Minnesota Forestry Research Notes

No. 274
January 1980

ECONOMIC IMPACT OF PRESCRIBING FOREST PRACTICES TO IMPROVE WATER QUALITY: A MINNESOTA CASE STUDY

Paul V. Ellefson and Ralph E. Weible*

The 1972 Amendments to the Federal Water Pollution Control Act directed public and private organizations to focus greater attention on the nation's waterways (U.S. Congress 1972). A large portion of this attention is to be directed to nonpoint sources of water pollution, many of which are unique to the forestry community. By law, states are required to define and implement packages of "best management practices" (BMPs). The latter are defined as "...practices or combination of practices that are...the most effective, practical means of preventing or reducing the amount of pollution generated by nonpoint sources..." (U.S. Office of Federal Register 1977). Minnesota, via the Pollution Control Agency, must define the package of forest practices that will meet the goals of the 1972 amendments and yet be consistent with physical, economic, and political conditions within the state. To do this requires an understanding of economic as well as the physical relationships between forest practices and water quality. For example, what are the added or marginal costs of prescribing forest practices thought capable of enhancing water quality? What impacts do these added costs have on landowner and timber purchaser net revenue? And what might be an economically optimum package of forest practices that will meet both legally imposed water quality standards and the revenue objectives of the landowner and the purchaser of timber?

A study designed to address questions of this nature was undertaken in 1977. Its purpose was twofold; namely, (1) determine the marginal cost of implementing management practices considered important to the reduction of nonpoint, forest sources of water pollutants, and (2) evaluate the impact on a timber purchaser's net revenue of requiring prescription of additional pollution-abating forest practices. The achievement of these purposes was limited in the following fashion: only costs, not benefits, of managing nonpoint, forest sources of pollution were analyzed; economic impact on a single timber purchaser was of major concern--regional impacts of alternative forest practices were not considered; forest practices prescribed to produce outputs other than timber were not assessed; and the analysis focused on a cost structure representative of state-owned forest land in southeastern Minnesota.

Study Area

The area selected for study was a 104-acre timber sale located within the Richard A. Doerr Memorial Hardwood State Forest, southeastern Minnesota. The forest and the timber sale were administered by the Lake City District of the Minnesota Department of Natural Resources. The sale area encompassed a narrow 3/4-mile-long dry wash and bottomland surrounded by 30-60 percent slopes which rise approximately 400 feet at the 600-foot-wide mouth of the draw. The dry wash is 15 feet at its widest point and is crossed several times by an access road. The forest cover was primarily overmature elm and oak. The purchaser of the sale was given instructions to cut and remove all merchantable elm regardless of form. Slash was to be kept out of the dry wash, and tops were to be limbed. Prescribed burning will be used to dispose of slash and promote regeneration of oak.

*Associate Professor, Forest Economics and Policy, and Research Assistant, respectively, College of Forestry, University of Minnesota.

Published by the College of Forestry, 1530 North Cleveland Avenue, St. Paul, Minnesota 55108. E. Sucoff, editor.

Total revenue approached $10,000, the bulk of which came from the sale of elm sawlogs and oak and butternut railroad ties. Total operating costs were $8,767. Of the latter, stumpage accounted for 37 percent. The cost of harvesting activities (e.g., felling, skidding, limbing, trucking) was set at $26.50 per acre assuming a production rate of one MBF per hour. Such a cost is consistent with harvesting cost estimates found in the literature (Mattson 1976; Gardner 1966; Tritch 1968; and Zasada 1971) and with cost estimates provided by the sale administrator.

Effect of Additional Forest Practices

The impact on net revenue that would occur if additional forest practices important to the production of quality water were required of the timber sale purchaser was evaluated. Based on a review of current literature and suggestions made by forest hydrologists, four practices were selected for testing: filter strips (30 foot and 60 foot), buffer strips (30, 60, and 100 foot), seeding of landings and trails, and design of skid trails. The added cost of these practices and their impact on total cost, net revenue, and rate of return are presented in Table 2. The filter and buffer strip options are mutually exclusive. Other practices which could be considered include closing of access roads, installation of water bars or broad-based dips, use of culverts, and appropriate site preparation, regeneration, and slash disposal techniques.

Filter Strip

Forest vegetation retained in filter strips can be used to reduce the flow of sediments and nutrients which may result from harvesting activities. Harvesting machines would not be permitted within the strip. All elm, however, would be cut and winched to an area outside the filter strip. A 30-foot filter strip would encompass 7.3 acres (U.S. Forest Service 1976) and would contain approximately 5.1 MBF of hardwood other than elm. Inability to harvest this volume represents a net revenue loss of $12 to the sale purchaser. Doubling the filter strip to 60 feet would double the total timber volume foregone and would increase skidding costs for elm located near the dry wash. Assuming a 25-percent increase in skidding costs, the added cost of a 60-foot filter strip would be $44 and would decrease the purchaser's net revenue to $1,168.

Buffer Strips

Buffer strips could be prescribed to serve functions similar to those accomplished by filter strips. Harvesting activities would not, however, be permitted within buffer strips. Prescription of a 30-foot, 60-foot, or 100-foot strip implies timber values foregone by the purchaser of $80, $160, and $266, respectively. Timber volumes excluded from harvesting within the sale area would be as follows: 30-foot buffer - 7.7 MBF, 60-foot buffer - 15.4 MBF, and 100-foot buffer - 25.4 MBF. The 100-foot buffer strip would reduce net revenue by nearly twenty percent.

Seeding Landings and Trails

Seeding exposed soil located in areas used as landings and main skid trails can increase water infiltration and reduce sediment flow. In the sale area, however, landings and trails occupied minimal acreages. Surface area allocated to twelve landings (each 43 feet by 43 feet) was only 0.5 acres. Main skid trails accounted for only 2 acres of the sale area's 104 acres (4 miles of trails, 6 feet wide). A mixture of grasses and legumes suitable for the sale area's soil and climate would be applied by a hand-cranked cyclone seeder. The cost of seed is estimated to be $21.78 per acre and the labor for applying it, $10.70 per acre (Sage and Tierson 1975). The added cost of seeding the 2.5 acres in landings and skid trails would be $80 more than the cost of current practices and would reduce the purchaser's rate of return by 1 percent.

Skid Trail Design

Skid trails designed at gentle angles to slopes can reduce water runoff rates and thus reduce erosion. If the purchaser of the timber sale was required to comply with more stringent design standards for skid trails, two major additional costs would be incurred, namely, the added cost of locating skid trails in sensitive portions of the sale area, and the increased time spent skidding logs on longer trails. Assuming such activities will require an additional 27.5 hours (i.e., 25 percent of sale harvesting time) at $20 per hour (i.e., hourly rate for skidder and operator), the purchaser of the sale would incur an additional cost of $550 and realize net revenue of $662.

Marginal Impact of Selected Practices

Selection of filter and buffer strips for the timber sale in question involves mutually exclusive options. If a 60-foot filter strip was selected and all other filter and buffer strip options were excluded from consideration, the purchaser of the timber sale would have a cost, revenue, and rate of return schedule as depicted in Table 3.

Discussion

Operating very close to an economic break-even point may be a very real situation for low volume timber operations which purchase small volume public timber sales. This appears to be especially so in southeastern Minnesota. Given such circumstances, rules and regulations requiring operators to undertake additional forest practices that may enhance or maintain water quality could lead to very serious negative economic impacts. This is especially so in light of market uncertainties and unsure estimates of timber volumes and species mix--all of which make a 13.8 percent rate of return on investment appear quite modest. If required to undertake additional forest practices, the operator faces a number of options: absorb the cost of the added practices and thereby accept a lower rate of return; look to other opportunities for investment of financial resources; or seek public subsidies that will cover the cost of undertaking the required practices - e.g., lower public stumpage prices, cash payments to perform required practices, or both.

The analysis focuses only on the timber sale purchaser's costs and revenues. From a social perspective, there may be some especially important benefits and costs which result from the purchaser's decision to undertake practices considered important to maintaining or enhancing water quality. Quite possibly, the benefits to society may justify such investments. Unfortunately, information to assess the value of benefits represented by reduced sediment and nutrient loads in water is sorely lacking (U.S. Forest Service and U.S. Environmental Protection Agency 1977). If available and included in the analysis, the benefits could very likely be sufficiently large to justify investments in appropriate forest practices.

LITERATURE CITED

Gardener, R. B. 1966. Designing efficient logging systems for northern hardwoods. USDA For. Serv. Res. Paper NC-7.

Mattsen, J. A. 1976. Harvesting research for maximum yield systems. USDA For. Serv. NCFES (unpublished memo).

Sage, R. W., Jr., and W. C. Tierson. 1975. Establishing vegetation cover along logging access road: techniques-cost-benefits. Northern Logger 24(4):16-17, 33-34, 38.

Tritch, J. W., H. H. Webster, and W. R. Bentley. 1968. Harvest costs and timber management. University of Wisconsin Forestry Note No. 141.

U.S. Congress. 1972. Federal Water Pollution Control Amendments. October 18, 1972. PL-92-500.

U.S. Forest Service. 1976. Timber Sale Preparation Handbook. Forest Service Handbook. USDA Superior National Forest Supplement No. 3, June 1, 1976, 604.14.1.

U.S. Forest Service and U.S. Environmental Protection Agency. 1977. Silvicultural Activities and Nonpoint Pollution Abatement: A Cost Effectiveness Analysis Procedure. EPA 600/8-77-018.

U.S. Office of the Federal Register. 1977. Code of Federal Regulations. 40 CFR 130.1

Zasada, A. Z. 1971. Economic considerations in mechanized harvesting in northern Minnesota. In Proc. of Confer. on Biological and Economics Considerations in Mechanized Timber Harvesting. University of Minnesota Agric. Exper. Sta. Report No. 116.

Table 1. Financial status of timber purchaser: total revenue, total cost, net revenue, 1977.

Item	Dollars
Total Revenue[a]	
Oak, Butternut (ties)	$ 6,125
Elm (sawlogs)	3,571
Basswood (sawlogs)	283
	$ 9,979
Total Costs	
Stumpage[b]	$ 3,261
Harvesting	2,756
Hauling	2,750
	$ 8,767
Net Revenue	$ 1,212

[a] Price delivered to mill: oak and butternut railroad ties, $3.50 per tie; elm, $96 per MBF: basswood, $101 per MBF.

[b] Stumpage purchase price: Railroad ties, $1.40 per tie; elm, $20 per MBF; basswood, $24 per MBF.

Table 2. Financial impact of added practices designed to enhance water quality, 1977.

Forest Practice	Added Cost	Total Cost	Net Revenue*	Rate of Return
	- - - - -dollars		- - - - - -	percent
Current Practices	--	8,767	1,212	13.8
Filter Strip (30 feet)	12	8,779	1,200	13.7
Filter Strip (60 feet)	44	8,811	1,168	13.3
Buffer strip (30 feet)	80	8,847	1,132	12.8
Seeding Landing Trails	81	8,848	1,131	12.8
Buffer Strip (60 feet	160	8,927	1,052	11.8
Buffer Strip (100 feet)	266	9,003	976	10.5
Skid Trail Design	550	9,317	662	7.1

* Total revenue = $9,979

Table 3. Marginal financial impact of requiring selected practices designed to enhance water quality, 1977.

Forest Practice	Marginal Cost	Total Cost	Net Revenue*	Rate of Return
	- - - - - -	dollars	- - - - -	percent
Current Practices	--	8,767	1,212	13.8
Filter Strip (60 feet)	44	8,811	1,168	13.3
Seeding Landing and Trails	81	8,892	1,087	12.2
Skid Trail Design	550	9,442	537	5.7

* Total revenue = $9,979

Published as Misc. Jour. Ser. Paper No. 1744 of the Univ. of Minn. Agr. Expt. Sta.