19-77.

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203. Holley, D. L. 1976. **Some economic considerations in comparing hardwood plantations with natural stands**. In: *Hardwood Short Course*, Raleigh, North Carolina. North Carolina State University, School of Forest Resources. pp. 111-122.

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.

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204. Holmes, T. P., W. R. Bentley, S. H. Broderick and T. Hobson 1990. **Hardwood stumpage price trends and characteristics in Connecticut**. *Northern Journal of Applied Forestry* 7(1): 13-16.

Gives stumpage price trends and average annual rates of change for stumpage prices in Connecticut for 1960–1987. Also discusses factors affecting these stumpage prices.

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205. Hooker, L. W. 1955. **Harvesting thinnings from young hardwood stands**. Seattle, Washington, Forest Products Research Society, Presented at Forest Products Research Society Annual Meeting. 12 pp.

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206. Hoover, W. L. 1983. **Maximization of present value of timber vs. financial maturity**. In: West Lafayette, Indiana, Purdue University, Department of Forestry and Natural Resources, Indiana Forest Products Marketing and Wood Utilization Report, Bulletin No. 173. pp. 9-15.

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.

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207. Hoover, W. L. 1985. **Historical price trends for oak logs and lumber, and the outlook**. In: J. E. Johnson Ed. *Proceedings: Challenges in oak management and utilization*, Madison, Wisconsin, March 28-29, 1985. University of Wisconsin, Madison, Cooperative Extension Service. pp. 81-95.

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.

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208. Hoover, W. L. 1987. **Forest management investment decision criteria**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 10-37.

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.

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209. Hoover, W. L. 1989. **Tax considerations and investment opportunities**. In: *The continuing quest for quality: Proceedings of the 4th Black Walnut Symposium*, Carbondale, Illinois, July 30-August 2, 1989. Walnut Council, Indianapolis, Indiana. pp. 288-299.

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

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210. Hoover, W. L. and J. M. Vasievich 1989. **Investment decision criteria**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Central Hardwood Notes 7.02. 3 pp.

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

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211. Hopper, G. M. 1987. **Manage hardwoods for profits**. In: *Forest land ownership in a period of change: Southeastern Forest Landowner Seminar*, Atlanta, Georgia, March 14, 1987. Athens, Georgia, University of Georgia, College of Agriculture, Cooperative Extension Service. pp. 75-84.

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.

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212. Hove, G. P. 1990. **A biological and financial stand development analysis of aspen, red pine, and jack pine management in Beltrami County, Minnesota**. M.S. Thesis, University of Minnesota, College of Natural Resources. 79 pp.

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213. Huyler, N. and C. B. LeDoux 1991. **A comparison of small tractors for thinning central hardwoods**. In: L. H. McCormick and K. W. Gottschalk Eds. *Proceedings: 8th central hardwood forest conference*, University Park, Pennsylvania, March 4-6, 1991. USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-148. pp. 92-104.

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.

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214. Huyler, N. K. 1982. **The cost of thinning with a whole-tree chip harvesting system**. *Northern Logger and Timber Processor* 31(1): 8-9, 14, 28-29.

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.

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215. Irland, L. C. 1988. **Prospects for high quality hardwoods**. In: O. F. Hall and R. L. McElwee Eds. *Eastern hardwoods-an emerging forestry frontier: Proceedings of the 18th Forestry Forum*, Blacksburg, Virginia, April 21-22, 1988. Virginia Polytechnic Institute and State University. pp. 44-55.

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.

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216. Irland, L. C. and D. I. Maass 1989. **Characterizing the North's hardwood resource**. In: S. B. Jones and J. A. Stanturf Eds. *Hardwood Forest Products Opportunities: Creating and Expanding Businesses: Proceedings*, Pittsburgh, Pennsylvania, October 16-19, 1989. Penn State School of Forest Resources, Pennsylvania Department of Commerce, Hardwoods Development Council. pp. 73-81.

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

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217. Jackson, B. D. and C. O. Turc 1989. **Tract rating system for hardwoods in Louisiana**. In: B. J. Stokes Ed. *Proceedings of the Southern Regional Council on Forest Engineering*, Auburn, Alabama, May 3-4, 1989. USDA Forest Service, Southern Forest Experiment Station; Auburn University, School of Forestry. pp. 51-59.

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.

218. Jiles, R. A. J. and J. W. Lehman 1960. **Hardwood logging methods and costs in the Tennessee Valley**. Tennessee Valley Authority, Report 232-60. 35 pp.

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219. Johnson, J. A., W. A. Hillstrom, E. S. Miyata and S. G. Shetron 1979. **Strip selection method of mechanized thinning in northern hardwood pole-size stands**. L'Anse, Michigan, Michigan Technological University, Ford Forestry Center, Research Note No. 27. 13 pp.

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.

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220. Jorgens, T. P. and D. Zimmerman 1987. **The economic prospects for short rotation intensive culture hybrid poplar production in Minnesota**. In: *Biomass Energy Cash Crop Project: Final report*. Minnesota Department of Public Service, Energy Division. 33 pp.

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.

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221. Kaya, I. and J. Buongiorno 1989. **A harvesting guide for uneven-aged northern hardwood stands**. In: *Making the most of the hardwood resource: Proceedings of the 17th Annual Hardwood Symposium of the Hardwood Research Council*, Merrimac, Wisconsin, May 7-10, 1989. Hardwood Research Council. pp. 83-98.

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.

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222. Kaya, I. and J. Buongiorno 1987. **Economic harvesting of uneven-aged northern hardwood stands under risk: a Markovian decision model**. *Forest Science* 33(4): 889-907.

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.

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223. Kearse, C. M. J. 1985. **A computer model to analyze management regimes in existing bottomland stands**. In: P. Dress and R. Field Eds. *Proceedings: 1985 Symposium on Systems Analysis in Forest Resources*, Athens, Georgia, December 9-11, 1985. Society of American Foresters. pp. 502-507.

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.

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224. Kellison, R. C. 1982. **Cost considerations for regenerating hardwood natural stands aud plautations**. In: J. L. Haymond Ed. *Proceedings, Second Annual Forestry Forum, Cost-effective regeneration practices*, Clemson, South Carolina, March 16, 1982. Clemson University, Cooperative Extension Service, Department of Forestry. pp. 24-30.

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.

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225. Kellison, R. C. 1988. **Extending the hardwood timber supply**. In: *Proceedings: Maine's Hardwood Resource: Quantity Versus Quality - Markets - Management*, Maine Agricultural Experiment Station, Miscellaneous Report No. 327. pp. 22-28.

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

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226. Kellison, R. C. and R. Resovsky 1984. **Economic opportunities in hardwood silviculture: plantation versus natural stand management**. In: R. W. Guldin Ed. *Payoffs from new techniques for managing and processing southern hardwoods. Proceedings: 1984 Southern Forest Economics Workshop*, Memphis, Tennessee, March 13-15, 1984. pp. 19-30.

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.

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227. Kennedy, H. E., Jr. and R. L. Johnson 1984. **Silvicultural alternatives in bottomland hardwoods and their impact on stand quality**. In: R. W. Guldin Ed. *Payoffs from new techniques for managing and processing southern hardwoods. Proceedings: 1984 Southern Forest Economics Workshop*, Memphis, Tennessee, March 13-15, 1984. pp. 6-18.

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

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228. Killcreas, W. E. 1976. **A computerized system for estimating the economic value and growth of natural timber stands in Mississippi**. Ph.D. Dissertation, Mississippi State University, Department of Agricultural Economics, Mississippi State, Mississippi. 135 pp.

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.

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229. Kimbrough, W. D. 1992. **A break-even analysis on the in-woods merchandising of hardwoods in the Alabama-Mississippi-Tennessee region**. M.S. Thesis, Mississippi State University. 92 pp.

Evaluates the effects of transportation costs and price differences between hardwood pnlpwood 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.

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230. Kimbrough, D. and S. H. Bullard 1992. **A break-even study on in-woods merchandising opportunities for hardwoods in the Alabama-Mississippi-Tennessee region**. In: J. C. Welker, Compiler. *Proceedings of the 1992 Southern Forest Economics Workshop on the Economics of Southern Forest Productivity: Competing in World Markets*, Mobile, Alabama, April 29-May 1, 1992. pp. 85-94.

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.

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231. Kincaid, W. H. J. 1982. **Silvicultural-economic assessment of black walnut management alternatives**. M.S. Thesis, University of Missouri, Columbia. 99 pp.

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232. Kincaid, W. H., W. B. Kurtz and H. E. Garrett 1982. **A silvicultural - economic model for black walnut**. In: *Black walnut for the future*, St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-74. pp. 122-126.

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.

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233. Kingsley, N. P. 1987. **Management of NIPF land: some thoughts on making it happen**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 135-142.

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

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234. Kingsley, N. P. and P. S. DeBald 1987. **Hardwood lumber and stumpage prices in two eastern hardwood markets: the real story**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-RP-601. 17 pp.

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

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235. Koenig, R. W. 1985. **Economic analysis of traditional forest management practices in Illinois**. M.S. Thesis, University of Illinois, Department of Forestry, Urbana, Illinois. 158 pp.

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236. Krambeer, C. L. 1992. **Business planning for marketing low-quality hardwoods**. Ph.D. Dissertation, Iowa State University. 200 pp.

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.

237. Kroll, T. J. 1991. **Opportunities and incentives for non-industrial private landowners managing hardwoods**. In: S. B. Laursen and J. F. DeBoe Eds. *Conference Proceedings. The oak resource in the upper midwest: implications for management*, Winona, Minnesota, June 3-6, 1991. St. Paul, Minnesota, University of Minnesota, Minnesota Extension Service, Publication Number NR-BU-5663-S.

Identifies 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.

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238. Kronrad, G. D., M. D. Smith, W. E. Gardner and D. R. Phillips 1985. **Prices and demand for graded oak in the Carolinas and Virginia: forest management implications**. North Carolina State University, Small Woodlot Forestry R & D Program, Research Notes Series 50. 7 pp.

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239. Kronrad, G. D., M. D. Smith, W. E. Gardner and D. R. Phillips 1985. **Prices and demand for graded oak in the Carolinas and Virginia: forest management implications**. In: F. W. Cubbage and V. L. Robinson Eds. *Joint proceedings of the 1985 Southern Forest Economics Workshop and 1984 Southern Economic Association Convention*, Raleigh, North Carolina, North Carolina State University. pp. 101-107.

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.

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240. Kronrad, G. D., W. E. Gardner and D. R. Phillips 1984. **Pricing by grade: motivation for managing natural stands of yellow-poplar**. N.C. State University, Small Woodlot Forestry R & D Program, Res. Notes Ser. 30.

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241. Kronrad, G. D., W. E. Gardner and D. R. Phillips 1984. **Pricing by grade: motivation for managing natural stands of yellow-poplar**. In: R. W. Guldin Ed. *Payoffs from new techniques for managing and processing southern hardwoods. Proceedings: 1984 Southern Forest Economics Workshop*, Memphis, Tennessee, March 13-15, 1984. pp. 31-39.

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.

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242. Kurtz, W. B. and J. C. Bliss 1989. **Silviculture and economic models for black walnut management**. In: *The Continuing Quest for Quality: Proceedings of the Fourth Annual Black Walnut Symposium*, Carbondale, Illinois, July 30-August 2, 1989. Indianapolis, Indiana, Walnut Council. pp. 260-280.

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.

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243. Kurtz, W. B., H. E. Garrett and W. H. Kincaid, Jr. 1984. **Investment alternatives for black walnut plantation management**. *Journal of Forestry* 82(10): 604-608.

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.

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244. Kurtz, W. B., H. E. Garrett and R. A. Williams 1981. **Young stands of scarlet oak in Missouri can be thinned profitably**. *Southern Journal of Applied Forestry* 5(1): 12-16.

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%.

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245. Kurtz, W. B., S. E. Thurman, M. J. Monson and H. E. Garrett 1991. **The use of agroforestry to control erosion - financial aspects**. *The Forestry Chronicle* 67(3): 254-257.

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.

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246. Lacy, S. E. 1991. **The forest stewardship and stewardship incentive programs for technical assistance and cost-sharing for private non-industrial forestland**. In: Radnor, Pennsylvania, USDA Forest Service, Northeastern Area State and Private Forestry, Forest Management Update No. 13. pp. 10-15.

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247. Lacy, S. E. 1991. **The Forest Stewardship Program: a new program for technical assistance and cost-sharing for private non-industrial forest land**. In: M. C. Vodak Ed. *Proceedings of the Conference [on] Uneven-Aged Management of Hardwoods in the Northeast*, Lambertville, New Jersey, April 9-10, 1991. Rutgers University, Rutgers Cooperative Extension. pp. 87-91.

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248. Lamson, N. I. and R. E. McCay 1978. **How to determine whether forest fertilization pays**. In: P. E. Pope Ed. *Central Hardwood Forest Conference II*, West Lafayette, Indiana, Purdue University. pp. 320-327.

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249. Lamson, N. I. and H. C. Smith 1987. **Precommercial treatments of 15- to 40-year old northern hardwood stands**. In: *Managing northern hardwoods: proceedings of a silvicultural symposium*, Syracuse, New York, June 23-25, 1986. State University of New York, College of Environmental Science and Forestry, Faculty of Forestry Miscellaneous Publication No. 13. pp. 160-175.

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.

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250. Lancaster, K. E. 1975. **A guide to hardwood timber stand improvement**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Area, State and Private Forestry. 7 pp.

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.

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251. Larson, B. C., C. S. Binkley and S. M. Winnett 1986. **Biomass harvesting: ecological and economic consequences**. In: *Symposium on the Productivity of Northern Forests Following Biomass Harvesting, Proceedings*, USDA Forest Service, General Technical Report NE-GTR-115. pp. 75-81.

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252. Laursen, S. B. and J. F. DeBoe 1991. **The oak resource in the upper midwest: implications for management**. University of Minnesota, Minnesota Extension Service, NR-BU-5663-S. 309 pp.

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253. Lea, R. and D. G. Brockway 1986. **Fertilization of northern hardwoods**. In: G. D. Mroz and D. D. Reed Eds. *Proceedings - A conference on the northern hardwood resource: management and potential*, Houghton, Michigan, August 18-20, 1986. Michigan Technological University. pp. 193-205.

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.

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254. Leak, W. B. 1969. **Financial maturity of yellow birch**. In: *Birch Symposium Proceedings*, Durham, New Hampshire, August 19-21, 1969. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station. pp. 145-146.

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.

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255. Leak, W. B. 1980. **Rapid economic analysis of northern hardwood stand improvement options**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Note NE-296. 6 pp.

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.

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256. Leak, W. B., S. M. Filip and D. S. Solomon 1968. **Rate of value increase for yellow birch in New England**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-120. 11 pp.

Uses quality data collected on the White Mountain National Forest to determine rate of value change (10-

year) for yellow birch for combinations of vigor class, initial dbh, log or veneer grade, and log height. A table is given for rate of return over dbh for sawlogs by vigor class. The range of rates of return is given by vigor class for veneer log trees. The effect of merchantable height and grade changes on rate of return is discussed.

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257. LeDoux, C. B. 1985. **When is hardwood cable logging economical?** *Journal of Forestry* 83(5): 295-298.

Uses computer simulation to predict costs of cable yarding in eastern hardwoods. Presents estimated yarding cost by average tree dbh for six yarders (Bitterroot, Koller 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 breakdowu 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.

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258. LeDoux, C. B. 1986. **MANAGE: a computer program to estimate costs and benefits associated with eastern hardwood management**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-GTR-112. 7 pp.

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.

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259. LeDoux, C. B. 1987. **ECOST - a stump-to-mill cost-estimating program for cable logging eastern hardwoods**. *The Compiler* 5(4): 33-34.

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.

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260. LeDoux, C. B. and J. E. Baumgras 1988. **Analysis of harvesting opportunities for thinning eastern hardwoods on steep terrain**. In: *Proceedings of the International Mountain Logging and Pacific Northwest Skyline Symposium*, Portland, Oregon, December 12-16, 1988. Oregon State University, College of Forestry. pp. 93-96.

Uses the ECOST computer model to determine stump-to-mill costs for six different cable yarders 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.

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261. LeDoux, C. B. and J. E. Baumgras 1989. **Contemporary logging technology for harvesting yonng central hardwoods**. In: *Proceedings Seventh Central Hardwood Forest Conference*, Carbondale, Illinois, March 5-8, 1989. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-132. pp. 190-195.

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.

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262. LeDoux, C. B. and J. E. Baumgras 1989. **Development of regional stump-to-mill logging cost estimators**. In: B. J. Stokes Ed. *Proceedings of the Southern Regional Council on Forest Engineering*, Auburn, Alabama, May 3-4, 1989. Auburn, Alabama, USDA Forest Service, Southeru Forest Experiment Station; Auburn University, School of Forestry. pp. 112-118.

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.

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263. LeDoux, C. B., J. E. Baumgras and R. B. Selbe 1989. **PROFIT-PC: a program for estimating maximum net revenue from multiproduct harvests in Appalachian hardwoods**. *The Compiler* 7(4): 27-32.

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

based on yarder/skidder choice.

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264. LeDoux, C. B., J. E. Baumgras, J. Sherar and T. Campbell 1991. **Production rates and costs of group selection harvests with a Christy cable yarder**. In: *Proceedings of the Forestry and Environment - Engineering Solutions Conference*, St, Joseph, Michigan, June 5-6, 1991. American Society of Agricultural Engineers. pp. 75-84.

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.

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265. LeDoux, C. B., M. D. Erickson and C. C. Hassler 1993. **Production rates and costs of group-selection harvests with ground-based logging systems**. In: A. R. Gillespie, G. R. Parker, P. E. Pope and G. Rink Eds. *Proceedings 9th Central Hardwood Forest Conference*, Purdue University, West Lafayette, Indiana, March 8-10, 1993. USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-161. pp. 363-372.

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.

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266. LeDoux, C. B., D. M. May and R. H. Widmann 1995. **Assessing the feasibility and profitability of cable logging in southern upland hardwood forests**. *Southern Journal of Applied Forestry* 19(3): 97-102.

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.

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267. LeDoux, C. B. 1985. **Stump-to-mill timber production cost equations for cable logging eastern hardwoods**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Researcb Paper NE-566. 6 pp.

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.

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268. LeDoux, C. B. 1987. **Estimating yarding costs for the Clearwater cable yarder**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-RP-609. 4 pp.

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.

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269. LeDoux, C. B. 1990. **Determining the economic feasibility of salvaging gypsy moth-killed hardwoods**. *Forest Products Journal* 40(5): 43-46.

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.

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270. Lee, A., J. B. Pickens and G. W. Lyon 1989. **Optimum bucking for hardwoods**. In: *Making the most of the hardwood resource. Proceedings of the 17th Annual Hardwood Symposium of the Hardwood Research Council*, Merrimac, Wisconsin, May 7-10, 1989. Hardwood Research Council. pp. 143-148.

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.

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271. Leopold, B. D., G. H. Weaver, J. D. Cutler and R. C. Warren 1989. **Pine-hardwood forests in north-central Mississippi: an economic perspective**. In: *Proceedings of pine-hardwood mixtures: a symposium on management and ecology of the type*, Atlanta, Georgia, April 18-19, 1989. USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-58. pp. 211-222.

Describes overstory and understory characteristics of 19 naturally regenerated pine-hardwood stands in north-ceutral Mississippi. Includes a very brief discussion of differences in value distribution between pine and hardwood for 1978 versus 1989 prices.

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272. Leslie, A. J. 1989. **On the economic prospects for natural management in temperate hardwoods.** *Forestry* 62: 147-166.

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.

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273. Lewis, P. J. 1990. **The impact of cutting method on northern hardwood stumpage prices.** M.S. Thesis, Michigan State University, Dept of Forestry. 155 pp.

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274. Lewis, G. D. and D. E. Chappelle 1964. **Farm woodland management cost and returns in the southern Piedmont of Virginia.** Asheville, North Carolina, USDA Forest Service, Southeastern Forest Experiment Station, Research Paper SE-15. 20 pp.

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.

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275. Loomis, J. B., E. R. Loft and B. A. Garrison 1995. **An economic assessment of hardwoods as habitat components for black-tailed deer in northern California conifer forests.** *Journal of Forestry* 93(8): 41-45.

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 ft^2 of retained basal area.

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276. Lothner, D. C. 1983. **Economic investigations of short rotation intensively cultured hybrid poplars.** In: E. A. Hanson Ed. *Intensive plantation culture: 12 years research*, St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-91. pp. 139-148.

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.

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277. Lothner, D. C., H. M. Hoganson and P. A. Rubin 1986. **Examining short-rotation hybrid poplar investments by using stochastic simulation.** *Canadian Journal of Forest Research* 16: 1207-1213.

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.

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278. Lottes, G. J. 1985. **Economics of integrated forestry systems in Illinois.** M.S. Thesis, University of Illinois, Urbana-Champaign, Illinois. 185 pp.

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279. Lu, H. C. 1992. **Ecouomic management of Wisconsin's northern hardwood forest stands: a mixed-species model.** Ph.D. Dissertation, The University of Wisconsin, Madison, Wisconsin. 145 pp.

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.

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280. Lu, H. C. and J. Buongiorno 1993. **Long- and short-term effects of alternative cutting regimes on economic returns and ecological diversity in mixed-species forests.** *Forest Ecology and Management* 58: 173-192.

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 m^2, 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+timher) is also compared by cutting guide for several initial stand conditions.

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281. Lucas, E. L. 1969. **An approach to yellow-poplar tree valuation.** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-137. 13 pp.

Presents the development and validation of a

"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.

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282. Luppold, W. G. 1985. **The causes of oak price variation**. *Minnesota Forest Marketing Bulletin* 28(4): 1-3.

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283. Luppold, W. G. 1987. **What determines the price of hardwood timber?** In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service, pp. 238-253

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.

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284. Luppold, W. G. and J. E. Baumgras 1995. **Price trends and relationships for red oak and yellow-poplar stumpage, sawlogs, and lumber in Ohio: 1975-1993**. *Northern Journal of Applied Forestry* 12(4): 168-173.

Examines trends in real prices for red oak and yellow-poplar stumpage, logs, and lumber in Ohio from 1975-1993. Discusses the relationship between these trends and domestic/export demand, technological advances, and stumpage supply. Briefly discusses factors affecting future supply/demand.

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285. Lyon, G. W. 1986. **Economics of all-aged hardwood stands**. In: G. D. Mroz and D. D. Reed Eds. *Proceedings - A conference on the northern hardwood resource: management and potential*, Houghton, Michigan, August 18-20, 1986. Houghton, Michigan, Michigan Technological University. pp. 308-320.

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 valne) 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 ft^2 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.

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286. Lyons, T. E. and S. H. Broderick 1986. **Managing oak forests for fuelwood**. University of Connecticut, Cooperative Extension Service, Report 86-71. 27 pp.

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287. Malac, B. F. and R. D. Heeren 1979. **Hardwood plantation management**. *Southern Journal of Applied Forestry* 3: 3-6.

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.

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288. Manthy, R. S. 1970. **An investment guide for cooperative forest management in Pennsylvania**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-156. 59 pp.

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.

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289. Manuel, T. M., K. L. Belli and J. D. Hodges 1993. **A decision-making model to manage or regenerate southern bottomland hardwood stands**. *Southern Journal of Applied Forestry* 17(2): 75-79.

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.

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290. Martin, J. and J. Lapidakis 1986. **Growth projections and economic evaluation of red pine and red oak management alternatives**. Madison, Wisconsin, University of Wisconsin, Extension and Dept. of Forestry.

291. Martin, A. J. 1988. **What's a forest tree worth? – Present value, future value, and rate earned.** *National Woodlands* 11(6): 8-9.

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

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292. Martin, G. L. 1982. **Investment-efficient stocking guides for all-aged northern hardwood forests.** Madison, Wisconsin, University of Wisconsin, College of Agricultural and Life Sciences, Research Report R3129. 12 pp.

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.

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293. Mattson, J. A. 1993. **Tree-section harvesting of northern hardwood thinnings.** St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Research Paper NC-312. 16 pp.

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.

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294. May, D. M. and C. B. LeDoux 1992. **Assessing timber availability in upland hardwood forests.** *Southern Journal of Applied Forestry* 16(2): 82-88.

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.

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295. McCauley, O. D. and J. J. Mendel 1969. **Adjusting quality index log values to represent local and regional eommercial sawlog product values.** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-149. 27 pp.

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 limber 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.

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296. McCauley, O. D. and G. R. Trimble, Jr. 1975. **Site quality in Appalachian hardwoods: the biological and economic response under selective silviculture.** USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-312. 22 pp.

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.

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297. McCauley, O. D. and D. P. Worley 1969. **An economic evaluation of precommercial thinning in predominately paper birch stands.** In: *Birch Symposium Proceedings*, Durham, New Hampshire, August 19-21, 1969. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station. pp. 128-134.

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.

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298. McCauley, O. D. and D. A. Marquis 1972. **Investment in precommercial thinniug of northern hardwoods.** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-245. 13 pp.

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.

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299. McCauley, O. D. and G. R. Trimble, Jr. 1972. **Forestry returns evaluated for uneven-aged management in two Appalachian woodlots**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-244. 11 pp.

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.

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300. McCay, R. and N. Lamson 1980. **Short-term gains from cutting Appalachian hardwood stands**. *Northern Logger and Timber Processor* 29(6): 16-17, 73.

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.

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301. McCay, R. E. and P. S. DeBald 1973. **A probability approach to sawtimber tree-value projections**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-254. 9 pp.

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.

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302. McCay, R. E. and W. B. White 1973. **Ecouomic analysis of the gypsy moth problem in the Northeast: I. Applied to commercial forest stands**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-275. 9 pp.

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.

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303. McGee, C. E. 1982. **Low quality hardwood stands: opportunities for management in the interior uplands**. New Orleans, Louisiana, USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-40. 22 pp.

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.

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304. McWilliams, W. H. and J. L. Faulkner 1991. **The bottomland hardwood timber resource of the coastal plain province in the south central USA**. Washington, D.C., American Pulpwood Association, Special Project 91-A-11. 46 pp.

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.

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305. Meadows, J. S. 1995. **Epicormic hranches and lumber grade of bottomland oak**. In: *Proceedings of the Twenty-Third Annual Hardwood Symposium – Advances in hardwood utilization: following profitability from the woods through rough dimension*, Cashiers, North Carolina, May 17-20, 1995. National Hardwood Lumber Association. pp. 19-25.

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.

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306. Mendel, J. J. 1969. **Financial maturity of paper birch**. In: *Birch Symposium Proceedings*, Durham, New Hampshire, August 19-21, 1969. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station. pp. 135-144.

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.

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307. Mendel, J. J., P. S. DeBald and M. W. Dale 1976. **Tree value conversion standards for hardwood sawtimber**. USDA Forest Service, Northeastern Forest

Experiment Station, Research Paper NE-337. 74 pp.

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.

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308. Mendel, J. J. and W. H. Smith 1970. **Quality index tables for some eastern hardwood species**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-167. 24 pp.

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.

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309. Mendel, J. J., T. J. Grisez and G. R. Trimble, Jr. 1973. **The rate of value increase for sugar maple**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-250. 19 pp.

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.

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310. Mendel, J. J. and G. R. Trimble, Jr. 1969. **The rate of value increase for yellow-poplar and beech**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-140. 27 pp.

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.

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311. Miller, G. W. 1991. **Practicing uneven-aged mauagement: does it pay? some economic considerations**. In: M. C. Vodak Ed. *Proceedings of the Conference [on] Uneven-Aged Management of Hardwoods in the Northeast*, Lambertville, New Jersey, April 9-10, 1991. Rutgers University, Rutgers Cooperative Extension. pp. 47-59 + 5 figures.

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.

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312. Miller, G. W. 1993. **Prescribing optimal harvests in forests containing even-aged and uneven-aged stands**. Ph.d. Dissertation, Virginia Polytechnic Institute and State University. 120 pp.

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.

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313. Miller, G. W. 1984. **Costs of reducing sapling basal area in thinned cherry-maple stands in West Virginia**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Rescarch Paper NE-540. 6 pp.

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 (<7" dbh) stems in commercial thinning to 45, 60, and 75% stocking in 60-year-old black cherry-maple stands in West Virginia. Also gives additioual 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.

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314. Miller, G. W. 1984. **Releasing young hardwood crop trees – use of a chain saw costs less than herbicides**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-550. 4 pp.

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.

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315. Miller, G. W. 1986. **Cultural practices in hardwood sapling stands – are they worthwhile?** In: H. C. Smith and M. Eye Eds. *Guidelines for Managing Immature Appalachian Hardwood Stands*, Morgantown, West Virginia, May 28-30, 1986. West Virginia University, College of Agriculture and Forestry and Cooperative Extension Service, SAF Publication 86-02. pp. 33-45.

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 economical.

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316. Miller, G. W. 1989. **Economic considerations of managing stands**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Central Hardwood Notes 7.01. 4 pp.

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.

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317. Miller, G. W. 1991. **Economic residual stand structure goals for single-tree selection in central Appalachian hardwoods**. In: *Proceedings of the Sixth Biennial Southern Silvicultural Research Conference*, Memphis, Tennessee, October 30-November 1, 1990. Asheville, North Carolina, USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-70. pp. 821-831.

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.

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318. Miller, G. W. 1993. **Financial aspects of partial cutting practices in ceutral Appalachian hardwoods**. Radnor, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-673. 9 pp.

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.

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319. Miller, G. W. and J. E. Baumgras 1994. **Efficient silvicultural practices for eastern hardwood management**. In: *Proceedings of the Twenty-Second Annual Hardwood Symposium: opportunities for the hardwood industry to address environmental challenges*, Cashiers, North Carolina, May 12-15, 1994. National Hardwood Lumber Association; in cooperation with the USDA Forest Service, Southeastern Forest Experiment Station, Primary Hardwood Processing and Products Unit. pp. 23-35.

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.

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320. Miller, G. W. and H. C. Smith 1991. **Comparing partial cutting practices in central Appalachian hardwoods**. In: L. H. McCormick and K. W. Gottschalk Eds. *Proceedings: 8th Central Hardwood Forest Conference*, University Park, Pennsylvania, March 4-6, 1991. USDA Forest Service, Northeastern Forest Experiment Station, General Technical Report NE-148. pp. 105-119.

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.

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321. Miller, G. W. and H. C. Smith 1993. **A practical alternative to siugle-tree selection**. *Northern Journal of Applied Forestry* 10(1): 32-38.

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.

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322. Miller, G. W. and R. L. Sarles 1986. **Costs, yields, and revenues associated with thinning and clearcutting 60-year-old cherry-maple stands.** Broomall, Pennsylvania, USDA Forest Service, Northeast Forest Experiment Station, Research Paper NE-582. 8 pp.

Presents logging costs (from time series data) and harvest revenues (assuming average yields and market prices) for three thinning treatments (75, 60, and 45 ft^2 residual BA) and a clearcut in 60-year-old West Virginia Allegheny hardwoods. Logging costs include felling, bucking, skidding, loading, hauling, and roads.

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323. Mills, W. L. 1980. **Risk/return tradeoff among forest and nonforest iuvestments.** Ph.D. Dissertation, Purdue University.

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324. Mills, T. J. and D. Cain 1978. **Timber yield and financial return performance of the 1974 forestry incentives act.** USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Research Paper RM-204. 56 pp.

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.

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325. Mills, W. L., Jr. and W. L. Hoover 1982. **Investment in forest land: aspects of risk and diversification.** *Land Economics* 58(1): 33-51.

Analyses risk/return of portfolio combinations of common stocks, government and corporate bonds, treasury bills, four farming options, and ten hardwood forest investments of varying tract size and site quality in Indiana for the periods of 1959-1978 and 1969-1978.

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326. Mills, W. L., J. M. Vasievich and W. L. Hoover 1988. **Timber investments in the eastern United States.** In: *Economic and social development: a role for forests & forestry professionals. Proceedings of the 1987 Society of American Foresters National Convention*, Minneapolis, Minnesota, October 18-21, 1987. Bethesda, Maryland, Society of American Foresters. pp. 339-342.

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.

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327. Mills, W. L. and J. C. Callahan 1979. **Financial maturity: a guide to when trees should be harvested.** West Lafayette, Indiana, Purdue University, Cooperative Extension Service, Extension Publication FNR 91. 11 pp.

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.

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328. Mitchell, W. C. and H. H. Webster 1961. **Ten-year earnings from two small woodlands.** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Station Paper 145. 31 pp.

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.

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329. Mitchie, B. R. 1981. **An economic investigatiou of uneven-aged northern hardwood management.** Ph.D. Dissertation, University of Wisconsin, Madison, Wisconsin. 154 pp.

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.

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330. Mitchie, B. R. 1985. **Uneven-aged management and the value of forest land.** *Forest Science* 31: 116-121.

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.

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331. Mitchie, B. R. and F. D. McCandless 1986. **A matrix model of oak-hickory stand management and valuing forest land**. *Forest Science* 32(3): 759-768.

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.

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332. Mize, C. W. 1988. **The rate of return of individual, forest-grown black walnut trees**. USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-120. pp. 867-873.

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.

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333. Murphy, P. A. and R. W. Guldin 1987. **Financial maturity of trees in selection stands revisited**. USDA Forest Service, Southern Forest Experiment Station, Research Paper SO-242. 5 pp.

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.

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334. Murray, R. L. 1989. **New resources for funding intensive forest management**. In: *Making the most of the hardwood resource. Proceedings of the 17th Annual Hardwood Symposium of the Hardwood Research Council*, Merrimac, Wisconsin, May 7-10, 1989. Hardwood Research Council. pp. 69-81.

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.

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335. Naughton, G. G. 1973. **Evaluating economic maturity of individual trees**. In: *Black walnut as a crop: Black Walnut Symposium Proceedings*, August 14-15, 1973. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-4. pp. 97-100.

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.

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336. Nelson, J. C. 1987. **Public land management-private land**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 118-123.

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.

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337. Niese, J. N. 1993. **An economic comparison of even- and uneven-aged management in Lake States northern hardwoods**. Ph.D. Dissertation, Michigan State University. 221 pp.

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.

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338. Niese, J. N. and T. F. Strong 1992. **Economic and tree diversity trade-offs in managed northern hardwoods**. *Canadian Journal of Forest Research* 22(11): 1807-1813.

Evaluates crop tree release, diameter limit, commercial clearcut, complete clearcut, and light, medium, aud 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.

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339. Niese, J. N. and J. M. Vasievich 1990. **Information needs for comparing even- and uneven-aged management in mixed hardwoods**. In: C. A. Hickman Ed. *Proceedings of the Southern Forest Economics Workshop*, Monroe, Louisiana, March 29-30,

1990. USDA Forest Service, Southern Forest Experiment Station, General Technical Report SO-79. pp. 11-22.

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.

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340. Niese, J. N., T. F. Strong and G. G. Erdmann 1995. **Forty years of alternative management practices in second-growth, pole-size northern hardwoods part II: Economic evaluation**. *Canadian Journal of Forest Research 25:1180-1188.*

Gives an economic evaluation of three levels of individual tree selection (60, 75, 90 ft^2/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.

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341. Noreen, P. A. 1968. **Economic evaluation of precommercial thinning in good-site aspen**. M.S. Thesis, University of Minnesota, College of Forestry, St. Paul, Minnesota. 19 pp.

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342. Noweg, T. A. and W. B. Kurtz 1987. **Eastern black walnut plantations: an economically viable option for conservation reserve lands within the corn belt**. *Northern Journal of Applied Forestry* 4: 158-160.

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.

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343. Ohman, J. H. 1970. **Value loss from skidding wounds in sugar maple and yellow birch**. *Journal of Forestry* 68(4): 226-230.

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.

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344. Olson, J. T., A. L. Lundgren and D. Rose 1978. **Equations for estimating stand establishment, release, and thinning costs in the Lake States**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Research Paper NC-163. 7 pp.

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.

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345. Pelkki, M. and J. M. Ringe 1994. **Marketing mixed stands of pine and hardwood**. *Forest Farmer* 53(10): 18-21.

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

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346. Perala, D. A. 1983. **Growth response and economics of thinning and fertilizing aspen and paper birch**. In: J. C. Stier Ed. *Silviculture of established stands in north central forests. Proceedings of the First Society of American Foresters Region V Technical Conference*, Duluth, Minnesota, September 14-16, 1983. Society of American Foresters, SAF Publication 83-11. pp. 100-107.

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.

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347. Perkey, A. W. 1991. **Management of established oak stands**. In: S. B. Laursen and J. F. DeBoe Eds. *Conference Proceedings. The oak resource in the upper midwest: implications for management*, Winona, Minnesota, June 3-6, 1991. St. Paul, Minnesota, University of Minnesota, Minnesota Extension Service, Publication Number NR-BU-5663-S. pp. 207-215.

Uses West Virginia stand and growth data for financial analysis of crop-tree release of 5 red oak crop trees/acre

(red oak site index$_{50}$ 70). 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).

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348. Perkey, A. W. 1993. **Managing red oak crop trees to prodnce financial benefits**. *Woodland Steward* 1(4): 4-6.

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.

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349. Pickens, J. B., A. Lee and Z. Tanja 1992. **Optimal bucking of northern hardwoods**. *Northern Journal of Applied Forestry* 9(4): 149-152.

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.

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350. Poppino, J. H. and D. R. Gedney 1984. **The hardwood resource in western Oregon**. USDA Forest Service, Pacific Northwest Forest Experiment Station, Resource Bnlletin PNW-116. 37 pp.

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351. Porterfield, R., K. Utz and W. Balmer 1977. **Financial evalnation of artificial vs. natnral regeneration of bottomland hardwoods**. In: *Proceedings - Second Symposium on Southeastern Hardwoods*, Dothan, Alabama, April 20-22, 1977. USDA Forest Service, Southeastern Area, State and Private Forestry. pp. 1-16.

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.

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352. Porterfield, R. L. 1972. **Financial returns from managing sonthern hardwood stands for pnlpwood**. *Journal of Forestry* 70(10): 624-627.

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.

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353. Porterfield, R. L. 1975. **Sawlogs or soybeans**. *Forest farmer* 34(10): 16, 17, 20.

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).

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354. Porterfield, R. L., K. Utz and W. Balmer 1979. **Analyzing alternative hardwood management strategies**. *Southern Journal of Applied Forestry* 3(1): 7-12.

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.

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355. Prosek, C. and B. Behr 1986. **The marketing and harvesting of aspen**. In: *In: Proceedings Woodland Owners and Users Conference, 1986*. University of Minnesota, Office of Special Programs. pp. 99-105.

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356. Rast, E. D., D. L. Sonderman and D. E. Hilt 1987. **Recognizing hardwood quality: key to increased profits**. In: *Symposium on Multiple-Use Management of California's Hardwood Resources*, San Luis Obispo, California, November 12-14, 1986. Berkeley, California, USDA Forest Service, Pacific Southwest Forest Experiment Station, General Technical Report PSW-100. pp. 273-278.

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

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357. Reed, D. D., M. J. Holmes and J. A. Johnson 1986. **A 22-year study of stand development and financial retnrn in northern hardwoods**. *Northern Journal of Applied Forestry* 3(1): 35-38.

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.

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358. Rich, M. F. 1989. **Planting loblolly pine and sycamore vs. natural regeneration on a bottomland site**. *Southern Journal of Applied Forestry* 13(1): 22-25.

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.

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359. Risbrudt, C. D. 1987. **Financial returns from timber stand improvement investments in eastern hardwoods**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 69-85.

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.

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360. Risbrudt, C. D. and J. A. Pitcher 1986. **Fiuancial returns from timber stand improvement investments**. *Northern Journal of Applied Forestry* 3: 52-58.

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.

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361. Roberts, M. 1986. **Logger's perspective of thinning hardwoods**. In: *Hardwood Thinning Opportunities in the Lake States: Proceedings of a Symposium*, Escanaba, Michigan, April 20, 1984. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-113. pp. 93-95.

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

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362. Roise, J. P., J. Chung and C. B. LeDoux 1988. **Optimal stocking of species by diameter class for even-aged mid-to-late rotation Appalachian hardwoods**. In: *1988 Symposium on Systems Analysis in Forest Resources*, Fort Collins, Colorado, USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Technical Report RM-161. pp. 166-172.

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.

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363. Rose, D. 1976. **Economic investigations of intensive silvicultural systems**. *Iowa State J. Res.* 50(3): 301-315.

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364. Rose, G. A. 1986. **Improved opportunities for marketing hardwoods from nonindustrial private forests: Michigan's Forest Improvement Districts**. In: G. D. Mroz and D. D. Reed, Compilers. *Proceedings: A Conference on the Northern Hardwood Resource*. pp. 413-418.

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365. Rose, D. and R. D. Kallstrom 1976. **Economic feasibility of intensive cultures**. In: USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-21. pp. 96-107.

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.

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366. Rudolph, V. J. and R. G. Bresnehan 1982. **Twenty years of management in a small woodlot of southern Michigan**. *Journal of Forestry* 80(10): 665-667.

Details the 20-year selection management of a 10-acre mixed hardwood stand in southern Michigan. Gives product yields and dollar value (1981) of harvests from the property.

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367. Sarles, R. L. and K. R. Whitenack 1984. **Costs of logging thinnings and a clearcutting in Appalachia using a truck mounted crane**. USDA Forest Service, Research Paper 545. 9 pp.

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368. Sarles, R. L. 1985. **Production and costs: chain saw felling in hardwood thinnings**. *Northern Logger and Timber Processor* 34(2): 24-25, 50, 56-57.

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.

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369. Schick, B. A. 1986. **Managing immature Appalachian hardwood stands for fiber**. In: H. C. Smith and M. C. Eye Eds. *Proceedings: Guidelines for managing immature Appalachian hardwood stands*, Morgantown, West Virginia, May, 28-30, 1986. West Virginia University Cooperative Extension Service; USDA Forest Service, SAF Publication 86-02. pp. 140-149.

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.

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370. Schnell, R. L. 1964. **Harvesting costs for hardwood pulpwood in the Tennessee Valley**. Norris, Tennessee, Tennessee Valley Authority, Division of Forest Relations. 3 pp.

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371. Schroeder, J. G. and H. A. Knight 1984. **Estimating the present and future value of yellow-poplar stands**. In: *Increased cost effectiveness in management and utilization of eastern hardwoods. Proceedings: Twelfth Annual Hardwood Symposium of the Hardwood Research Council*, Cashiers, North Carolina, May 8-11, 1984. Hardwood Research Council. pp. 28-38.

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.

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372. Screpetis, G. D. 1972. **Hardwood utilization to increase land owner return**. *Southern Lumberman* 225(2800): 163-164.

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

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373. Shaffer, R. M., K. R. Brummel, T. W. Reisinger and B. J. Stokes 1993. **Impact of group selection silviculture on timber harvesting productivity and cost in Appalachian hardwood timber stands**. *Northern Journal of Applied Forestry* 10(4): 170-174.

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.

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374. Shaffer, R. M. and R. S. Taumas 1992. **A comparison of sheared and sawhead-felled stump heights on six nonindustrial private timber sales in southeastern Virginia**. *Southern Journal of Applied Forestry* 16(3): 140-142.

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.

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375. Shifley, S. R. 1987. **Evaluating management alternatives with TWIGS and ERGYS**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 168-187.

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.

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376. Shifley, S. R., G. J. Brand and L. F. Ohmaun 1986. **Timber and squirrels: forecasting and evaluating the options**. *Northern Journal of Applied Forestry* 3(2): 46-49.

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%.

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377. Sibal, P. V. 1987. **An economic analysis of farm-scale short rotation intensive culture hybrid poplar production in Northwestern Minnesota**. In: *Biomass Energy Cash Crop Project: Final Report*. Minnesota Department of Public Service, Energy Division. 25 pp. + 28 tables + 101 pp. computer printouts.

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378. Sibal, P. V., J. L. Bowyer and D. P. Bradley 1984. **Log merchandising in aspen**. *Journal of Forestry* 82(7): 420-425.

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.

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379. Siegel, W. C. 1987. **The role of the federal income tax in forest management**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 38-52.

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.

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380. Slusher, J. P., F. Crouse and L. R. Frye 1987. **Selling walnut timber**. University of Missouri - Columbia, Extension Division, Agricultural Guide 5051. pp.

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381. Smith, C. H. and P. S. Debald 1975. **Economics of even-aged aud uneven-aged silviculture and management in eastern hardwoods**. In: *Proceedings: Forest Service Workshop on Uneven-aged Silviculture and Management in the Eastern United States*, Morgantown, West Virginia, July 15-17, 1975. Washington, D.C., USDA Forest Service, General Technical Report WO-24. pp. 121-137.

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.

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382. Smith, D. M. 1987. **Financial analysis of even-aged mixed hardwood stands**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 86-96.

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

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383. Smith, H. C. and G. W. Miller 1987. **Economic considerations of uneven-aged hardwood management**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvauia State University, School of Forest Resources and Cooperative Extension Service. pp. 97-110.

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.

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384. Smith, H. C. and G. W. Miller 1987. **Managing Appalachian hardwood stands under four regeneration practices – 34-year results**. *Northern Journal of Applied Forestry* 4(4): 180-185.

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.

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385. Smith, H. D. 1973. **Decision making under uncertainty: should hardwood plantations be established?** Raleigh, North Carolina, North Carolina State University, School of Forest Resources, Technical

Report No. 49. 62 pp.

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 growth and yield and financial evaluation by species. 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.

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386. Smith, R. C. 1973. **Returns from two systems of multicropping**. In: *Black walnut as a crop: Black Walnut Symposium Proceedings*, Carbondale, Illinois, August 14-15, 1973. USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-4. pp. 106-110.

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

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387. Smith, H. C. 1980. **An evalnation of fonr uneven-age cntting practices in central Appalachian hardwoods**. *Southern Journal of Applied Forestry* 4(4): 193-200.

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

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388. Smith, H. C., G. R. Trimble, Jr. and P. S. DeBald 1979. **Raise cntting diameters for increased retnrns**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-445. 7 pp.

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.

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389. Sonderman, D. L. 1984. **Qnality response of 29-year-old even-aged central hardwoods after thinning**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-546. 9 pp.

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.

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390. St. Clair, J. B. 1984. **Economic evalnation of Lake States tree improvement programs**. M.S. Thesis, University of Wisconsin, Madison, Wisconsin.

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391. Starkey, D. A., S. W. Oak, G. W. Ryan, F. H. Tainter, C. Redmond and H. D. Brown 1989. **Evaluation of oak decline areas in the Sonth**. 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.

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392. Steiner, K. C. 1987. **The role of artificial regeneration in managing eastern hardwoods**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 111-117.

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

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393. Stier, J. C. 1990. **Economic efficiency of forest tree improvement programs in the North Central region**. *Evaluation Review* 14(3): 227-246.

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.

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394. Stine, R. 1980. **Economics of utilizing oak for energy**. In: *Proceedings of the symposium on the ecology, management, and utilization of California oaks*, Claremont, California, June 26-28, 1979. Berkeley, California, USDA Forest Service, Pacific Southwest Forest and Range Experiment Station, General Technical Report PSW-44. pp. 345-353.

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

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395. Straka, T. J. and S. H. Bullard 1987. **State cost-share programs for nonindustrial private forestry investments**. In: *Forests, the World, & the Profession. Proceedings of the 1986 Society of American Foresters National Convention*, Birmingham, Alabama, October 5-8, 1986. Bethesda, Maryland, Society of American Foresters. pp. 262-266.

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

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396. Strauss, C. H. 1987. **The influence of state forests on timber markets**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 61-68.

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.

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397. Stringer, J. W., G. W. Miller and R. F. Wittwer 1988. **Applying crop-tree release in small-sawtimber white oak stands**. Broomall, Pennsylvania, USDA Forest Service, Northeast Forest Experiment Station, Research Paper NE-620. 7 pp.

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.

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398. Strong, T. F. and J. N. Niese 1994. **Tree quality in hardwood ecosystem management: what are the biological and economic tradeoffs?** In: L. H. Foley Ed. *Silviculture: from the cradle of forestry to ecosystem management. Proceedings of the National Silviculture Workshop*, Hendersonville, North Carolina, November 1-4, 1993. USDA Forest Service, Southeastern Forest Experiment Station, General Technical Report SE-88. pp. 156-166.

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399. Stuart, W. B., T. A. J. Walbridge and S. E. O'Hearn 1978. **Economic and productivity comparisons between full tree chippiug and conventional harvesting systems on a variety of stand types**. In: *TAPPI Annual Meeting Proceedings*, Chicago, Illinois, March 6-8, 1978. pp. 89-97.

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400. Stubbs, J. 1986. **Hardwood epicormic branching – small knots but large losses**. *Southern Journal of Applied Forestry* 10(4): 217-220.

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

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401. Sturos, J. A. and M. A. Thompson 1986. **Harvesting hardwood thinnings**. In: *Hardwood thinning opportunities in the Lake States: Proceedings of a symposium*, Escanaba, Michigan, April 20, 1984. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-113. pp. 31-48.

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 poletimber 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 poletimber under three levels of mechanization. Case V gives cost of strip-selection thinning of northern hardwood poletimber on steep slopes (up to 50%) using a Timberjack feller/buncher.

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402. Sturos, J. A., R. M. Barron, E. S. Miyata and H. M. Steinhilb 1983. **The economics of a mechanized multiproduct harvesting system for stand conversion of northern hardwoods**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Research paper NC-237. 12 pp.

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.

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403. Thiede, G. J. 1986. **Economics of thinning from the forest management standpoint**. In: *Hardwood thinning opportunities in the Lake States: Proceedings of a Symposium*, Escanaba, Michigan, April 20, 1984. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical

Report NC-113. pp. 102-107.

Explores the economic returns possible with pre-commercial and commercial selection thinning of northern Michigan poletimber-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.

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404. Thompson, M. A. and J. A. Sturos 1991. **Performance of a portable chain flail delimber/debarker processing northern hardwoods**. USDA Forest Service, Research paper NC-297. 14 pp.

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

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405. Thompson, M. A. 1991. **Thinning northern hardwoods with chain saws and forwarders**. *Northern Journal of Applied Forestry* 8(4): 149-153.

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

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406. Thomson, T. A. 1983. **Financial aspects of tree improvement strategies within the context of a publicly held firm**. Ph.D. Dissertation, University of California, Berkeley, California. 242 pp.

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407. Thomson, T. A. 1987. **Financial risk and timber portfolios for some southern and midwestern species**. In: *Proceedings of the Joint Annual Meeting of the Southern Forest Economics Workers – Midwest Forest Economists*. pp. 46-55.

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408. Thomson, T. A. 1991. **Efficient combinations of timber and financial market investments in single-period and multi-period portfolios**. *Forest Science* 37(2): 461-480.

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.

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409. Thomson, T. A. 1992. **Risk and return from investments in pine, hardwoods, and financial markets**. *Southern Journal of Applied Forestry* 16(1): 20-24.

Gives average return and risk-return efficieut portfolio weights for investments in pine, oak, gum, ash, S&P stocks, corporate bonds, US government bonds, and US treasury bills during the period 1956-1984.

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410. Thurman, S. L. 1989. **The economics of agroforestry on Missouri soils**. M.S. Thesis, University of Missouri, Columbia, Missouri. 378 pp.

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411. Timko, M. G. 1962. **Evaluation of volume, growth, quality, and value of loblolly pine, virginia pine, and upland hardwoods in the lower Piedmont of North Carolina**. M.S. Thesis, North Carolina State University, School of Forest Resources, Raleigh, North Carolina.

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412. Trimble, G. R., Jr. 1965. **Improvement in butt-log-grade with increase in tree size for six hardwood species**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-31. 15 pp.

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.

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413. Trimble, G. R., Jr., J. J. Mendel and R. A. Kennell 1974. **A procedure for selection marking in hardwoods – combining silvicultural considerations with economic guidelines**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-292. 13 pp.

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.

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414. Trimble, G. R., Jr. and J. J. Mendel 1969. **The rate of value increase for northern red oak, white oak, and chestnut oak**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-129. 29 pp.

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.

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415. Trimble, G. R., Jr. 1971. **Diameter-limit cutting in Appalachian hardwoods: boon or bane**. USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-208. 14 pp.

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.

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416. Ulrich, A. H. 1988. **U.S. timber production, trade, consumption, and price statistics 1950-86**. Washington, D.C., USDA Forest Service, Miscellaneous Publication 1460. 81 pp.

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.

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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.

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418. USDA Forest Service 1982. **An analysis of the timber situation in the United States, 1952-2030**. Washington, D.C., USDA Forest Service, Forest Resource Report no. 23. 499 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.

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419. Utz, K. A. 1985. **Taxes affecting forestry investments**. In: *Proceedings - Third Symposium on Southeastern Hardwoods*, April 16-17, 1985. USDA Forest Service, Southern Region. pp. 23-27.

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

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420. Utz, K. A. and W. E. Balmer 1970. **Rehabilitate or regenerate**. In: *Proceedings of Symposium on Southern Appalachian Hardwoods*, Asheville, North Carolina, September 22-23, 1970. Atlanta, Georgia, USDA Forest Service, State and Private Forestry, Southeastern Area. pp. 7-22.

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. Discnsses 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.

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421. Utz, K. A., W. E. Balmer, H. D. Hammond and F. Shropshire 1977. **Investment analysis of bottomland hardwoods**. Atlanta, Georgia, USDA Forest Service, Southeastern Area, State and Private Forestry. 7 pp.

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.

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422. Utz, K. A. and D. H. Sims 1981. **Investment analysis of uplaud oak stands**. Atlanta, Georgia, USDA Forest Service, Southeastern Area, State and Private Forestry, Forestry Report SA-FR-12. 44 pp.

Uses the PAR-3 computer program to determine present net worth and internal rate of return nsing 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.

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423. Varnedoe, L. E., Jr. 1993. **Government programs available to timberland owners**. *Forest Farmer* 52(3): 32-34.

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.

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424. Vasievich, J. M. 1978. **Economic feasibility of intensive management**. In: *Proceedings of the Eighth Forestry and Wildlife Forum*, Virginia Polytechnic Institute and State University. pp. 36-49.

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425. Vasievich, J. M. 1984. **How to fignre financial retnrns from hardwood timber management**. In: *Increased cost effectiveness in management and utilization of eastern hardwoods. Proceedings: Twelfth Annual Hardwood Symposium of the Hardwood Research Council*, Cashiers, North Carolina, May 8-11, 1984. Asheville, North Carolina, Hardwood Research Council. pp. 67-80.

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.

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426. Vasievich, J. M. 1989. **A dozen recommendations for managing hardwood forests profitably**. In: *Proceedings of the Seventh Central Hardwood Conference, 1989*, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-132. pp. 18-24.

Presents management recommendations for landowners to increase revenue from hardwood forest land. Discusses professional forestry assistance, stand cultural treatments, harvesting and regeneration, and financial planuing.

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427. Wagstaff, F. J. 1985. **Economics of nsing Gambel oak for firewood**. In: *Proceedings of the 3rd Utah Shrub Ecology Workshop*, Provo, Utah, 1983. pp. 53-58.

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428. Wagstaff, F. J. 1984. **Economic considerations in nse and management of gambel oak for fuelwood**. Ogden, Utah, USDA Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INT-165. 8 pp.

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.

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429. Wallace, R. G. 1987. **Potential and needs of intensifying northern hardwood management**. In: *Managing northern hardwoods: proceedings of a silvicultural symposium*, Syracuse, New York, Juue 23-25, 1986. State University of New York, College of Environmental Science and Forestry, Faculty of Forestry Miscellaneous Publication No. 13. pp. 3-13.

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.

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430. Weaver, G. H. 1966. **An economic evalnation of harvesting alternatives for an upland oak stand on the southern Indiana forage farm**. M.F. Thesis, Purdue University, Lafayette, Indiana. pp.

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431. Weaver, G. H. and S. H. Bullard 1983. **Mississippi's severance tax and Forest Resonrce Development Program**. *Journal of Forestry* 81(10): 663-664.

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

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432. Webster, H. H. 1964. **Identifying major timber management opportnnities in Wisconsin**. Madison, Wisconsin, University of Wisconsin, Forest Research Note 144. 6 pp.

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433. Webster, H. H. 1960. **Timber management opportunities in Pennsylvania**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Station Paper 137. 37 pp.

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.

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434. Webster, H. H. 1963. **Timber management and economic analysis, a case stndy**. Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-14. 26 pp.

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 poletimber and small sawtimber stands. Also discusses allocation of a given budget.

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435. Webster, H. H. 1983. **Marketing hardwood resources**. In: *America's hardwood forests – opportunities unlimited. Proceedings of the 1982 Convention of the Society of American Foresters*, Cincinnati, Ohio, September 19-22, 1982. Bethesda, Maryland, Society of American Foresters, SAF Publication 83-04. pp. 11-16.

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.

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436. Webster, H. H. 1986. **Some strategic considerations in managing hardwood forests in the Lake States**. In: *Hardwood thinning opportunities in the Lake States: Proceedings of a symposium*, Escanaba, Michigan, April 20, 1984. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, General Technical Report NC-113. pp. 1-5.

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.

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437. Webster, H. H. and J. C. J. Meadows 1971. **Economic evaluation of intermediate operations in oak stands**. In: *The Oak Symposium Proceedings*, Morgantown, West Virginia, August 16-20, 1971. pp. 74-83.

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.

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438. Wells, J. L. 1977. **Economics of timber resource availability in a Tennessee timbershed**. M.S. Thesis, University of Tennessee, Knoxville, Tennessee.

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439. White, D. 1987. **Your role in the economic management of eastern hardwoods**. In: *Economics of Eastern Hardwood Management: Penn State Forest Resources Issues Conference*, University Park, Pennsylvania, March 9-11, 1987. The Pennsylvania State University, School of Forest Resources and Cooperative Extension Service. pp. 262-269.

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

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440. White, D. C. and G. E. Campbell 1988. **Optimal tree size for harvest in an uneven-aged stand of npland hardwoods**. Urbana-Champaign, Illinois, University of Illinois, Agricultural Experiment Station, Department of Forestry, Forestry Research Report No. 88-8. 30 pp.

Uses a hypothetical uneven-aged mixed upland hardwood stand in Illinois (white oak SI=70 ft., RBA=70 ft^2 , LDT=32 in., q=1.3) and the TWIGS growth model to determine tree size that maximizes net 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.

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441. White, Z. W. 1986. **Inflnences on timber investments by state and national policies**. In: *Proceedings: 14th Annual Hardwood Symposium of the Hardwood Research Council*, Cashiers, North Carolina, May 18-21, 1986. Memphis, Tennessee, Hardwood Research Council. pp. 26-29.

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

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442. Wiedenbeck, J. K. and P. A. Araman 1993. **Possible demands for eastern hardwoods resulting from harvest restrictions in the Pacific Northwest**. *Forest Products Journal* 43(10): 51-57.

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.

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443. Williams, R. A., W. B. Kurtz and H. E. Garrett 1978. **Silvicultural and economic implications of thinning scarlet oak stands in southern Missouri**. In: P. E. Pope Ed. *Proceedings of the Central*

Hardwood Forest Conference II, West Lafayette, Indiana, West Lafayette, Indiana, Purdue University. pp. 425-433.

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444. Winebar, B. L. and J. E. Gunter 1984. **Cost of forest management practices in the Lake States**. Michigan Agricultural Experiment Station, Research Paper 457. pp. 2-8.

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.

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445. Wishart, J. 1985. **Southern hardwood resource opportuuities**. In: *Proceedings - Third Symposium on Southeastern Hardwoods*, April 16-17, 1985. USDA Forest Service, Southern Region. pp. 3-13.

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

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446. Worley, D. P. 1963. **Calculating optimum product combinations from stauding trees**. Columbus, Ohio, USDA Forest Service, Central States Forest Experiment Station, Research Paper CS-7. 17 pp.

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.

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447. Worley, D. P. 1970. **The "let it grow" treatment for timber – is it economically worthwhile?** Upper Darby, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-157. 37 pp.

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.

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448. Yaussay, D. A. and R. L. Brisbin 1989. **Evaluating standing timber using STUMP**. In: *Making the most of the hardwood resource. Proceedings of the 17th Annual Hardwood Symposium of the Hardwood Research Council*, Merrimac, Wisconsin, May 7-10. 1989. Hardwood Research Council. pp. 41-51.

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.

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449. Yaussy, D. A., R. L. Brisbin and M. J. Humphreys 1988. **Predicting volumes and numbers of logs by grade from hardwood cruise data**. Broomall, Pennsylvania, USDA Forest Service, Northeastern Forest Experiment Station, Research Paper NE-613. 17 pp.

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.

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450. Young, N. 1993. **Growing hardwoods for uature and profit**. *Forests & People* 43(4): 12-14.

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

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451. Zahner, R. 1982. **Some benefits of establishing planted pine-natural hardwood mixtures**. In: J. L. Haymond Ed. *Proceedings, Second Annual Forestry Forum, Cost-effective regeneration practices*, Clemson, South Carolina, March 16, 1982. Clemson University, Cooperative Extension Service, Department of Forestry. pp. 13-23.

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

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452. Zasada, Z. A. 1952. **Does it pay to thin young aspen?** *Journal of Forestry* 50: 747-748.

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 15x15-spaced crop tree thinning plot are compared, and break-even thinning cost is estimated.

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453. Zinkhan, F. C. 1995. **Forest economics: the management of options and values**. *Journal of Forestry* 93(1): 25-29.

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

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454. Zinn, G. W. 1986. **Marketing as a factor in the management of immature hardwood stands.** In: H. C. Smith and M. C. Eye Eds. *Guidelines for managing immature Appalachian hardwood stands*, Morgantown, West Virginia, May 28-30, 1986. West Virginia University, College of Agriculture and Forestry and Cooperative Extension Service, SAF Publication 86-02. pp. 8-21.

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.

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455. Zinn, G. W. and E. Pepke 1989. **Let the market help prescribe forest management practices**. St. Paul, Minnesota, USDA Forest Service, North Central Forest Experiment Station, Central Hardwood Notes 7.04. 4 pp.

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.

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456. Zipper, C. E. 1983. **Economic analysis and the planting of hardwood trees on surface mined lands**. In: *Proceedings Third Annual Better Reclamation with Trees Conference*, Terre Haute, Indiana, June 2-3, 1983. Purdue University, Department of Forestry and Natural Resources. pp. 202-216.

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.