Final Report to Vermont Monitoring Cooperative
"A social, economic and institutional feasibility analysis of alternative silvicultural management practices"

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The purpose of this project was to conduct seed research in support of the Vermont Forest Ecosystem Management Demonstration Project (FEMDP), a project which is evaluating sustainable forest management techniques for the northern forest region. In particular it compares the effects of traditional cutting techniques to those that are designed to enhance the structural complexity and ecological function of the forest. The socio-economic study was designed to preliminarily assess the social and economic feasibility of the structural complexity treatments relative to more conventional ones.

We initially proposed to address four questions:

1. Do the proposed systems result in a net gain or loss to the forest owners, when Net Present Value is used as a measure?
2. How sensitive is economic feasibility of these systems to factors including the scale and financial situation of the forest owner, fluctuations in the prices of the various wood product outputs, costs of labor and equipment inputs and risk factors arising from uncertainty in markets?
3. What are the institutional and economic factors that mediate wood product prices and harvesting costs at the local and regional levels?
4. Under what conditions might forest owners be willing to adopt these systems even when they result in net economic losses? What are the social and cultural factors that may mediate this decision? To what extent can these non-market values be quantified?

Given time and resource constraints, we were only able to empirically address questions 1 and 2, which deal with economic issues. Questions 3 and 4, which are social and institutional in nature, could only be addressed at an anecdotal level. However, we were able to highlight critical social and institutional issues that should be addressed in greater detail in subsequent empirical research.

Our economic analysis was preliminary in that it consisted only of a snapshot in time. The available data allowed us to compare the costs and revenues from the various silvilcultural treatments for a single cutting cycle. In the future we hope to derive net present value figures which incorporate predicted future streams of income from the

forest under the different treatments. However, doing so will require long-term monitoring data of the growth rates of the forest under different treatments.

Linking costs and revenues by treatment required keeping track of all wood products throughout the chain of custody. Towards this end we created a data entry sheet for the loggers in which they recorded daily all their hours worked by treatment unit. Those hours were broken down by labor and equipment usage, including the equipment type. The loggers also kept daily records of added expenses, such as breakdowns, weather related work and timber marking. Logs were sorted by treatment, allowing mill receipts (or receipts from firewood or chipwood) to be grouped by treatment. Thus, costs and revenues could be compared for each treatment.

All data were entered in an Access relational database. The series of linked tables included hours worked, lumber receipts by load, costs per hour by type, added expenses, chipwood receipts and firewood receipts. One of the most difficult factors to quantify was hourly costs for labor and equipment usage. What the logger charges per hour is an inadequate metric because it is an abstract flat number that represents a variety of short-term and long term costs and overhead, as well as uncertainty. The actual economic cost of an hour of labor or equipment usage is much more difficult to calculate, for it is a function of the opportunity cost of the resources spent on it. So, for instance, we calculated the cost of operating the skidders and the tree shear (Timbco) as a function of the monthly payment for those pieces of equipment, plus a factor for maintenance. Even in the case of a skidder that was fully paid off, we gave it a cost equal to what the monthly payment would have been, since there is an opportunity cost to having money sunk into that piece of equipment, rather than in some other investment. While monthly payment data were obtained from the logger, we did not have accurate average maintenance cost data, which instead had to be estimated. For hired labor, we calculated the hourly cost as the wage rate paid to them plus an additional estimated percentage for overhead. One of the more difficult issues was figuring the hourly cost of the principal business owning logger (Tom Lincoln and Richard Lavigne), since these are not observed. The cost of labor for business owners who also do labor that could be hired out is not easy to derive because of the large number of functions these people usually fulfill as well as the risk and uncertainty that they must face. In other words, when the company does well, they are paid a good wage, but they are not when it does poorly. To get an adequate idea of the owner's wage rate, one would have to average out the range of profits and losses over time. While this will be an important area of future research, for the preliminary study we simply took the hired workers' wage rate and inflated it by a given amount, based on conversations with industry professionals.

We then generated revenues, costs and net profits under a range of scenarios, given in figures 1 and 2 and tables 1 and 2. The first scenario, which we call "non-profit" (NP) assumes that none of the marking costs or incidental (unplanned) maintenance costs are included in profit calculations. The second, which we call "semi-profit," (SP) assumes that marking costs are included but not incidental maintenance. The third, called "for-profit" (FP) assumes that incidental maintenance and marking costs are included. Units 2m, 2j, 3m and 3j are the structural complexity cuts, while the others use traditional

silvilcultural systems. These simulate how costs might be internalized differently under a variety of scenarios, from one where only the value of the timber is a concern, to one where there is multiple purposes for the forestry operation, as is often the case on the land of many small woodlot owners.

It is important to keep in mind that these figures represent economic profits under a competitive market. That is, at zero profit, it is assumed that the owner has already paid himself for his labor. Profit above and beyond this are gains to the company that can be used to pay dividends to the owner or to invest in the growth of the company above and beyond what their normal rate of investment would be. Under a perfectly competitive market, we would assume that all jobs would result in zero economic profit. However, in reality, given the great range of uncertainty in quantifying the expenses, the job would probably require a perceived positive profit to be considered "economically feasible."

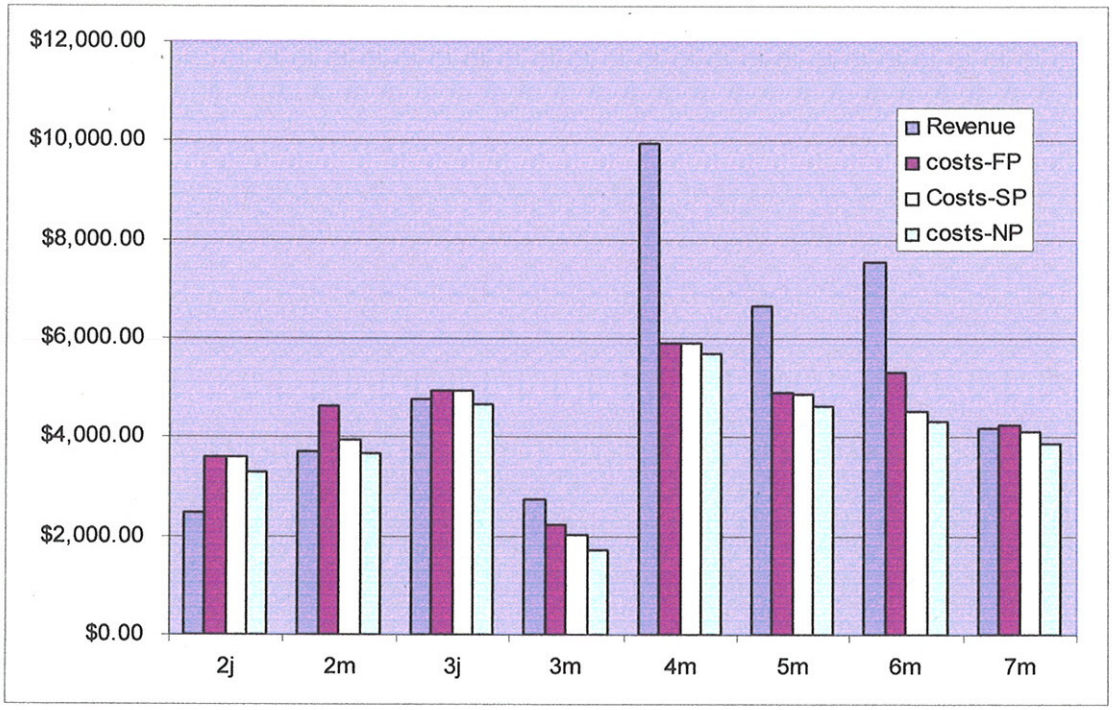

Figure 1. Costs and revenues by treatment

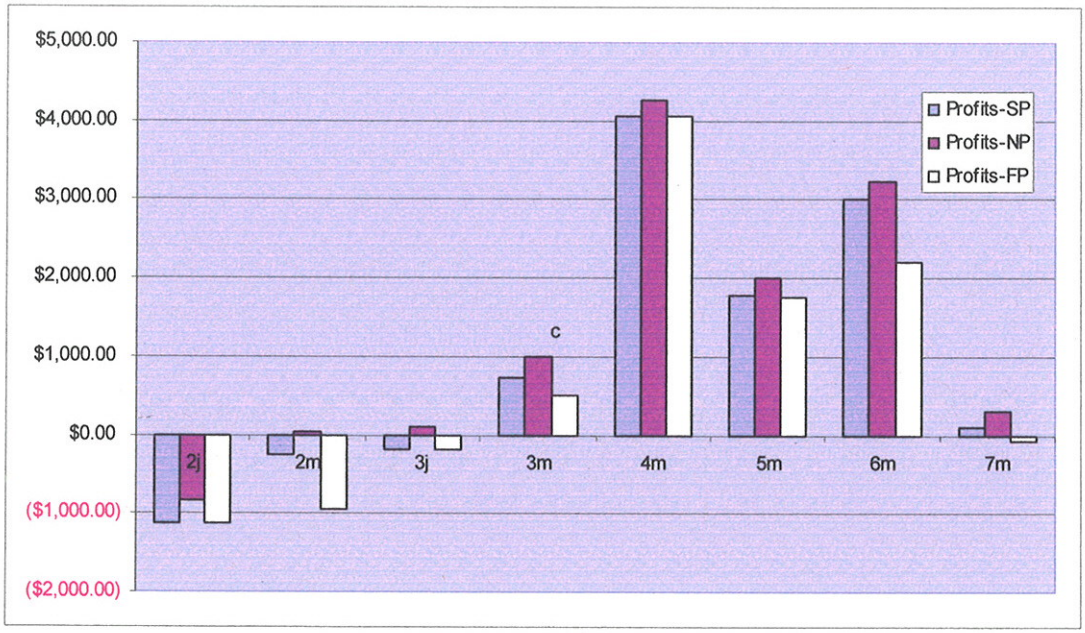

Figure 2. Net profits by treatment

Unit	Profits-FP	Profits-SP	Profits-NP
2j	($1,134.82)	($1,134.82)	($846.82)
2m	($942.72)	($262.72)	$25.28
3j	($179.13)	($179.13)	$108.87
3m	$509.45	$719.45	$1,007.45
4m	$4,055.00	$4,055.00	$4,271.00
5m	$1,750.28	$1,780.28	$1,996.28
6m	$2,215.33	$3,015.33	$3,231.33
7m	($68.70)	$91.30	$307.30

Table 1. Net profits by treatment (negative values in parentheses)

Unit	Total revenue	Total costs-FP	Total costs-SP	Total costs-NP
2j	$2,451.93	$3,586.75	$3,586.75	$3,298.75
2m	$3,686.28	$4,629.00	$3,949.00	$3,661.00
3j	$4,767.87	$4,947.00	$4,947.00	$4,659.00
3m	$2,736.95	$2,227.50	$2,017.50	$1,729.50
4m	$9,956.00	$5,901.00	$5,901.00	$5,685.00
5m	$6,638.28	$4,888.00	$4,858.00	$4,642.00
6m	$7,535.83	$5,320.50	$4,520.50	$4,304.50
7m	$4,194.30	$4,263.00	$4,103.00	$3,887.00

Table 2. Costs and revenues by treatment

As these data show, given our estimated costs, only one of the four structural complexity units yields a net profit (3m) under all scenarios. Under the non-profit scenario, only 2j is unprofitable, but 2m and 3j are near enough to zero that their net profitability is in doubt. Those two are also unprofitable under the semi-profit scenario. Hence, it appears that, on average, structural complexity cuts yield less revenue than standard ones, but the stand conditions are extremely important in mediating the profitability, regardless of method. In other words, 3m had better conditions than the other structural complexity units. 2j appears to be clearly unprofitable, even if we were to lower the hourly cost estimates. On the other hand, 3j is marginal and would become profitable in all scenarios if we altered the hourly costs even by a small amount.

Future Directions

This seed research has provided useful guidance for the direction of future research on the subject. Among the topics that we hope to address in greater detail are the following:

1. The accuracy of the costs estimates. We hope to conduct further interviews with the loggers and library research to get better estimates of hourly costs. After generating mean, lower bound and upper bound cost estimates, we then hope to do a sensitivity analysis of profits to cost estimates.
2. Sensitivity to wood product prices. This study gave us an estimate of profitability during a short snapshot in time. We hope in the future to analyze outputs under a greater range of market conditions, allowing us to see how profitability changes and how product substitution occurs. Doing a simple sensitivity analysis with the data above would be somewhat misleading in that mills often demand different types of wood from loggers as prices of different wood products change.
3. Long-term value maximization. We hope to go beyond a simple one period assessment of accounting profits, to do a long-term assessment of net present value maximization. Using growth models calibrated with growth rate data, we hope to quantify the tradeoffs of letting trees grow, versus liquidating them, which will allow us to calculate the long-term economic profitability of a given cut to the landowner as well as the short term profitability to the logger.
4. Social and institutional feasibility of alternative cutting strategies. We hope to look at what are the non-economic roadblocks that stand in the way of small woodlot owners adopting such practices. In particular, we will look at issue of information availability, constraints imposed by contractors, trucking and transportation issues and the other purposes for which landowners undertake forest management. We also hope to look at the institutional factors that effect stumpage and wood product prices at the regional level.