An Economic Guide to Silviculture

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Abstract

The paper describes an economic guide to silviculture which is designed to provide field personnel with an easy way of determining the financially sound alternative or possibility when choosing between various forestry practices, primarily with respect to reforestation.

The guide consists of a number of charts, one for each of six rotation periods between 40 years and 100 years. Each chart shows three quadrants which are used as nomogrammes for various purposes.

Since the economic efficiency of silvicultural operations basically depends on the quality of the land, this guide can be used for an exploratory analysis of the capability spectrum of a given management unit against the background of selected economic criteria. Such an analysis would show how much of the productive forest land can be managed continuously to produce a desired rate of return on capital invested in land, machinery, labour and administration. The guide can also be used to give an outline of the input of labour, employment opportunities, that can be justified annually in various kinds of silvicultural work.

Un guide d'économie en sylviculture

Résumé

Le guide d'économie forestière présenté aux sylviculteurs vise le praticien sur le terrain pour faciliter le choix des interventions dans l'optique de la rentabilité financière. Il est fait mention plus particulièrement de la pratique du reboisement.

Le guide est constitué de graphiques correspondant à chacune des six (6) rotations comprises entre quarante et cent ans. Chacun des graphiques comprend trois (3) quadrants utilisés comme nomogrammes.

La rentabilité économique des opérations sylvicoles dépend fondamentalement des conditions de milieux. Le guide permet d'explorer les diverses possibilités offertes dans l'unité d'aménagement en fonction des critères économiques choisis. Une telle analyse permet de déterminer la proportion de terres boisées que l'on peut aménager de façon permanente pour donner un taux de rentabilité désirable sur le capital investi, le matériel, la main-d'oeuvre et les services administratifs engagés. Un tel guide peut servir à fixer les grandes lignes concernant l'apport de travail et les possibilités d'emploi, qui peuvent être justifiées annuellement dans les divers domaines de l'activité sylvicole.

Analyses of the economic efficiency of silvicultural measures in forestry involve not only the costs of treatment but also the net returns that can be obtained from the harvest operations. A chain of evaluations from the initial costs to the returns consists of a number of links that require not only knowledge of the basic facts for given locations and conditions, but also a series of time-consuming and repetitious calculations.

Because of the long time lapse between the stand establishment, when the first costs are incurred, and the final harvest operation when the last return is obtained, appraisals of the time element enter the calculations at several points in the primary production. Since the costs and the returns occur on different occasions and with different frequencies, they must be put on a comparable level in the analyses. This revaluation is obtained by the application of formulae based on some acceptable rate of interest. Although the formulae have been converted into useful interest tables, the field personnel, who do not have easy access to data computers, face a considerable amount of calculation when testing the financial justification of various silvicultural projects.

Speculations on the future costs and prices, and effects of inflation are avoided if the analyses are based on the present costs and prices. The effects of inescapable misjudgements incurred when using the present cost-price relationships for the future products are reduced by discounting the returns to the present time, and by recurrent analyses applied when the conditions change and warrant a reappraisal of the practices.

Objective....

The purpose of this guide is to assist the field personnel in appraising the potential of given locations for the application of alternative silvicultural practices. In cases where a large investment is requested for projects involving reforestation or cleaning of natural regeneration, such as those covered by the provincial-federal agreements, the question of whether the investment is financially sound should be raised. The guide will show, within the limits of accuracy prescribed by the basic data, the maximum silvicultural investment that each particular location can carry at a given rate of interest.

Information Needed

The basic facts that the field personnel need to know to be able to use the guide are obtained from the local experience concerning total yield, costs and prices. The additional data needed should be available from the general administration, i.e., the acceptable rate of interest, the annual costs of administration per acre, and the rotation period.

Description

The guide principally consists of a number of sheets, one for each rotation period.¹ Each sheet shows three quadrants with simple graphs (Fig. 1). The line slopes in quadrants 1 and 3 are established according to interest tables.

¹ Complete sets covering rotation periods from 40 years to 100 years can be obtained from the Department of Regional Economic Expansion.

Quadrant 1 gives the present value per unit volume harvested at a certain stumpage value (price per unit at roadside, minus total cost of felling, processing, skidding, etc.) for various rates of interest over the rotation period given. Since this value has a theoretical interest only it has not been indicated.

Quadrant 2 gives the present value of the stand per acre harvested at the end of the rotation age for various total yields.

Quadrant 3 gives the present value of the annual cost of administration (overhead, fire protection, access roads, etc.) for various rates of interest.

The vertical axis in Quadrant 1 can be used whether the unit of measurement is cunit (100 cu. ft.), cord or M fbm, as long as the lines in Quadrant 2 represent volume in the same unit of measurement.

considered in this guide as a delayed cost of stand establishment. Brush control can be considered in the same way.

If the field personnel are informed of the acceptable rate of interest and the annual cost of administration per acre (including fire protection, supervision, overhead, taxes, land rent if necessary), the guide can be used as demonstrated in the following example. (Fig. 1, Alternative I)

Conditions:

Acceptable rate of interest	5%
Rotation period	50 years
Stumpage value	\$12/cord
Final yield	50 cords/acre
Annual costs of administration, total	\$1.50/acre

The first step is to enter quadrant 1 at a stumpage value of \$12/unit. We proceed to the line representing 5% rate of interest. From the point of interception we continue vertically upward into quadrant 2 until we reach the line for 50 units per acre. From this point of interception we then continue horizontally to the left and read a value of \$52 on the vertical axis. This is the present value of our harvest of the 50-year old stand.

The second step is to enter quadrant 3 from an annual cost of \$1.50 and continue upward till we reach the line for 5% rate of interest. From this point of interception we proceed to the right and read a value of \$27 on the vertical axis.

The difference between the value of \$52 obtained in the first step and the value of \$27 obtained in the second step, i.e., the **residual value** (\$25), is the approximate maximum silvicultural cost that this site will be able to carry if we want to have 5% rate of return on our investment.

Should this residual value be less than the cost of planting, the choice of silvicultural method for this site would be restricted to sowing or natural regeneration. If a new stand **cannot** be obtained by natural regeneration (e.g., no seed source) artificial sowing will be a silvicultural alternative for this site. As long as sowing and previous site preparations (controlled burning, brush control, clearing, or scarification) needed to get a good stand started do not cost more than \$25 per acre, we know that this silvicultural practice is financially sound, i.e., will give a return of 5%.

If we can get a good stand started promptly without artificial sowing (seed source available), the final decision will obviously be to depend on natural regeneration, without or with preparatory measures that do not cost more than \$25 per acre. Of course, prompt natural regeneration at no cost would be a preferred choice even when the residual value is large enough to cover the cost of planting. However, planting could then be preferable if its additional cost was exceeded by the marginal gains (e.g. higher total yield).

Suppose, now, that the field personnel knows that a plantation costs \$50 per acre. If this cost is added to the present value of the annual cost (\$27/acre), we obtain a total of \$77 (Fig. 1, Alternative

Directions

To use this guide, the field personnel need to know the volume of the natural or planted stand that can be grown on a given site within the given rotation. This yield information can be based on any reliable statistics from nearby sample plots in comparable stands, or on the mean annual increment assigned to the location by the Canada Land Inventory (CLI).

Of course, the local field personnel should know the price that can be obtained at the roadside for the assortments cut from the mature stand, as well as the cost of delivering the timber to the roadside. The difference between the price and the cost is the stumpage value of the timber.

Thinning, which is here defined as a cutting operation that gives a profit in young stands, has not been considered in this guide. However, it can be included as an approximation by adding a percentage to the present value, e.g., 10%—15%, obtained from the harvest operation.

Cleaning, which is here defined as a cutting operation that gives no profit in young stands, will be

II). We reverse the procedure described above by entering quadrant 2 from this value on the vertical axis, and continue horizontally to the right until we reach the higher volume that we expect from the plantation, say 60 units/acre. Proceeding vertically downwards into quadrant 1, we reach the line representing 5% rate of interest. From this point we continue to the left and read \$14.50 on the vertical axis. This is the stumpage value per unit which must be realized from the harvest operation to justify this cost of planting. If the cost of harvesting is \$10/unit, the price of the timber at the point of delivery must be \$24.50 ($14.50 + 10$)/unit.

When the stumpage value realized from the harvest is low, e.g., \$6/unit (Fig. 1, Alternative III) because of certain adverse conditions such as a low average diameter of the timber, inefficient equipment, or difficult terrain, we find that the present value of the return per acre barely equals the present value of the annual costs. There is certainly no room for much silviculture under these conditions, not even cleaning in young stands. Actually, natural regeneration at no cost is the only practical alternative.

The procedures described above can be repeated for shorter or longer rotation periods. The most attractive rotation will then be the one that gives the greatest residual value.

The usefulness of the guide can be extended to the case where the residual value is smaller than the cost of planting. If a natural stand can be obtained "without costs", we can expect this stand to require a cleaning operation (defined above). A stand that, for certain conditions, gives a residual value of, e.g., \$14/acre, can be cleaned at an age of 20 years at a maximum cost of \$25/acre when the acceptable rate of interest is 3%, and at a cost of \$37/acre when the rate of interest is 5% (Table 1).¹

Conclusions

The examples and various assumptions discussed above have shown how the guide can be used. Its value depends on the exactness of the basic data

¹ Table 1 is computed on the basis of interest tables.

Table 1. Maximum Allowable Cleaning cost, \$/Acre

Residual Values* \$/Acre	10-year-old Stand				20-year-old Stand				30-year-old Stand			
	2%	3%	4%	5%	2%	3%	4%	5%	2%	3%	4%	5%
2.....	2	3	3	3	3	4	4	5	4	5	6	9
4.....	5	5	6	7	6	7	9	11	7	10	13	17
6.....	7	8	9	10	9	11	13	16	11	15	20	26
8.....	10	11	12	13	12	14	18	21	14	20	26	35
10.....	12	13	15	16	15	18	22	26	18	24	32	43
12.....	15	16	18	20	18	22	26	32	22	29	39	52
14.....	17	19	21	23	21	25	31	37	25	34	46	60
16.....	20	22	24	26	24	29	36	42	29	40	52	69
18.....	22	24	27	30	27	32	39	48	32	44	58	78
20.....	24	27	30	33	30	36	44	53	36	49	65	86
22.....	27	30	33	36	33	40	48	58	40	54	70	95
24.....	29	32	36	39	36	43	52	64	43	58	77	104
26.....	32	35	39	42	39	47	57	69	47	63	84	112
28.....	34	38	42	46	42	50	61	74	50	68	91	121
30.....	37	40	44	49	45	54	66	80	54	73	97	130

*from graph (differences between the present values of harvest operations and the present values of annual costs)

for each location. It can be used in selecting the silvicultural measure, that is the one that is financially the most sound for each compartment of a management unit. It can thereby be useful subsequently in planning manpower requirements, and in a statement on the investment that can be made according to the financial criteria given.

To use the guide to their advantage, the field personnel should establish carefully a firm picture of the annual costs of administration, etc., and a good knowledge of the influence of average tree size on the profit from harvest operations. Since the cost of time is of major importance in forest management, the choice of interest rate is crucial and this choice alone may decide whether silvicultural measures should be carried out at all in some locations. If we are able by means of this simple guide to establish a fair idea of the area where continuous forestry can be pursued under certain known economic conditions, we can reserve the unprofitable areas for other uses, e.g., recreation. The forestry staff can then devote their full attention more effectively to profitable forest land, instead of ineffectively to all land and wastefully to some.

Used in combination with the Canada Land Inventory classification for forestry, this guide will produce a large-scale delineation of land that can be planted profitably under certain economic conditions. It may appear that land in capability classes III, IV and the better half of V can be planted, while the rest of class V and the better half of VI can only carry the costs of less expensive silvicultural measures, such as artificial sowing and cleaning. The remainder of the land in class VI may barely be able to pay for the annual administration costs, while land in class VII will be considered an economic impediment.

Through a screening procedure of this kind, which can be detailed when the rating of productivity is refined, it will be possible to identify and eliminate unprofitable locations and treatments from the confines of a project. We may find that out of a project proposal for 1,000 acres, only 700 acres should be treated if we want financially sound and effective investments (federal, provincial or private).