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Impact of Timber Production and Transport Costs on Stand Management

Chris B. LeDoux

Abstract

Decisions to manage immature eastern hardwood stands on steep terrain must be based on an understanding of the impact of timber production costs on optimal rotation length and present net worth. Planners and managers can make improved decisions by knowing how the interaction of timber production and transportation costs affect individual stand management. Simulations with a complete systems model indicate that managers and planners must consider cable logging technology, transportation network standards, and transport vehicles.

The Author

Chris B. LeDoux is an industrial engineer and Project Leader with the Northeastern Forest Experiment Station, Morgantown, West Virginia.

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Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA 19008
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Introduction

Interest in promoting management of immature eastern hardwood stands has increased (USDA 1981, Smith and Eye 1986). The efficient management of eastern hardwood stands located on steep terrain depends on logging and processing technology, current and future market demands and prices for hardwood products, stand growth and yield response, stand composition, and landowners objectives.

Decisionmakers must know which stand and harvesting variables affect costs and benefits and understand how these variables interact for a particular management plan. They must be able to develop a financially sound plan that accounts for the short- and long-term effects of individual silvicultural treatments. Finally, decisionmakers must be abreast of logging technology, transportation networks, and transport vehicles. The choice of logging equipment will constrain stand management significantly.

In this article, the impact of cable logging technology, transportation network standards, and transport vehicles on stand management is evaluated with a complete systems simulation model called MANAGE (LeDoux 1986). The results can be used to help planners and managers understand the impact of timber production costs on eastern hardwood management.

Cable Logging Technology

The initial entry into a young stand is difficult financially. The low volumes and value removed per acre generally make thinnings and cleanings impractical. However, improvement cleanings and thinnings must be done early in the life of the stand to fully capture the benefits of thinning (Marquis 1986, Dale and Hilt 1986). It is desirable that product and volumes removed during early thinnings include related logging costs. It is important to match logging technology to initial entry conditions to ensure financially feasible short-term outcomes (LeDoux and Brodie 1982, LeDoux 1986).

For example, Table 1 shows the present net worth derived from thinning a 40-year-old red and white oak stand with three different machine configurations. The Ecologger I is a medium-sized cable yarder capable of handling small and large logs. The Radio Horse 9 prebunching winch is small and designed for handling small logs. The Bitterroot cable yarder is a small yarder capable of handling small logs. The three logging systems differ in initial investment costs as well as in the size of crews required. For example, the prebunching winch would require two people, the small Bitterroot two people, and the medium-sized Ecologger I a crew of three or four.[1]

Table 1.—Harvesting by different machine configurations for the initial entry[a]

Machine configuration	Stump-to-landing cost	Present net worth
	Dollars/acre	
Prebunching Radio Horse 9 Swinging Bitterroot	408.06	-78.32
Yarding Ecologger I	338.54	-8.80
Yarding Bitterroot	313.69	16.05

[a]Conditions—Forest model plot No. 3; age, 40; site index, 70; trees/acre, 201; stand composition, red and white oak; basal area, 81.3; volume/acre, 1,945 ft^3 (Smalian's method); average stand d.b.h., 7.4; volume cut/acre, 978 ft^3; firewood value, $329.74/acre; wood sold as firewood at roadside, $30.00/cord; real interest rate, 4%.

Although prebunching small logs to increase the efficiency of the swing machine is generally desirable (LeDoux and Butler 1982), prebunching logs with the Radio Horse 9 and swinging them with the small Bitterroot yarder would be very expensive and result in losses of $78.32 per acre. The prebunch and swing cost is high because the limited capacity of the Bitterroot Yarder is not improved by bunching. Using the medium-sized Ecologger I yarder to log this scenario would be expensive and result in losses of $8.80 per acre. Using the small Bitterroot to yard the small logs and volumes would result in net gains of $16.05 per acre. Thus, the short-term goal of thinning to clean the stand and recover logging costs can be met by using the Bitterroot yarder. The long-term benefits of thinning evolve over time and are not addressed here. Careful selection and matching of cable logging technology to initial stand entry can achieve both short- and long-term stand management objectives.

[1]The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture or the Forest Service of any product or service to the exclusion of others that may be suitable.

Table 2.—Simulated optimal rotation length and present net worth by road and truck class and hauling distance[a]

Haul distance (miles)	*Road class 2; truck class 1*		*Road class 3; truck class 3*	
	Optimal rotation	Present net worth	Optimal rotation	Present net worth
	Years	*Dollars/acre*	*Years*	*Dollars/acre*
15	90	530.83	100	470.96
25	90	521.79	100	427.13
35	90	512.76	100	383.31
45	90	503.72	100	339.48
55	90	494.69	100	295.66
65	90	485.65	110	257.78
75	100	477.51	120	221.62
85	100	469.21	120	189.93
95	100	461.73	120	158.24
105	100	453.83	120	126.54
115	100	445.94	140	97.91
125	100	438.05	170	80.91
135	100	430.16	180	72.45
145	100	422.27	180	65.19
155	100	414.38	180	57.93
165	100	406.48	180	50.67
175	100	398.59	190	44.73

[a]Conditions—Forest model plot No. 3; age, 40; site index, 70; trees/acre, 55; average stand d.b.h., 11.2 inches; volume/acre, 966 ft^3 (Smalian's method); real interest rate, 4%.

Haul Distance and Transportation Network

Managers also must consider the haul mileage, transportation network, and vehicles from stump-to-mill. The distance that products must be hauled from stump-to-mill will have an impact on the way a stand is managed. The road standards and vehicles used for transporting products will impact stand management significantly.

In the previous discussion of cable logging technology, the products from the thinning were sold as firewood at roadside. Transporting them to a mill site would not be economical. The residual stand products—sawlogs—would be transported to a mill at final harvest. The residual stand growth and development were simulated using MANAGE. Table 2 shows the optimal (maximum present net worth) rotation length and related present net worth by truck and road class, and haul mileage for the residual stand.

On road class 2 and 3 a loaded log truck can achieve speeds of 35 and 25 miles per hour, respectively. Truck class 1 is a truck tractor, 6X4, tandem axle with tandem 30- to 35-foot trailer and an additional 15- to 20-foot trailer. Truck class 3 is a truck tractor, 4X2, single axle with tandem trailer. Gross vehicle weights are 105,000 and 59,000 pounds, respectively, for truck class 1 and 3.

Figure 1 shows the difference in present net worth per acre for transporting products with alternate road and truck class configurations. In all situations, present net worth decreases as haul mileage increases. Present net worth dramatically decreases the farther products are transported on poorer roads with smaller trucks. For example, the difference in present net worth at 15 miles from the mill is $59.87 per acre (Fig. 1), while the difference at 105 miles from the mill is $327.29 per acre or a 547 percent increase. Haul mileage and road and truck class also affect optimal rotation age.

Managers may use the data in Table 2 to form management contours by haul distance and road and truck class configurations. Accordingly, Figures 2 and 3 show management zones or contours for a hypothetical woodshed. Clearly, the advantage of better roads and larger capacity trucks is demonstrated with optimal rotations of 90 years from the mill out to 65 miles and 100-year rotations to the back reaches of the woodshed (Fig. 2). By contrast, smaller trucks on poorer roads dictate longer and longer rotations for stands that are far away from the mill (Fig. 3).

It is imperative that planners and managers account for transportation costs in stand management objectives. For example, if a planner assumed transportation to take place over good roads with large trucks for the 175-mile distance, present net worth would be $398.59 per acre. However, if the products from the future stand were hauled on poor roads and with small trucks, the present net worth per acre would be $44.73, a loss of $353.86 per acre.

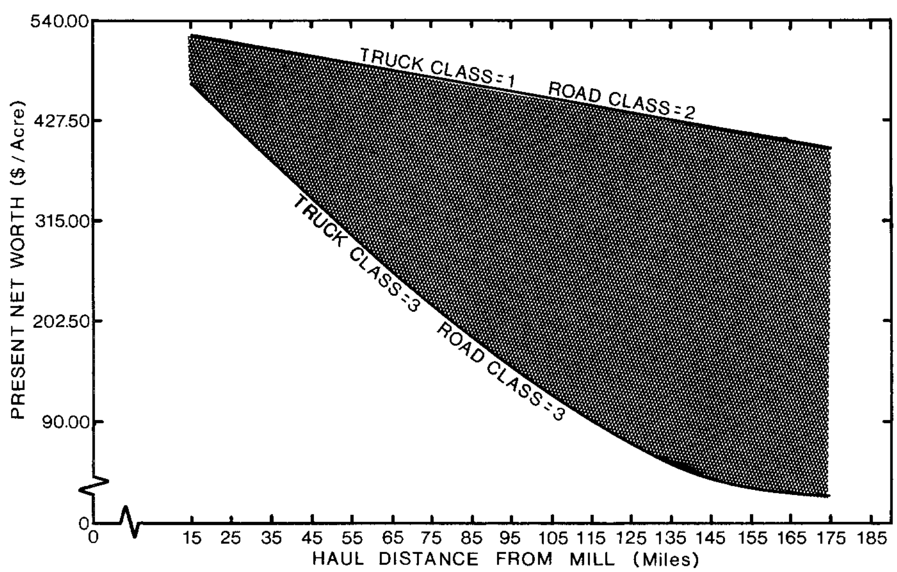

Figure 1.—Simulated present net worth by haul distance and road and truck class combinations.

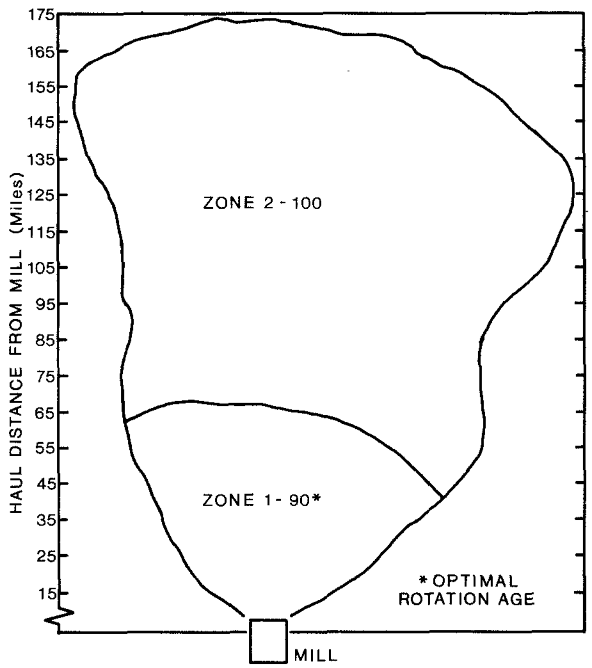

Figure 2.—Simulated management zones or contours for a hypothetical woodshed by hauling distance to a mill. Conditions: road class 2, truck class 1.

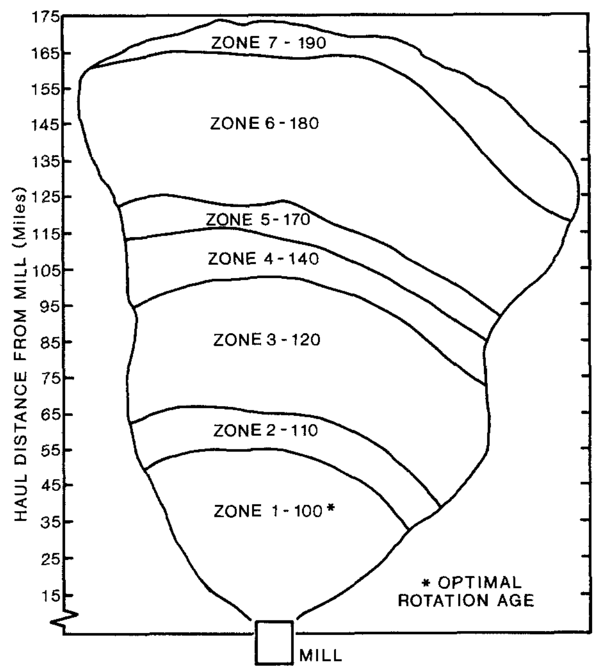

Figure 3.—Simulated management zones or contours for a hypothetical woodshed by hauling distance to a mill. Conditions: road class 3, truck class 3.

Considerations for Managers

Simulations presented here demonstrate the impact that timber production costs have on eastern hardwood management. How to manage a specific stand depends on the interaction of logging equipment, transportation networks, and transport vehicles, and how these variables directly affect optimal rotation length and related present net worth. The costs of timber production severely influence forest management prescriptions over the entire rotation period.

Failure to consider logging and transportation costs may result in suboptimal decisions. Planning and analysis projections may represent gross errors in rotation and present net worth yields. Decisionmakers need to consider future products and the method of merchandising. Managers may wish to develop management zones or contours that account for logging technology and transportation costs. Failure to do so could result in costly decisions based on erroneous projections.

Although this work was based on data from one forest model plot and one tree distribution, similar analyses could be conducted for other conditions by simply making more simulation runs. For example, the results in Figures 2 and 3 are based on identical stands, site quality, species, and the use of logging technology as opposed to conventional ground-based logging technology. In the applied setting, this is usually not the situation as sites and species vary, as well as logging technology. It is beyond the scope of this article to deal with all aspects of stand management, and it is not envisioned that such results as those summarized here will provide all the answers.

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Evaluates the impact of cable logging technology, transportation network standards, and transport vehicles on stand management. Managers can use results to understand the impact of timber production costs on eastern hardwood management.

Keywords: Cable logging; stand management.

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