ECONOMIC ANALYSIS - THE BASIS
AND AVAILABLE TOOLS

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ABSTRACT:

Adequate economic evaluation of long-term timber management plans is essential to sustain a viable timber industry. This is equally important for government, industry, and private land owners. The analysis of forest transportation networks is an integral part of a timber management plan.

The successful evaluation and implementation of a forest timber management plan depends upon two key factors-- economic and physical feasibility. Economic feasibility is applied in the evaluation of a specific plan alternative and in the analysis of different planning alternatives for the same project area. Physical feasibility of a management plan must be determined prior to implementation of the plan on the ground.

The economic analysis of a forest transportation network alternative must be included in the economic evaluation of the entire planning area through some logical time span. This paper illustrates the necessary steps that must be taken to execute the economic analysis of a harvest plan alternative, including the transportation network.

Introduction

The economic evaluation of forest transportation system alternatives must be included in development of an overall forest timber management plan. Without this critical step large sums of money can be wasted with projects that could never generate a positive cash flow on the investment.

The development of a successful management plan should be done by an interdisciplinary team. The key members of this team are the silviculturist, engineering transportation planner, and or forest engineer. The input of other resource specialists may be required, depending upon site-specific conditions. These specialists could include a hydrologist, geotechnical engineer, fisheries biologist, etc.

Physical feasibility of the overall timber harvest plan must be established prior to implementation. Coordination is critical between the forester's silvicultural prescriptions, and the harvest and transportation plans. Without this coordination severe problems can arise regarding economic and physical feasibility of the plan. Ground specific silviculture prescriptions can be made that are economically and physically infeasible to execute. If road transportation plans are made without consideration of the silvicultural or harvest plan, roads can be improperly located to facilitate the most economical harvest methods meeting the designated silvicultural prescriptions.

An Example Economic Evaluation

The following example will illustrate the basic economic evaluation of a harvest plan alternative. It is assumed that a coordinated silviculture, transportation, and harvest plan has been developed for the Kia Timber Management Plan Alternative No. 1. The transportation network will facilitate the stump to mill harvest of the entire planning area. The road network meshes with the stump-to-landing logging plan and future administrative management of the area.

The economic analysis follows the general procedures outlined by Kramer (1). The analysis is computed with the aid of an IBM PC program named Timber Sale Economics (TSE). The publication by Kramer (1) and the economic analysis computer program can be obtained from the Logging Industry Research Association.

The Kia Management Plan-- Alternative No. 1 is a 250 hectare tract that is to be purchased and planted with radiata pine. The area main haul road right-of-way was previously purchased. The silvicultural prescription specifies a precommercial thinning and pruning at age five, and a 265 M^3/Ha harvest at final rotation. Final clearcut harvest occurs at age 30. The entire area can be harvested with ground-based equipment. The planning area is divided into four harvest units that will be logged in the same year. Figure 1. illustrates the the initial entry plan for planting the entire area . A low standard access road is to be constructed on the main haul road location to facilitate planting. Figure 2. illustrates the final harvest plan alternative.

In the example problem costs and benefits have been computed for all major management activities through the rotation within the planning area. Evaluation of taxes has not been included. A time line of management activities is developed in Figure 3. This illustrates the timing sequence, and costs and benefits of each specific management event occurring during the rotation.

There are several methods used to determine economic viability of management activity (Kramer (1), Grant and Ireson (2), Riggs (3), and Winfrey (4). Three methods commonly applied are present net value (PNV), internal rate of return (IRR), and benefit-cost ratio (B/C). These three analysis procedures are used by the U.S. Forest Service in timber management planning.

The present net value is the sum of discounted benefits minus the sum of discounted costs of a given management plan. These activities are discounted at a given interest rate to a specified base year. The internal rate of return is the specific interest rate at which the PNV is equal to zero. Benefit-cost ratio is the ratio of the sums of the discounted benefits divided by the sum of the discounted costs.

PNV is computed from the information taken from Table 1. or Figure 3. applying a 10% interest rate using the TSE economic analysis program. The computer output is displayed in Table 2. The total present value benefit is $184,139 and total present value cost is $251,771. The PNV is -$67,631, indicating that the project will generate a negative cash flow of this amount at a 10% interest rate. This project alternative is therefore not economically feasible at a 10% interest rate.

Figure 1. Kia Timber Management Plan Alternative 1
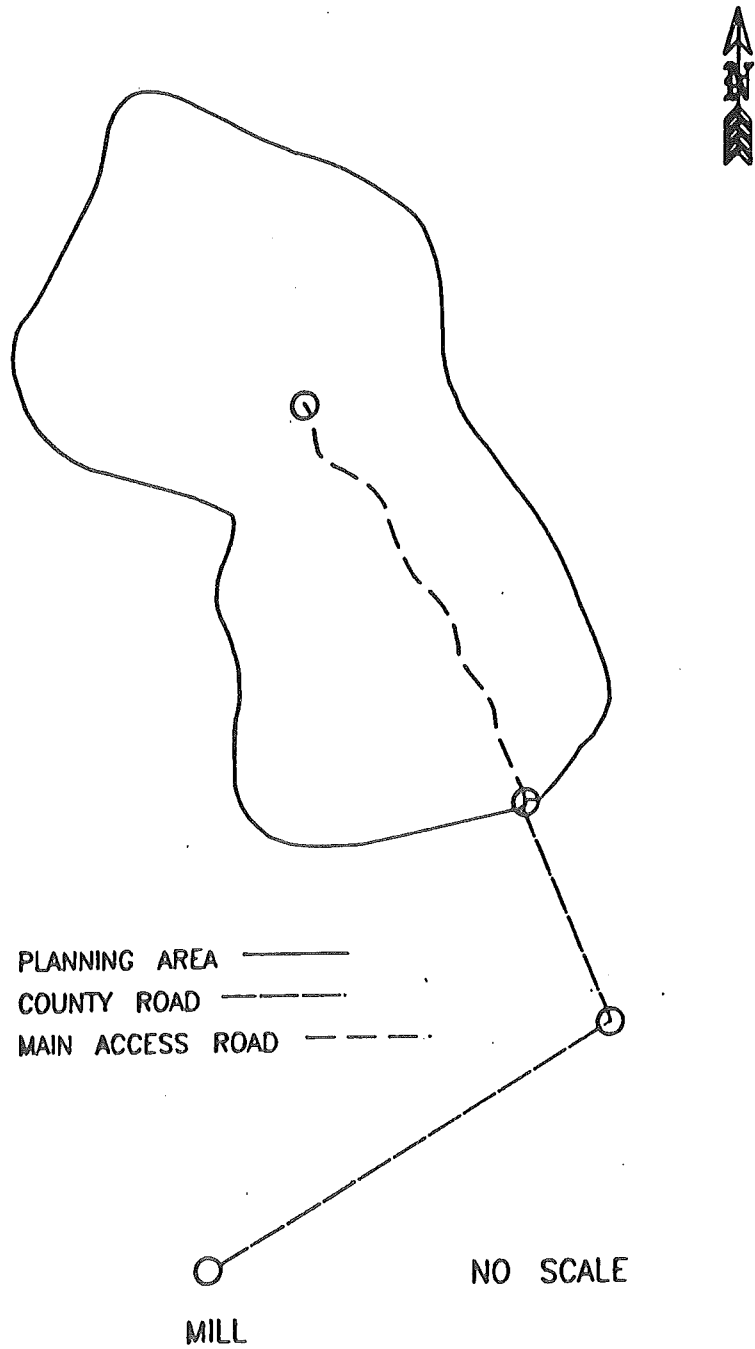Transportation Plan for Planting

PLANNING AREA ————
COUNTY ROAD ————·
MAIN ACCESS ROAD ————·

NO SCALE

MILL

Figure 2. Kia Timber Management Plan Alternative 1
Final Transportation and Harvest Plan

PLANNING AREA
COUNTY ROAD
MAIN ACCESS ROAD
TEMP. ROADS
TRACTOR HAULING

UNIT 1
UNIT 2
UNIT 3
UNIT 4

NO SCALE

MILL
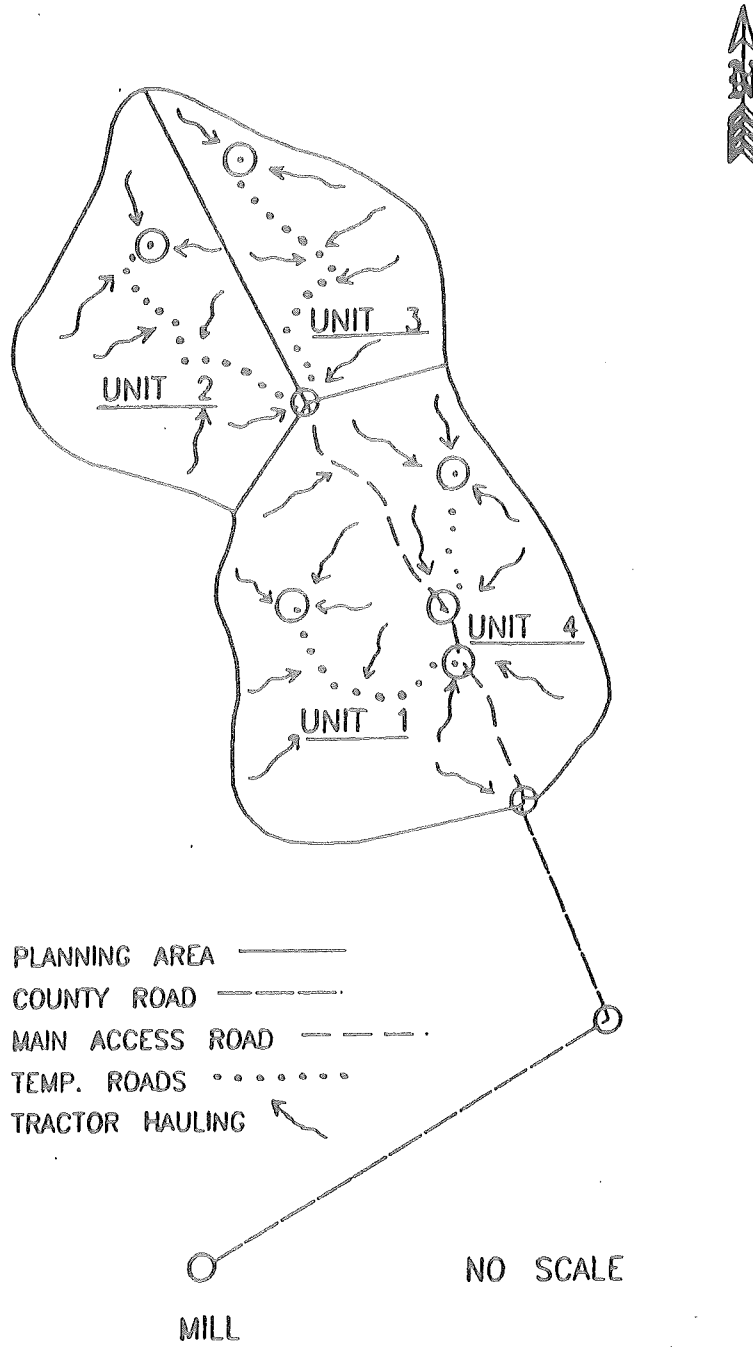
Figure 3. Kia Timber Management Plan Alternative 1
Time Line of Costs and Benefit Cash Flows

BASE YEAR 1988 = 0

BENEFITS (+$)

COSTS (-$)

Land Purchase
$81,250

Road
Construc-
tion
$15,200

Planting
$87,500

Thinning/Prunning
$62,500

Timber Value
$3,213,125

Reconstruc-
tion
Main Road
$19,000

Construct
Landings
Temp. Roads
$20,800

Final Harvest
Stump to Truck
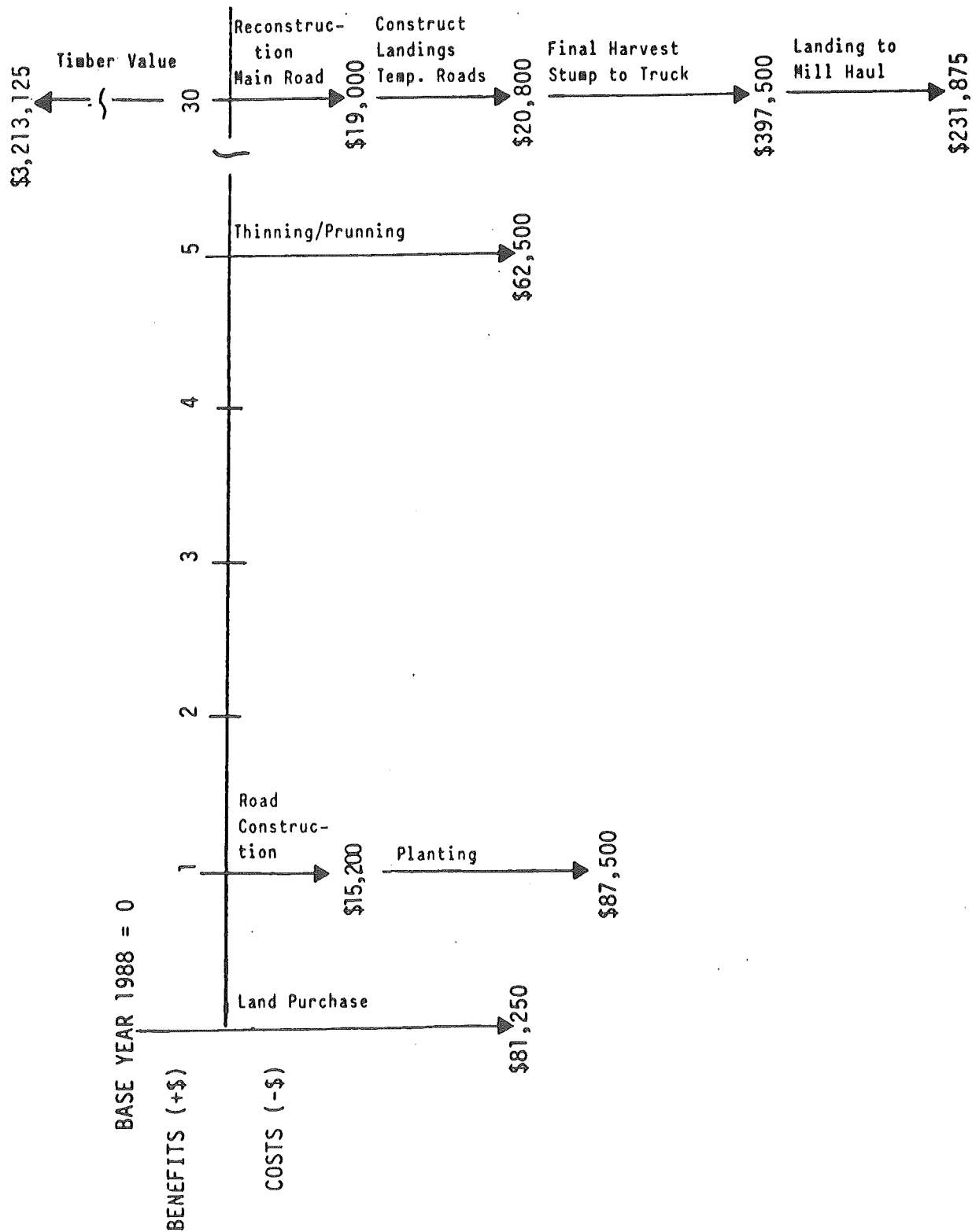$397,500

Landing to
Mill Haul
$231,875

1   2   3   4   5   30

Table No. 1.   Kia Timber Management Plan Alternative 1
Cost and Cash Flow Summary

Year	Activity	Computation	Cost($)	Benefits($)
0	Land Purchase	(250Ha)($325/Ha)	81,250	-----
1	Construct Access Road for Planting	($8,000/Km)(1.9Km)	15,200	-----
1	Planting	($350/Ha)(250Ha)	87,500	-----
5	Thinning & Pruning	($250/Ha)(250Ha)	62,500	-----
30	Reconstruct Main Access Road	($10,000/Km)(1.9Km)	19,000	-----
30	Construct Landings and Temporary Roads	($8,000/Km)(2.6Km)	20,800	-----
30	Final Harvest Stump to Truck	(265M/Ha)(250Ha)($6.00/M)	397,500	-----
30	Transportation Landing to Mill	(265M/Ha)(250Ha)($3.50/M)	231,875	-----
30	Value of Timber	(265/Ha)(250Ha)($48.50/M)	----	3,213,125

Table 2.   Kia Timber Management Plan Alternative 1
PNV Output

Present Net Value of a Long Term Project

KIA TIMBER MANAGEMENT PLAN ALTERNATIVE 1.

The Base Year is   0
The Interest Rate is 10.0%

Year	Activity	Cost($)	Benefit($)	Discount Factor	PVC($)	PVB($)
0	Land Purchase	81,250	0	1.0000	81,250	
1	Construct Access Road	15,200		0.9091	13,818	
	Planting	87,500			79,545	
5	Thinning/Pruning	62,500		0.6209	38,808	
30	Reconstruct Access Road	19,000		0.0573	1,089	
	Const. Landings/Temp. Roads	20.000			1,192	
	Final Harvest	397,500			22,780	
	Transportation	231,875			13,288	
	Stumpage		3,213,125			18(39

The total Present Value Benefit is $184,139

The total Present Value Cost $251,771

The Present Net Value is   -$67,631

The Present Value Benefit/Cost Ratio is   0.73

Next the IRR is computed to determine the sensitivity of the project to change in interest rates. The TSE program is run several times with various interest rates until the present-value benefits are approximately equal to the present-value costs. At this point the PNV is approximately equal to zero. A graphical representation of these values is illustrated in Figure 4. The IRR is approximately 8.5% where the PNV is approximately equal to zero. Examination of the graph in Figure 4. indicates that the economic plan is sensitive to changes in the applied interest rate. The PNV is a positive $33,932 at 8% interest and a negative $24,351 at 9% interest. If the 10% interest is the minimum acceptable rate of return then another project alternative must be developed and analyzed to try and reduce costs or increase benefits.

Now let's develop a second alternative for the planning area. Assume that all the land within the planning area is owned by the government. In this new alternative there is no land purchase cost and all other costs and benefits are the same as in alternative 1. The acceptable rate of return or interest rate is 10%. The results of this analysis are are shown in Table 3. The PNV now has a positive return of $13,619 and the B/C is 1.08. This alternative generates a positive cash flow. The project will now generate a positive return on the investment over a 30-year period.

Concluding Remarks

The timber management planning area economic analysis examples presented in this paper are simplistic, yet the process can be applied to a more detailed planning scenario. Economic planning is equally important for private land owners, industry, and government. Economic feasibility of long-term timber management projects is an important phase of strategic resource planning.

Table No. 3. Kia Timber Management Plan Alternative 2
PNV Output

Present Net Value of a Long Term Project

KIA Management Plan Alternative 2

The Base Year is   0
The Interest Rate is 10.0%

Year	Activity	Cost($)	Benefit($)	Discount Factor	PVC($)	PVB($)
0	Land Purchase		0	1,0000		
1	Construct Access Road	15,2000		0.9091	13,818	
	Planting	87,500			79,545	
5	Thinning/Pruning	62,500		0.6209	38,808	
30	Reconstruct Access Road	19,000		0.0573	1,089	
	Const. Landings/Temp. Roads	20,800			1,192	
	Final Harvest	397,500			22,780	
	Transportation	231,875			13,288	
	Stumpage Value		3,213,125			184,139

The Total Present Value Beneift is . $184,139

The Total Present Value Cost is $170,521

The Present Net Value is   +$ 13,619

The Present Value Benefit/Cost Ratio is   1.08

Figure 4. Kia Timber Management Plan Alternative 1
Internal Rate of Return
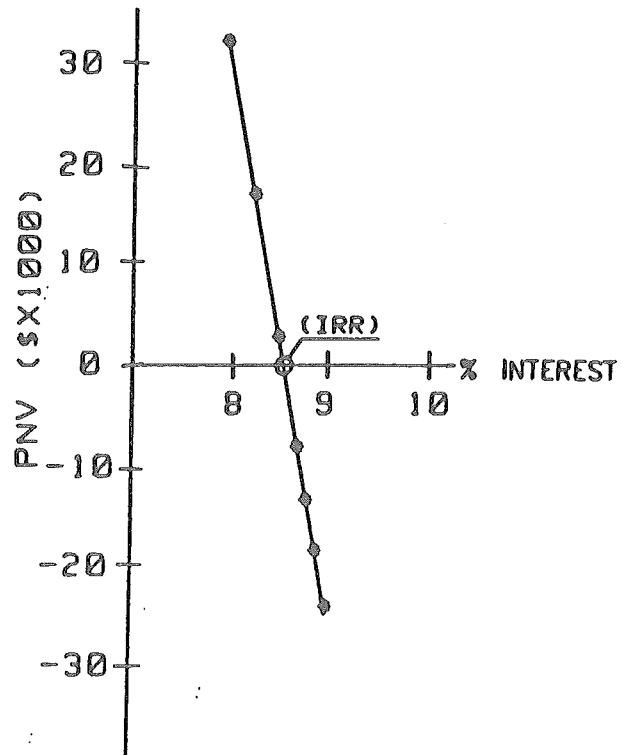
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2. Kramer, B.W., "Timber Harvest Economic Analysis Guide", Revision 1, U.S.D.A. Forest Service, Portland, Oregon, 1987.

3. Riggs, J.L., "Engineering Economics", McGraw-Hill, York York, New York, 1977.

4. Winfrey, R., "Economic Analysis of Highways", International Textbook, Scranton, Pennsylvania, 1969.