A CONCEPTUAL BASIS FOR EVALUATING THINNING PROJECTS

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ABSTRACT

Successful thinning of eastside trees requires a knowledge of small wood handling systems, and a commitment to the distant future. Costs can be reduced if marketing of material is coupled with a knowledge of stem and stand characteristics. Excessive taper and limbiness make product values lower and costs higher in eastside pine than in other types.

INTRODUCTION

The goal of thinning is to increase or maintain the growth and value of the residual crop in a cost effective manner. Timing and extent of operations will usually be ascertained by a present net worth analysis, and the act of thinning will impact other important timber management concerns, such as shortening the rotation and gaining allowable cut effects.

Thinning operations simultaneously involve both small wood handling problems and silvicultural problems of response and damage. While proper timing is of great importance silviculturally so as to obtain the desired response and to be biologically "right," size of material handled is of critical importance to the economical handling of small trees. The combination of economic constraints and material handling problems normally results in the compromise of silvicultural goals, and this alone may negate the value of the operations to the larger objectives of achieving response from the forest stand. This is unacceptable both biologically and economically if based on the long rotations characteristic of this type.

In order to be effective in thinning eastside pine we must determine the "seriousness" of our intent. Research plots designed to determine optimal stand response are certainly of value, but may be irrelevant if we are to apply cost effective methods to thinning several million acres. The scope of operations is such that an entire compatible system must be developed in order to reach the end goal.

Economics is the framework which surrounds both the biological problems of response and the technical problems of wood handling. The emphasis may differ by ownership type, and goals may be stated differently for each owner, whether Forest Service, industrial, or small landowner. Each operates in a different context and has different constraints regarding cash flow, asset utilization, availability of capital, willingness to take risk, and desired time to recapture investments.

Eastside Characteristics

Eastside pine presents several problems which inhibit economic thinning, and these are a result of both the low site and the isolation of the area. Low site contributes to the extreme taper that exists in young trees, as well as to the large number of limbs that is characteristic of trees in this type. Lack of growth response is a site factor that causes us to wonder if our grandchildren will see the crop trees in the thinned stand become useful. Isolation means that there is both a lack of markets and a lack of labor force. These negative features are countered to a degree by the general ease of access and presence of flat ground that exists throughout much of the Eastside. These factors are all key in thinnings because of the following:

1. Markets for thinned products are the basis for short term value and instant cash flow. This is, in turn, critical to reduction of the cost of operations in a present net worth analysis.

2. Equipment used in thinning dictates production levels and sets capital and personnel requirements.

3. Tree size, density of cut, and primary transport distance are the three most im-

portant stand factors which decide the success of any given mix of equipment and personnel.

The impact on marketing of isolation and low site means that transport distances are long, and that conventional products are not available until stem diameters are relatively large. The market requirements for larger stem sizes as well as the operational requirements of a heavy cut per acre impact the silvicultural prescription, which in turn affects the size and type of handling equipment needed. Each machine has an optimal range for handling various piece sizes. The machinery dictated by stem size will also dictate a production rate necessary to support that equipment on an economic basis.

Operations Analysis

It is readily apparent that as tree size increases, the sale value of the wood contained therein increases dramatically on a volumetric basis, as seen in figure 1. This is due to increased handling efficiencies in large sizes, increased grade recovery, increased volume recovery, bark to wood ratios, and marketability. It may not be obvious that the real picture for well developed markets in small wood is step-variable (fig. 2). This is due to diameter breaks which allow a piece to move into the next tier of value.

These diameter breaks correspond to the increase possible in-product value as stems grow into a possible range of products. These steps might correspond to energy chips, fuelwood, posts, and sawlogs. Pulpwood would replace fuelwood and post values in the southeastern U.S., but this is currently not the existing opportunity for eastside thinnings. Any solid wood product such as sawlogs or posts is greatly affected by taper, so that merchantability on the Eastside will mean a relatively large d.b.h..

It is also common knowledge that the cost of gathering wood decreases with rising log or tree size (fig. 3).

When broken into the components of falling, skidding, and loading, however, the picture may be altered with the application of appropriate technology. Figure 4 shows a potential per stem cost for cutting based on three different felling methods.

Each of the falling methods will be most efficient operating within a range of sizes--and hence range of products. Each method may be followed by a different piece handling system following falling. These methods can then be combined with appropriate skidding machinery to remove products from the woods. This would range from no skidding to larger and more costly machinery as stem size increases. Each step-up in horsepower increases the productivity of the system as well, increasing the need for support machinery, trained personnel, planning input, etc. The same analysis can be applied for loading and trucking, mixing and matching machinery when appropriate.

Biomass operations can avoid much of the problem of selection of machinery by using swather-type cutters such as Jaws III or the Canadian A-line swather. These demand a very large scale commitment in terms of production capabilities, processing plant, and land base. These machines may be useless as thinning tools, as emphasis on production precludes care for the residual stand. Since residue utilization and biomass production is addressed in another paper it will not be discussed in depth.

Thinning Approaches

While it is instructive to look at the components of operations, thinning is not merely a process of selecting one machine from column A and two from column B. In actuality, each choice is dependent on silvicultural goals, stand characteristics, markets, and available machinery. The following identifies some of the types of market possibilities and operations available for thinned material:

1. Thin to waste: This precommercial thinning method is all that can be done currently with material less than a 4" stump diameter. It is best done early, can be quite selective, and can be done with a small crew on a small scale without much planning or organization. If trees cut are less than 3" on the stump, a rotary hand-held brushcutter can handle the falling job with greater selectivity and at 50-75 percent of the cost of using a chainsaw. Chainsaw thinning to waste has commonly been the rule in stands up to 8" d.b.h. Precommercial thinning of this size class tends to be very wasteful of fiber, is excessively costly, increases fire danger, is unsafe, looks horrible, and may not be done heavily enough or early enough to

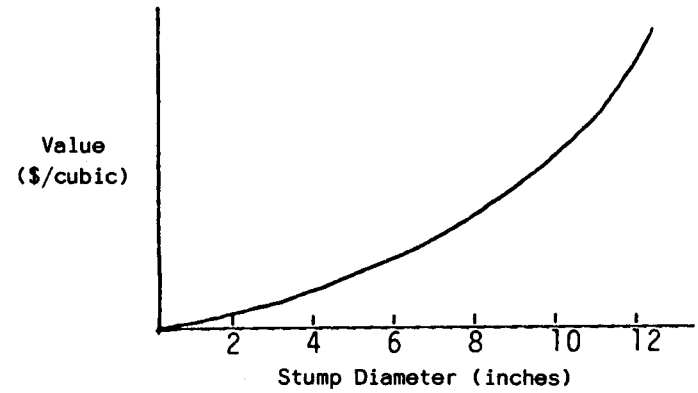

Figure 1.--Generalized wood value in current markets.

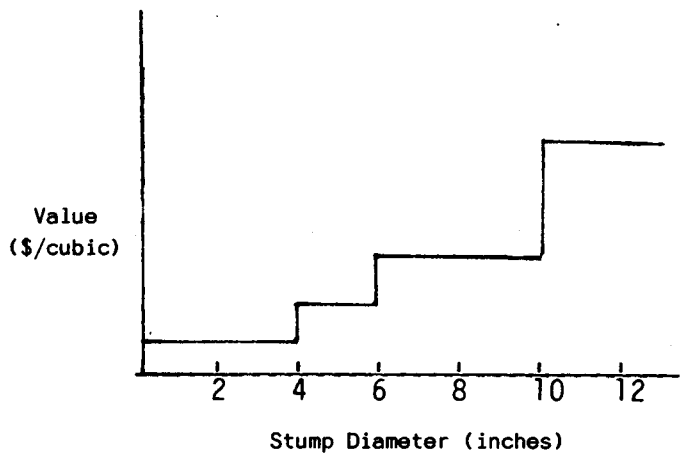

Figure 2.--Wood value in a developed market.

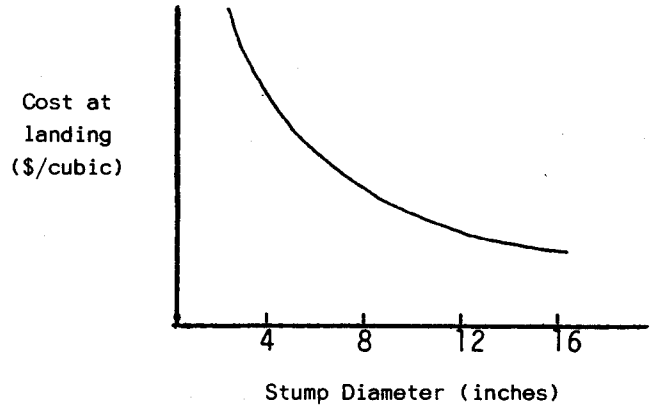

Figure 3.--Logging costs for different tree diameters.

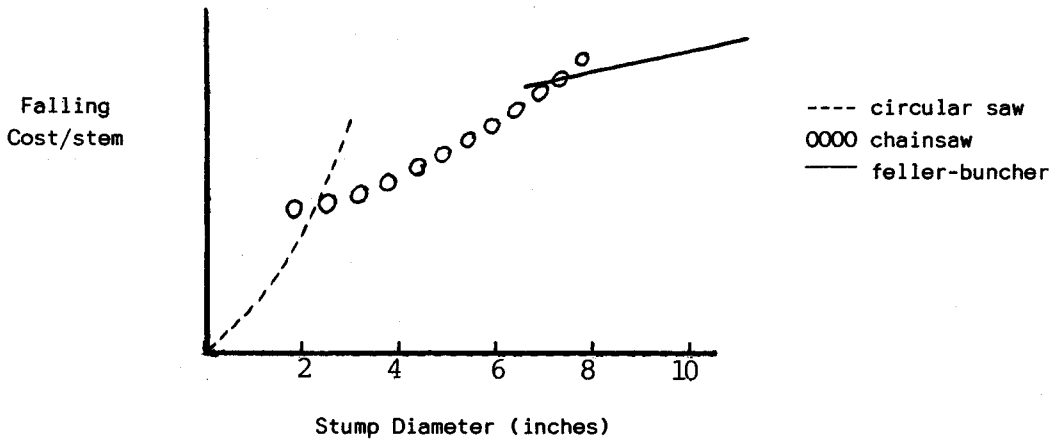

Figure 4.--Felling cost with different mechanical means.

accomplish silvicultural goals.

2. Thin to utilize, marginally economic: This type of operation is usually chainsaw felled using a light skidder, tractor, or even pickup truck to remove utilizable material. This may require only low levels of capital with a small inexperienced crew. It can be small scale but must be well organized with some silvicultural training necessary to accomplish the primary goal.

   This approach normally will not recoup all dollars expended, and contains marketing problems as the products are normally firewood and fenceposts. As operations become more sophisticated and have higher production, a post peeler or firewood processor may be utilized, which requires further market development as well as a means of economically handling product residues. Taper can be a significant inhibitor to both operations and utilization, as a lot of small stem handling is demanded. Handling can be manual in low production or small scale operations, but must be increasingly mechanized as piece size begins to weigh in excess of 90 pounds.

3. Commercial thinning with mechanized systems: This approach requires organization, markets, capital and experienced crews. It takes a serious commitment by large and specialized contractors and demands silvicultural input to avoid high-grading the stand. The reliance on feller-bunchers and forwarders will increase productivity over chainsaws and skidders, but may require row thinnings rather than selection thinnings. The reliance on stump and biomass harvesters and other processing equipment builds in a large cost that currently can only be recouped by sawlog sales, as biomass harvesting alone creates products of such low value that conversion will tend toward a negative cash flow as well as demands the creation of new biomass facilities. There is a developing processing plant near Susanville, although this facility will probably rely more on accessible and cheap logging residue rather than on expensive thinning debris.

   The reliance on mechanized systems will necessarily alter silvicultural opportunities, modifying the goal of thinning "frequently and lightly" to "fewer and heavier." Excessive residual stand damage may negate the value of thinning, particularly in true fir stands. Also, compaction may be a lasting problem.

   These problems have been faced in other countries and it is instructive to note that the Swedish Nordfors system is being tried successfully in the southeastern U.S. This is a system which uses a highly trained labor force, a knowledge of ergonomics, and light specialized equipment to manually commercially thin.

Loss Envelope

By combining per acre costs and values, an "envelope" of operations loss can be inspected. Figure 5 illustrates the influence of tree size and appropriately applied technology on income in a developed market, with the break-even point defining the difference between precommercial and commercial thinning (at about 14" stump diameter). Per acre dollar flows are illustrated, with a rather generalized overstocked acre being the assumed norm. Number of stems/acre will obviously affect costs and here are unrealistically assumed to be the same for a range of sizes for illustrative purposes.

The loss envelope shows that the front end cost of any thinning is high, but the important information is to be found by comparing the magnitude of loss at differing tree sizes.

Costs taken alone may make a thinning too expensive to contemplate, while product marketing may reduce the loss to acceptable levels. It would be necessary to compare the handling costs following falling with the values of products to be derived in order to make this decision.

The 4-8" stump diameter represents a size range to be avoided when developing priorities for thinning based on income. Unfortunately, this is the primary range in which foresters tend to become cognizant of the need for thinning. It is also the range in which growth may be the most responsive, and the lack of thinning at this stage may doom the stand to stagnation and loss of any future value. Any technological

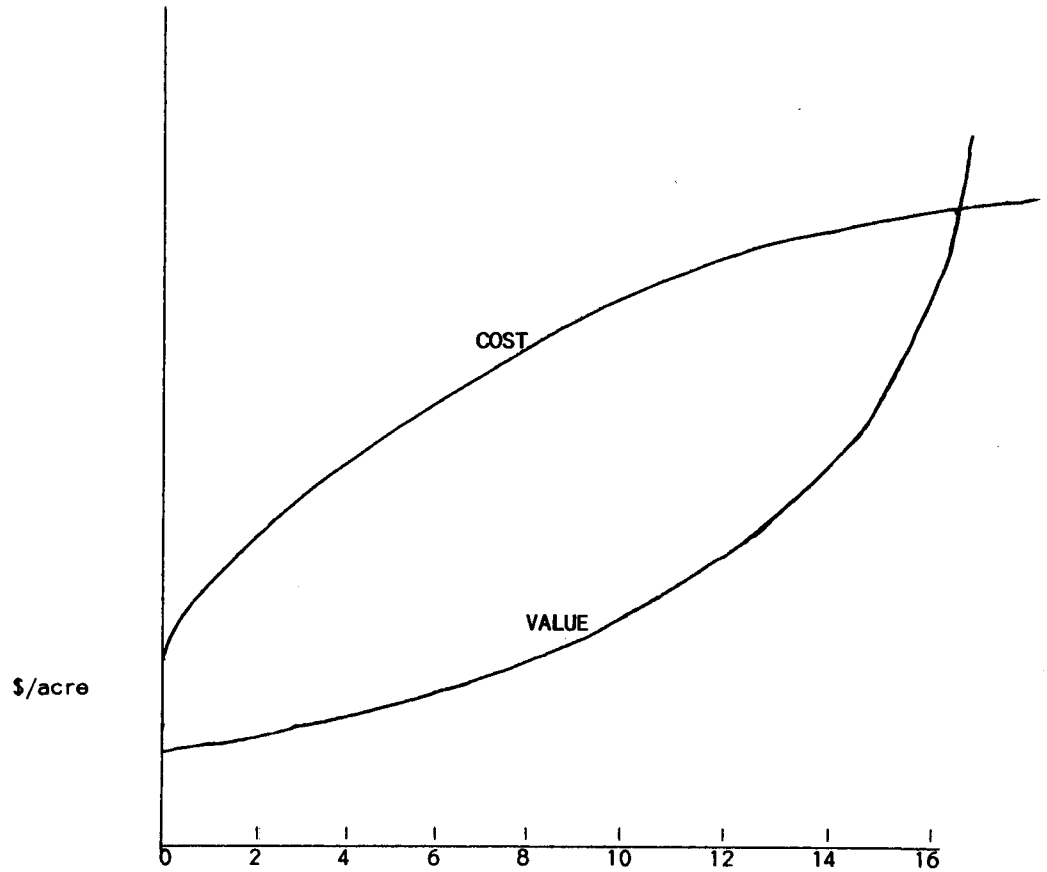

Figure 5.--Loss incurred per acre for thinning & utilizing differing tree sizes.

input to improve thinning productivity will cost more, often defeating the goal of income generation. Manual methods such as the Nordfors techniques can materially improve production, but face problems of the work being monotonous and strenuous, with access to a large trained labor force severely limited due to the isolation of the eastside.

The primary area in which to improve the deficit situation in the 6-10" size range is in product marketing. If a large institution or industrial firm were to strive to develop and increase markets for small whole wood products, the deficit situation could change materially. The developed post and pole markets of Idaho are a case for study, but equally important could be agricultural or landscape application, highway usage, fuelwood potentials, or other promising areas. Unfortunately, the forest industry has concentrated on selling sawn boards, to the detriment of roundwood applications, and a governmental attempt at market development may lie outside the realm of feasibility. By ignoring marketing possibilities, the high cost of thinning is unreduced by product sales, and commercial thinning will continue to be based on sawlog values.

One obvious way to avoid the expense of precommercial thinnings is to avoid the problem initially in plantation establishment. By taking the lead from agricultural application of precision plantings, the number of seedlings and cost of planting can be greatly reduced. If the end goal is 125-150 crop trees per acre, it may be more advantageous to accept some growth loss and site control loss, to spend more on seedling establishment and protection, and to avoid letting our plantation stagnate due to our inability to develop budgetary priority for the necessary thinning.

The cost and slow response of eastside thinning causes one to pause and to question the wisdom of thinning, but nonaction will inevitably lead to loss of the resource to stagnation or fire. The decision for desired crop tree spacing should be made early and scheduled entries should be carefully planned to avoid huge cash expenditures in thinning large useless trees. The primary goal of valuable fiber production needs to be constantly borne in mind if our thinning is to be effective and if our forestry is to be successful.

SUMMARY

Thinning eastside pine successfully requires a sound application of biology and economics to stands in which success is possible. The optimal thinning operation would either be one in which costs did not exceed income or one in which the net present value of the future stand exceeds the costs of today's thinning operations. Tree size is a key variable to be included in such analyses. Market development is a means of broadening the availability of feasible stands to such desired goals. Low site and isolation affect the possibility of such application in the eastside type. The scale of the resource to be managed demands large and productive answers. Harvesting for fuel may be a future answer for economical thinnings, but the application of large machinery and high production rates often carries a concomitant result of excessive stand damage which negates the operation itself. Good inventory and early analysis will help to determine which stands will need to be thinned, while a knowledge of operational economics will help to determine when. In planning forest thinnings, foresters may not be able to maximize benefits, but they should be able to avoid maximizing costs.